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USACE / NAVFAC / AFCEC / NASA **UFGS-33 16 15 (November 2020)**

Preparing Activity: USACE **Superseding**
UFGS-13 16 15 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION 33 16 15

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11/20

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SECTION 33 16 15

WATER STORAGE STEEL TANKS
11/20

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NOTE: This guide specification covers the requirements of ground-supported (flat-bottomed) bolted and welded standpipes and reservoirs, and elevated welded steel water storage tanks 190 to 3800 kL 50,000 to 1,000,000 gallon capacity. Bolted elevated tanks are uncommon so this guide specification only covers welded elevated tanks.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

PART 1 GENERAL

****
NOTE: This Section covers welded and bolted steel water storage tanks and includes the design, fabrication, and erection of a complete new system or to augment an existing or future water distribution system. This specification must be edited to specify the required type of tank. See AWWA M42 "Steel Water Tanks" for general information on the selection, design, construction, maintenance, inspection, and repair of steel water tanks for potable water storage.

The following information will be shown on the project drawings:

1. Detail plans to show tank location, elevation, valve vault if required, and connection to system.

2. Accessories as depth indicator, telemetering automatic controls, protection against freezing, or other special project requirements.

3. Requirements of UFC 3-260-01 and the Federal Aviation Agency to determine if tank constitutes an obstruction and hazard to aerial navigation. If so, show pattern for orange and white painting. Detail obstruction lights or beacon and intermediate lights as required. Refer to Federal Aviation Agency Aviation Circular AC 70/7460-1M, "Obstruction Marking and Lighting", UFC 2-26-04 and UFC 3-535-01.

4. Requirements for cathodic protection system, including details of anodes, anode layout, wiring connections, and rectifier (as applicable).

****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2017) Steel Construction Manual

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2018) Hypochlorites
AWWA B301	(2010) Liquid Chlorine
AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2018) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2020) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C150/A21.50	(2014) Thickness Design of Ductile-Iron Pipe
AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA C500	(20019) Metal-Seated Gate Valves for Water Supply Service
AWWA C504	(2015) Standard for Rubber-Seated Butterfly Valves
AWWA C508	(2017) Swing-Check Valves for Waterworks Service, 2 In. Through 48-In. (50-mm Through 1,200-mm) NPS
AWWA C600	(2017) Installation of Ductile-Iron Mains

and Their Appurtenances

AWWA C652 (2019) Disinfection of Water-Storage Facilities

AWWA D100 (2011) Welded Steel Tanks for Water Storage

AWWA D103 (2009; Errata 2010; Addenda 2014) Factory-Coated Bolted Steel Tanks for Water Storage

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020) Structural Welding Code - Steel

AWS D1.3/D1.3M (2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M (2003; R 2016) Standard Specification for Gray Iron Castings

ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80 (2019) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 22 (2018) Standard for Water Tanks for Private Fire Protection

NSF INTERNATIONAL (NSF)

NSF/ANSI 61 (2020) Drinking Water System Components - Health Effects

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 150/5345-43 (2019; Rev J) Specification for Obstruction Lighting Equipment

1.2 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other

submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Qualifications; G[, [_____]]

SD-02 Shop Drawings

Detail Drawings; G[, [_____]]

Tank Installation; G[, [_____]]

Piping and Valve Installation; G[, [_____]]

SD-03 Product Data

Manufacturer's Technical Literature; G[, [_____]]

System Description; G[, [_____]]

Foundations; G[, [_____]]

Heating System; G[, [_____]]

Alarm System; G[, [_____]]

Disinfection Procedures; G[, [_____]]

Valves; G[, [_____]]

Pipe, Fittings, Joints and Couplings; G[, [_____]]

Joint Sealants and Gaskets; G[, [_____]]

SD-05 Design Data

Manufacturer's Design Analysis; G[, [_____]]

Foundation Design Analysis; G[, [_____]]

SD-06 Test Reports

Tank Installation; G[, [_____]]

Testing of Valves and Piping; G[, [_____]]

Hydrostatic Test; G[, [_____]]

Leak Test; G[, [_____]]

SD-07 Certificates

Tank Coating System; G[, [_____]]

Pipe Lining and Coating; G[, [_____]]

SD-08 Manufacturer's Instructions

Shipping, Handling, and Storage; G[, [_____]]

1.3 QUALITY ASSURANCE

1.3.1 Manufacturer's Qualifications

The manufacturer and installer must demonstrate a minimum 10 years of experience in the manufacturing and construction of [elevated] [standpipe] [reservoir] steel water storage tanks. Manufacturer must be able to demonstrate experience through the design and construction of at least 5 completed projects of similar type and size with references with current position, address, and contact information.

