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USACE / NAVFAC / AFCEC / NASA	**UFGS-43 41 16.16 40 (August 2017)**

Preparing Activity: NASA	**Superseding**
	UFGS-43 41 16.16 40 (August 2014)
	UFGS-43 41 16.16 (August 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

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08/17

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SECTION 43 41 16.16 40

VERTICAL ATMOSPHERIC TANKS AND VESSELS
08/17

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NOTE: This guide specification covers the requirements for fiberglass-reinforced polyester storage tanks and accessories for use in aggressive chemical service at atmospheric pressures and is limited to flat-bottomed, aboveground, vertical, cylindrical 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 does not cover vertical tanks with dished or conical bottoms, vertical tanks for buried service, pressure vessels, and horizontal tanks for both above-ground and buried services.

Related work specified elsewhere includes:

a. Cast-in-place concrete

b. Anchor bolts (provide calculations that determine bolt types, sizes and quantities required.)

c. Plastic pipe

d. Acid-resistant pipe

e. Chemical valves

f. Liquid-level gages

As a minimum, show on drawings:

a. The physical location of each tank

b. The location of all accessories to be furnished with each tank

c. Concrete-foundation details for each tank

d. Anchoring details for attaching each tank to the foundation

e. A schedule with connections, size, quantity, and location of tanks.

Specify connection usage such as drain, vent, or overflow and location by top or side. Coordinate this schedule with accessories and the locations shown on drawings.

****

****

NOTE: If Section 22 00 00 PLUMBING, GENERAL PURPOSE is not included in the project specification, insert applicable requirements thereof and delete the following paragraph.

****

Section 22 00 00 PLUMBING, GENERAL PURPOSE applies to work specified in this section.

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.
****

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 SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard

ASTM INTERNATIONAL (ASTM)

ASTM C581	(2020) Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures, Intended for Liquid Service
ASTM D5948	(2005; R 2012) Standard Specification for Molding Compounds, Thermosetting

BRITISH STANDARDS INSTITUTE (BSI)

BS EN 13121-3	(2016) GRP Tanks and Vessels for Use Above Ground — Part 3: Design and Workmanship

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 7005-2	(1988) Metallic Flanges Part 2: Cast Iron Flanges

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA 2.63	(2004) Tank and Storage Tank Un-pressurized
RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

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

Record Drawing of Existing Conditions

List of Product Installations; G[, [____]]

SD-02 Shop Drawings

Coordination Drawings; G[, [____]]

Equipment Room Layout; G[, [____]]

Fabrication Drawings; G[, [____]]

Installation Drawings; G[, [____]]

SD-03 Product Data

Equipment and Performance Data

Equipment Foundation Data

Storage Tanks; G[, [____]]

Accessories; G[, [____]]

SD-04 Samples

Manufacturer's Standard Color Charts for Laminates; G[, [____]]

Flanged Nozzles; G[, [____]]

Inlet Nozzles; G[, [____]]

Outlet Nozzles; G[, [____]]

SD-05 Design Data

Design Analysis and Calculations; G[, [____]]

SD-06 Test Reports

Chemical Resistance Tests

Tank Integrity

Verification of Liquid-Level Indication Results

Verification of Relief Device Results

Hydrostatic Tests; G[, [____]]

SD-07 Certificates

Certificates of Conformance

Installers; G[, [____]]

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-09 Manufacturer's Field Reports

Manufacturer's Field Reports

SD-10 Operation and Maintenance Data

Operation and Maintenance Manual

SD-11 Closeout Submittals

Record Drawings

1.3 QUALITY CONTROL

Submit a list of product installations for fiberglass-reinforced polyester storage tanks, identifying at least five units, similar to those proposed for use, that have been in successful service for at least 5 years. Identify purchaser, address of installation, service organization, and date of installation.

Submit certificates of conformance at least [30] [_____] days before work begins, verifying the following items comply with the standards and specifications:

a. Storage tanks: Provide the manufacturer's certification that storage tanks are suitable for storage of specified chemicals.

b. Installer: provide signed statements that installers have knowledge of the requirements of the applicable standards, including NASA RCBEA GUIDE, and specifically RCBEA 2.63, and installation practices

in order to ensure the tanks are installed in a sound, undamaged condition.