Provide certified manufacturer's design analysis, detail drawings, and foundation design analysis by an authorized licensed engineer in the geographical area where construction will take place, having a minimum 4 years of experience as an engineer knowledgeable in design and analyses of steel storage tanks and its foundations. Submit a certificate signed by a registered professional engineer, providing the following information:

a. Description of the structural design loading conditions used for the design of entire tank including the foundation.

b. Description of the structural design method and codes used in establishing the allowable stresses and safety factors applied in the design.

c. A statement verifying that the structural design has been checked by experienced engineers specializing in hydraulic structures.

d. A statement verifying that the detail drawings have been checked by experienced engineers specializing in hydraulic structures to determine that they agree with the design calculations in member sizes, dimensions, and fabricating process as prescribed by applicable AWWA, ACI, and other applicable standards.

1.3.2 Welding Qualifications

Qualification of welding procedures, welders, and welding operators must be in accordance with Section 8.2 of AWWA D100 or AWWA D103 and AWS D1.1/D1.1M and AWS D1.3/D1.3M.

1.3.3 Tank Coating System Certifications

Coating materials for interior applications and all other materials which will be in normal contact with potable water must conform to NSF/ANSI 61. Certification by an independent third-party organization that all interior coatings and materials that come in contact with potable water must comply with NSF/ANSI 61 must be provided.

1.4 SHIPPING, HANDLING, AND STORAGE

Deliver paint in unopened containers with unbroken seals and labels showing designated name, specification number, color, directions for use, manufacturer, and date of manufacture, legible and intact at time of use. Handle and store water storage tank systems, components, and parts to prevent distortions and other damage that could affect their structural, mechanical, or electrical integrity. Replace damaged items that cannot be restored to original condition. Store items subject to deterioration by exposure to elements, in a well-drained location, protected from weather, and accessible for inspection and handling.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design Requirements

****

NOTE: When required by the corrosive nature of stored water, lack of proper maintenance facilities, or by climatic conditions, this paragraph will be modified to provide for a corrosion allowance per AWWA D100 or AWWA D103.

The capacity of the tank will be based on calculations according to UFC 3-230-01 WATER STORAGE, DISTRIBUTION, AND TRANSMISSION. The elevation at the top of the foundation will be not less than 200 mm 8 inches above the finished grade.

UFC 3-301-01 Chapter 5 "NON BUILDING STRUCTURES" Section 5-3 states the design of tanks for storage must be per AWWA. The design loads must be in accordance with AWWA, ASCE 7, IBC, and local codes whichever controls. Tanks for fire protection

service must also conform to NFPA 22.
****

The design, fabrication, and erection of the [elevated] [standpipe] [reservoir] steel water storage tank must be in accordance with the requirements of AWWA D100 or AWWA D103 and ASCE 7-16. Submit design analyses and manufacturer's technical literature.

The following data and information are supplied as a basis for design and erection of the tank and appurtenances:

Tank Capacity and Dimensions

a. Top Capacity Level (TCL) [_____]
b. Bottom Capacity Level (BCL) [_____]
c. Head Range [_____]
d. Diameter [_____]
e. Tank Height [_____]
f. Top of Foundation Elevation [_____]

Seismic Design Criteria

a. Seismic Use Group [_____]
b. Seismic Importance Factor, IF [_____]
c. Site Class [_____]
d. Ss [_____]
e. S1 [_____]

Design Wind Loading

a. Design Wind Speed, V [_____]
b. Gust Factor, G [_____]
c. Importance Factor [_____]
d. Exposure Category [_____]

Roof Design Loading

a. Roof Live Load [_____]
b. Ground Snow Load [_____]

2.1.2 Elevated Tank

Sizing and design of welded steel elevated tank must be in accordance with Section 4 of AWWA D100 and AISC 325. The tank must be a [multi-column] [pedosphere] [fluted column] of [double ellipsoidal type] [double-cone type] [spherical type] [spheroidal type] [the style shown] [or as approved]. [The welded steel tower supporting the tank must be constructed of structural shapes of the open type, or of tubular sections, to permit inspection and painting. The tower must be thoroughly braced with horizontal struts and diagonal ties. The tower columns may be vertical or inclined as the design may require. Main column splices must be as few as possible and must be located as near as practicable to the intersection of the centerline of the struts. Splice plates must be welded so as to hold the members in line and transmit any tension or shearing stresses to which the members may be subjected. The connections of the tank, with the columns must be made to distribute the load properly over the column sections and over the shell of the tank.] [The single-pedestal supporting the tank must be all welded steel, cylindrical column with the transition at the top and bottom of the pedestal in accordance with

manufacturer standard.]

2.1.3 [Standpipe][Reservoir]

The [standpipe] [reservoir] must have such standard shell height and diameter that will meet the requirements for the selected standard capacity and for the high-water level specified. The range between high and low water levels will be approximately [_____] mm feet. The [standpipe] [reservoir] must have [column supported cone roof] [clear span self-supporting [cone roof,] [toriconical roof,] [umbrella roof,] [dome roof, or] [ellipsoidal roof,] [aluminum dome roof,] as approved]. The [standpipe] [reservoir] must be of welded or bolted construction designed in accordance with AWWA D100 or AWWA D103 and AISC 325.

2.1.4 Foundation

Foundation design and construction must be in accordance with [Section 12 of AWWA D100] [Section 13 of AWWA D103] and ACI 318. The foundation design must be based on recommendations provided in the Geotechnical investigation included with the Contract Documents. Recommendations for the foundation type, foundation depth, and design soil-bearing pressure are defined in this report.

2.2 MATERIALS

Provide materials conforming to the following requirements:

2.2.1 Steel

Comply with design requirements of Section 2 of AWWA D100 or Section 2 of AWWA D103 and AISC 325.

2.2.2 Shop Fabrication

Section 9 of AWWA D100 or Section 7 of AWWA D103.

2.2.3 Ductile-Iron Pipe

Pipe, fittings, joints and couplings for fluid conductors, except for overflow pipe, must be ductile-iron pipe and must be either of the following:

2.2.3.1 Bell-and-Plain End Pipe

****
NOTE: See AWWA C150/A21.50 or C151 for thickness design of ductile iron pipe. Piping materials, other than ductile iron, conforming to Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING may be used when warranted.
****

AWWA C150/A21.50 and AWWA C151/A21.51, for not less than 1035 kPa 150 psi working pressure, unless otherwise shown or specified. Joints must be push-on or mechanical-joint conforming to AWWA C111/A21.11 with pressure rating equivalent to that of the pipe. Provide standard thickness cement mortar lined in accordance with AWWA C104/A21.4.

2.2.3.2 Flanged Pipe

Flanged pipes must conform to the applicable portions of AWWA C110/A21.10, AWWA C115/A21.15 and AWWA C151/A21.51, for not less than 1035 kPa 150 psi working pressure, unless otherwise shown or specified. Pipe must have flanged ends in accordance with AWWA C115/A21.15. Provide standard thickness cement mortar lining in accordance with AWWA C104/A21.4.

2.2.4 Specials and Fittings (except for overflow pipe)

2.2.4.1 Ductile-Iron with Bell-and-Plain End

AWWA C110/A21.10 and AWWA C151/A21.51 for not less than 1035 kPa 150 psi working pressure, unless otherwise shown or specified. Provide standard thickness cement mortar lining in accordance with AWWA C104/A21.4.

2.2.4.2 Ductile-Iron with Flanged Ends

AWWA C110/A21.10 and AWWA C151/A21.51 for not less than 1035 kPa 150 psi working pressure unless otherwise shown or specified. Fittings must have flanged ends in accordance with AWWA C110/A21.10. Provide standard thickness cement mortar lining in accordance with AWWA C104/A21.4.

2.2.4.3 Steel Piping

Pipe, ASTM A53/A53M, Standard Weight, zinc-coated for not less than 1035 kPa 150 psi working pressure unless otherwise shown or specified. Fittings, ASME B16.4, Class 125, zinc coated; or ASME B16.3, Class 150, zinc coated, threaded.

2.2.4.4 Joints Inside Valve Chamber

All joints inside the valve chamber must be flanged.

2.2.5 Valves

Provide all valves from one manufacturer.

2.2.5.1 Gate Valves

Gate valves must be opened by turning counterclockwise. Valves 80 mm 3 inches and larger must be stem type with joint ends compatible for the adjoining pipe conforming to AWWA C500. Valves smaller than 80 mm 3 inches must be all bronze and must conform to MSS SP-80, Type 1, class 150. Valves 80 mm 3 inches or larger located in valve chambers must be equipped with hand-operating wheels and must be flanged.

2.2.5.2 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves must be opened by turning counterclockwise. Valves must conform to AWWA C504. Body and disc must be cast iron, conforming to ASTM A48/A48M. Shaft must be 18-8 stainless steel. Resilient seat must be bonded to the valve body. Butterfly valves must be stainless steel to rubber seated, tight closing type. Flanged-end valves are required in valve chamber. Provide a union or sleeve-type coupling in the chamber to permit removal.

2.2.5.3 Check Valves

Check valves must conform to AWWA C508 and be of the horizontal swing-check type, suitable for the purpose and the operating conditions. The body must be cast iron with flanged ends with pressure rating equivalent to that of the connecting pipe.

2.2.5.4 Altitude Valve

The supply to the [elevated tank] [standpipe] [reservoir] must be controlled by a one-way [_____] mm inch altitude valve, automatic in operation and accurately set to prevent overflow of the [elevated tank] [standpipe] [reservoir]. The valve must have flanged ends and a heavy cast iron body, must be bronze fitted with renewable cups and seats, and must be designed without metal-to-metal seats. The valve must be cushioned when opening and closing to prevent water hammer or shock. Valves must be provided with a travel indicator to determine operating position. All necessary repairs and/or modifications other than replacement of the main valve body must be made possible without removing the valve from the pipeline.

2.2.6 Pressure Gauge

Pressure gauge of the direct-reading type, equipped with a shutoff cock, must be provided, in the valve chamber, on the tank side and on the discharge side of the check or altitude valve. Gauges must have 150 mm 6 inch dials, must be stem mounted, and must conform to ASME B40.100. Accuracy of gauges must be Grade A or better. Gauges must be calibrated in kPa and psi psi in not more than10 kPa and psi 2 psi increments from 0 to 350 kPa and 0 to 50 psi 0 to 50 psi in excess of the normal operating pressure at the tank.

2.2.7 Joint Sealants and Gaskets

The lap joint sealant must be a one component, moisture cured, polyurethane compound in accordance with Section 4.10 of AWWA D103. The sealant must be suitable for contact with potable water must comply with NSF/ANSI 61. Neoprene gaskets and tape type sealer must not be used in liquid contacting surfaces.

2.3 ASSEMBLIES

****

NOTE: The following tank accessories and assemblies must be coordinated for the specific type of tank being specified. Other components may need to be included based on service, maintenance, and operational needs of the facility.

Adequate accessibility must be provided to the exterior of the tank for maintenance, inspection and painting. This may include items such as walkways, safety railing, tie-off anchors for scaffolding or rope inspections.

Adequate access, ventilation, and supporting accessories to the interior of tank must be provided to facilitate tank maintenance, inspection, painting, and for sanitizing and cleaning for

environmental contamination such as Legionella.
****

2.3.1 Tank Accessories

Section [5][7] of AWWA D100 or Section 7 of AWWA D103 and as specified. Additional requirements for accessories are as follows:

2.3.1.1 Steel Riser

****
NOTE: The minimum riser diameter must be 910 mm 36 inches in localities where freezing temperatures occur. Riser diameter equal to or greater than 36 inches must have a manhole located 3 feet above the base.
****

Center steel riser must conform to Section 5.1 of AWWA D100 must not be less than [_____] mm inches in diameter. A safety grill must be provided at the top of the riser with an 18 inch by 18 inch hinged door. [A minimum 18 x 24 inch elliptical access manhole must be provided approximately 3 feet above the base of the wet riser. The hatch must open inward.]

2.3.1.2 Roof Hatches

Provide two access hatches 180 degrees apart on the roof of the tank. One hatch must be 30 inch diameter and allow access from the roof to the interior of the tank. The hatch will be hinged and equipped with a hasp for locking. The hatch cover must have a 2 inch downward edge. The second hatch will be 24 inch diameter and flanged with a removable cover so constructed that an exhaust fan may be connected for ventilation during inspection, maintenance, painting, and cleaning operations. The openings must have a minimum 4 inch curb

2.3.1.3 Tank Vent

Clog resistant tank vent must be centrically located on the tank roof above the maximum weir crest elevation. The vent must conform to Section 5.5 or 7.5 of AWWA D100 or Section 7.7 of AWWA D103. The tank vent must have an intake and relief capacity sufficient to ensure that excessive pressure or vacuum, either entering or leaving the tank, will not be developed during maximum flow rate. The vent will be tank manufacturer's standard mushroom type constructed with corrosion resistant screen to prevent the ingress of wind driven debris, insects, birds and animals. The vent must be designed to ensure fail-safe operation in the event that screen frosts over or otherwise clogged and the bottom of the screen must be sufficiently elevated for snow consideration in the area

2.3.1.4 Overflow

The overflow for the tank must consist of an overflow weir box and [stub overflow] [outside drop pipe, adequately supported and] capable of discharging at a rate of [_____] L/second gpm with [_____] mm inches of head [, without the water level exceeding [_____]]. [The top of the weir must be [_____] mm inches below [_____].] [The weir must be located as indicated.] The [stub overflow must be steel, ASTM A53/A53M or equal,

must project at least 12 inches from the shell, and must be fitted with a screen] [overflow pipe must be steel, ASTM A53/A53M or equal, and must terminate 300 to 600 mm 1 to 2 feet above grade not to be obstructed by snow or ground clutter and must be fitted with a flapper valve or course corrosion-resistant screen to prevent ingress of animals and insects].

2.3.1.5 Shell Access Manholes

Number, type, location, and size of manholes must be as shown on the drawings.

2.3.1.6 Pipe Connections

Number, type, location, load, and size of pipe connections must be as shown on the drawings. Inlet pipe connections to extend [_____] mm inches above tank bottom and must be provided with deflectors as shown on the drawings. Outlet pipe connections to extend [_____] mm inches above tank bottom and must be provided with vortex breakers as shown on the drawings. Pipe connections to the tank must include a flexible coupling outside the tank to allow for differential movement. Pipe connections through the shell must include protection from freezing and vandalism. Piping must allow for differential movement when the tank is filled and drained. Special flexible, extendable connections must be provided for tanks subject to seismic loads.

2.3.1.7 Ladders, Platforms, and Safety Devices

Ladders, platforms, and safety devices must be provided in accordance with Sections 7.4 of AWWA D100 or Sections 7.4 and 7.5 of AWWA D103. Location of ladders must be as shown on the drawings. Sections 7.4 of AWWA D100 and Sections 7.4 and 7.5 of AWWA D103 represent the minimum requirement. In addition, safety cage, rest platforms, roof platforms, roof ladder handrails, and other safety devices must be provided as required by federal or local laws or regulations.

2.3.1.8 Balconies

Provide a balcony a minimum of 600 mm 2 feet wide with a standard guard railing. Provide a structural steel railing with a top rail 1050 mm 42 inches above balcony platform with an intermediate rail halfway between. Guard rail must be capable of withstanding a force of 888 N 200 pounds applied in any direction. Install a steel toe board with minimum height of 100 mm 4 inches. Bottom of toe board must be a maximum 6 mm 1/4 inch from platform top. Extend guard rail and toe board entire length of balcony except where access openings are required. For balcony floors use diamond plates a minimum of 6 mm 1/4 inch thick, punched or drilled for drainage. [Equip access openings in guard rail with a gate which closes automatically.] Hatches through balcony floor must be counterbalanced or otherwise arranged to open from below.

2.3.2 Valve Chamber

Valve chamber must be sufficiently large to house all control valves and fittings; and allow for unobstructed maintenance and replacement. Pipes, valves, and fittings must be supported on concrete blocks where necessary. The valve chamber must be constructed to provide not less than [_____] mm feet of cover over the pipes. The valves and fittings must extend from the [standpipe] [reservoir] [riser pipe] connection to a point one length of pipe outside the valve chamber walls on the main or feed

line to the [elevated tank] [standpipe] [reservoir]; the drain line will be carried to an outlet as indicated on the drawings. The access manhole must be not less than 760 mm 30 inches in diameter.

2.3.3 Anchors for [Standpipe] [Reservoirs]

The following requirements must be met:

a. An adequate number of anchors designed to prevent overturning for the maximum design uplift forces on the [standpipe] [reservoir] must be installed. If anchor bolts are used, the nominal diameter must not be less than 25 mm one inch, plus a corrosion allowance of at least 6 mm 1/4 inch on the diameter. If anchor straps are used, they must be pre-tensioned before welding to the tank shell.

b. The anchor bolts must be a right angle bend, hook, or plate washer, while anchor straps must have only a plate welded to the bottom. The anchors must be inserted into the foundation to resist the computed uplift.

c. Attachment of anchors to the shell must not add significant localized stresses to the shell. The method of attachment must consider the effects of deflection and rotation of the tank shell. Anchors must not be attached to the tank bottom. Attachment of the anchor bolts to the shell must be through stiffened chair-type assemblies or anchor rings of adequate size and height.

2.3.4 High and Low Water Level Alarm System

Provide high and low level devices for alarm monitoring and an intermediate device for tank water level status. All three water levels must be indicated by their respective pilot lights; green for high, amber for intermediate and red for low water levels, and a buzzer for low and high water levels. Buzzer and the respective pilot lights at high and low water levels must be energized while the high or low water level pilot device is actuated. Depressing a silencing button must silence the buzzer indicating the water level and must remain in OFF condition. The pilot light must remain energized. Resetting the pilot light must de-energize the pilot light and release the buzzer from its sealed-off condition.

2.3.5 Heating System

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NOTE: Water tanks subject to freezing (tanks that primarily serve fire protection systems and those where the daily consumption is small) must be provided with heating facilities in accordance with NFPA 22. The heating system must be of such capacity that the temperature of the coldest water in the tank or tank riser, or both, is maintained at or above 5.6 degrees C 42 degrees F during the coldest weather.

****

Provide tank heating to comply with NFPA 22 and with capacity to maintain 5.6 degrees C 42 degrees F at all times including coldest temperatures and lowest consumption.

2.4 COATINGS

2.4.1 Tank Coating System for Welded Tanks

Provide exterior coating systems conforming to Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES and interior coating systems conforming to Section 09 97 13.16 INTERIOR COATING OF WELDED STEEL WATER TANKS.

2.4.2 Tank Coating System for Bolted Tanks

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NOTE: Bolted tanks are factory coated, interior and exterior. No field painting is needed other than repair to damaged areas. Where cathodic protection will be installed, electrical continuity must be established across the bolted joints to ensure proper cathodic protection system operation

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As supplied by the manufacturer.

2.5 CONCRETE WORK

Concrete work must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.6 CHLORINE

AWWA B300 for hypochlorites or AWWA B301 for liquid chlorine, mixed with water to give the solutions required in AWWA C652.

PART 3 EXECUTION

3.1 FOUNDATIONS

Foundations for the [standpipe] [reservoir] [tank columns and riser] and for the valve chamber must be constructed of concrete, reinforced where necessary, and designed in accordance with Sections 12 and 13.7 of AWWA D100 or Sections 13 and 14.5 of AWWA D103 for earth with a bearing value of [_____] MPa psf, at elevation [_____], and constructed in conformance with the applicable requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE, except as shown or specified herein. A Type 1 or Type 2 foundation per AWWA D100 or AWWA D103 must be provided for the [standpipe] [reservoir].

3.2 EXCAVATING, FILLING, AND GRADING

Excavating, filling, and grading must conform to the applicable requirements of Section 31 00 00 EARTHWORK.

3.3 CATHODIC PROTECTION

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NOTE: Evaluate need for cathodic protection on an individual project basis.

****

Cathodic protection must be provided, conforming to Section 26 42 15.00 10 CATHODIC PROTECTION SYSTEM (STEEL WATER TANKS).

3.4 LIGHTNING PROTECTION

****

NOTE: Evaluate need for lightning protection on an individual project basis.

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Lightning protection must be provided, conforming to Section 26 41 00 LIGHTNING PROTECTION SYSTEM.

3.5 OBSTRUCTION LIGHTING

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NOTE: Obstruction lighting will be included in the contract specifications only when required and will be detailed on the drawings, in accordance with UFC 3-535-01 or FAA AC 70/7460-1.

****

Obstruction lighting must be provided and installed as shown, and must conform to Section 26 56 20 AIRFIELD AND HELIPORT LIGHTING AND VISUAL NAVIGATION AIDS and FAA AC 150/5345-43.

3.6 TANK INSTALLATION

Submit detailed erection drawings, before proceeding with any fabrication. Complete drawings with details of steel, piping and valve installation, and concrete work, and of the assembling of items required for the total installation. Use standard welding symbols in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M. Details of welded joints referenced on the drawings must be included. Tank installation must be in accordance with the following requirements:

3.6.1 Welding

Section 8 of AWWA D100 or AWWA D103 and AWS D1.1/D1.1M and AWS D1.3/D1.3M.

3.6.2 Erection

Section 10 of AWWA D100 or AWWA D103 and in accordance with manufacturer's procedures using factory trained and certified erectors.

3.6.3 Inspections and Testing

Tank inspection and testing must be in accordance with Section 11 of AWWA D100 AWWA D103. Mill and shop inspections [are not required] [are required and must be performed by an approved commercial inspection agency]. Perform the radiographic inspections of the welded tank shell, the hydrostatic test and the vacuum box leak test of the tank bottom. Final hydrostatic and leak tests must be performed before painting of welded tanks.

3.7 PIPING INSTALLATION (EXCEPT FOR OVERFLOW PIPING)

3.7.1 General Guidelines

Where details of fabrication or installation are not shown on the drawings, installation must conform to Section 1 and 4 of AWWA C600.

3.7.2 Testing of Valves and Piping

After the [elevated tank] [standpipe] [reservoir] has been erected and the valves and piping installed, and before field painting is begun, the valves and piping must be hydrostatically tested in accordance with Section 5 of AWWA C600. Submit each coating manufacturer's technical data, application instructions, Safety Data Sheets (SDS), and certificate for compliance for VOC content. Submit copies of the following test results:

a. Manufacturer's mill test reports for plate material.

b. Mill and shop inspections by a commercial inspection agency.

c. After acceptance of the structure, the radiographic film and test segments.

At the conclusion of the work, a written report covering the hydrostatic test and certifying that the work was inspected in accordance with Section 11.2.1 of AWWA D100.

Replace with sound material any defective material disclosed by the pressure test; the test must be repeated until the test results are satisfactory.

3.7.3 Pipe Lining and Coating of Underground Ductile-Iron Piping

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NOTE: Appendix A of AWWA C105/A21.5 will be utilized in determining whether polyethylene encasement should be used.

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Polyethylene encasement in accordance with AWWA C105/A21.5 of underground ductile-iron piping must be provided in addition to cement-mortar lining.

3.7.4 Plugging Ends

Cap or plug pipe ends left for future connections as directed.

3.8 PAINTING AND COATING OF TANK

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NOTE: Some state and local environmental agencies have enacted environmental regulations that may restrict the application of some coating systems. Content of the regulations varies widely. The designer must contact the appropriate state and local authorities to determine if the paint systems are acceptable. If these systems are not acceptable, the designer must determine the best acceptable system and revise this specification accordingly. However, any deviation from this specification and AWWA Standards must be submitted with justification to CEMP-ET for approval.

If the tank constitutes an obstruction to air navigation, the paint system applied to the exterior

of the tank will be an orange and white pattern per AC 70/7460-1M and UFC 2-26-04 and UFC 3-535-01.
****

Each coating manufacturer's tank coating system technical data, application instructions, SDS, and certificate for compliance for VOC content must be submitted to the Contracting Officer. Application, curing time, mixing and thinning of the coating materials must be in strict accordance with the manufacturers instructions. The use of thinners must not alter the required minimum dry thickness or adversely affect the VOC content.

3.8.1 Exterior Surfaces (Welded Tanks)

Provide an exterior coating system conforming to Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES.

3.8.2 Interior Surfaces (Welded Tanks)

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NOTE: Section 09 97 13.16 Part 2 identifies the interior coating system for both potable and non-potable water tanks as one based on military specification MIL-DTL-24441. This system may be used where the ambient temperatures are above 10 degrees C 50 degrees F. There are currently no products listed as meeting the NSF/ANSI 61 on the NSF/ANSI database for potable water applications but the navy has internally approved specific batches. A second option for potable water tanks allows any 3 coat epoxy polyamide coating system having NSF/ANSI 61 approval. The specifier may opt to edit this paragraph by referencing military specification MIL-PRF-23236. Class 9 of this specification is dedicated to potable or freshwater but not seawater tanks and has several products on the QPL listing. By specifying Class 9/18 an alternate high build coating system can be obtained that is applied using plural component application equipment. Plural component systems can typically be applied at quite low temperatures and cure rapidly allowing tanks to be put into service quickly however, they require specialized equipment and training that may not be available from small business contractors. Performance of the above MIL-PRF-23236 systems is considered similar to the MIL-DTL-24441 system. When MIL-PRF-23236 systems are specified the contract should require they be applied at a minimum as 2 coat systems and that they be applied in strict accordance with the manufacturer's recommendations.
****

Provide an interior coating system conforming to Section 09 97 13.16 INTERIOR COATING OF WELDED STEEL WATER TANKS.

3.8.3 Bolted Tanks

****
NOTE: AWWA D103 Section 12 identifies coating

systems that are applied in the manufacturer's own facilities. Performance and cost of the various systems varies significantly. The specifier should select the system that is most appropriate for the specific application. Galvanized coatings are disallowed when the stored water is corrosive. Glass coatings typically provide the longest service life but are only available as the manufacturer's standard color on both the interior and exterior of the tank. Thermoset liquid suspension coatings allow the greatest selection of exterior colors.

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The surfaces of both the interior and exterior of the tank must be coated in accordance with [Section 12.3, Galvanized Coatings][Section 12.4, Glass Coatings][Section 12.5, Thermoset Liquid Suspension Coatings][Section 12.6, Thermoset Powder Coatings] of AWWA D103. Color must be [as indicated] [as approved]. Coating damage during transportation and construction must be repaired per manufacturer's recommendations.

3.9 DISINFECTION

The [elevated tank] [standpipe] [reservoir] and connecting lines thereto must be disinfected with chlorine before being placed in operation.

3.9.1 Tank

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NOTE: In areas subject to regulations which are more stringent than requirements contained in AWWA C652, the local requirement will apply and will be specified.

AWWA C652 covers three methods for disinfection. Typically, only one method will be used for a given storage facility disinfection, but combinations of the methods may be used. The three methods are:

1. Chlorination of the full storage facility such that the end of the appropriate retention period the water will have a free chlorine residual of not less than 10 mg/L.

2. Spraying or painting of all storage facility water contact surfaces with a solution of 200 mg/L available chlorine.

3. 3. Two-step process of chlorinating the bottom portions of the storage facility with 50 mg/L free chlorine followed by filling to the overflow with potable water to be held not less than a period of 24 hours.

****

[After coating system has been cured, inspected, and approved cured, rinse tank with potable water.] After flushing, the [elevated tank] [standpipe] [reservoir] must be disinfected in accordance with [AWWA C652] [Method 1] [Method 2] [or] [Method 3]. After the chlorination procedure is completed

and before the storage facility is placed in service, the Contracting Officer will collect samples of water in properly sterilized containers for bacteriological testing from the full facility in accordance with Section 5 of AWWA C652. The tank will not be accepted until satisfactory bacteriological results have been obtained.

3.9.2 Piping

The valves and piping must be disinfected in accordance with Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

-- End of Section --