1.4 DELIVERY, STORAGE, AND HANDLING

In order to prevent damage, handle and store the tanks in accordance with the manufacturer's guidelines. Provide verification that the tanks have no damage, surface defects, or poor quality laminates.

All damaged or defective tanks or removable covers will be rejected by the Contracting Officer. Remove immediately from the project site.

Concurrent with delivery of the tanks, submit [three][_____] copies of the manufacturer's Operation and Maintenance Manual.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Record Drawing of Existing Conditions

Submit a record drawing of existing conditions, including underground utilities, at least [30] [_____] days before construction work begins.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Fabrication Drawings

Submit fabrication drawings for fiberglass-reinforced polyester storage tanks, including construction and anchorage details, at least [30] [_____] days before construction work starts.

Submit the manufacturer's standard color charts for laminates so that a visual inspection of the surface finish and color can be performed.

Submit the manufacturer's catalog data for storage tanks including spare parts.

2.1.2 Loading Conditions

****

NOTE: Show equipment and accessory loads affecting tank shells and tops, if required. Show wind load for exterior tanks and tank top design load when top manways are specified.

****

Provide tanks conforming to the loading conditions specified in project requirements.

2.1.3 Chemical Storage Requirements

Provide design analysis and calculations for fiberglass-reinforced polyester storage tanks, complying with BS EN 13121-3.

****

NOTE: The Project Manager should review NASA RCBEA criteria under section 2.63 (2.63.1, 2.63.2, and 2.63.3) to determine the extent of required

acceptance documentation.
****

Submit test reports for chemical resistance tests in accordance with ASTM C581.

Submit test reports for the following:

a. Tank integrity

b. Verification of liquid-level indication results

c. Verification of relief device results

Results of previous successful tests are acceptable provided that the laminates tested are representative of the tank material specified for this project.

2.1.4 Capacity and Dimensional Requirements

****
NOTE: Capacities vary up to 300 kiloliter 75,000 gallons.
****

Provide the minimum capacity as measured in liter gallons to the top of the straight shell or wall height as indicated.

****
NOTE: Diameters vary up to 5 meters 16 feet. Wall heights vary up to 14 meters 47 feet.
****

Ensure that the diameter and straight shell or wall height are as specified.

2.1.4.1 Liquid-Level Gauge

Provide the tank with a liquid-level armored gauge glass sight tube [with flanges], indicating between 10 and 90 percent of tank capacity.

2.2 ASSEMBLY

****
NOTE: Select either filament-wound or contact-molded construction.

Filament winding is a process for tank fabrication in which continuous strands of fiberglass impregnated with resin are wound over the inner corrosion barrier in a predetermined geometric pattern.

Contact molding is a process for tank fabrication in which the structural reinforcement comprises sprayed, chopped-fiberglass supplemented with woven-glass roving fabric. This process is also known as hand layup, spray layup, pressure molding, or contact pressure molding. The pressure is seldom

greater than that required to hold the materials together during fabrication.

Tanks up to 1.5 meters 5 feet are less expensive when fabricated by contact-molding methods. Strength requirements in larger tanks make filament-wound structures more economical. Filament winding offers equivalent strength with less shell thickness, and laminate quality is also improved.

****

[Provide a contact-molded tank, conforming to BS EN 13121-3 ASTM D5948.

][Provide a filament-wound tank, conforming to BS EN 13121-3 ASTM D5948.
]

****

NOTE: Select one of the following for the tank top.

****

[Provide a tank with an open top, with a reinforcing flange in compliance with ISO 7005-2 or a rib [and removable cover].

][Provide a tank with a closed top.
]

****

NOTE: Select one of the following types if the tank is required to have a closed top.

The end of a filament-wound cylindrical container normally appearing convex is called a domed top.

The end of a filament-wound or contact-molded tank normally appearing concave is called a dished top.

****

[Provide a tank with a [dome] [dished] [flat] closed top.
]

****

NOTE: Select one of the following for top fabrication.

Separate fabrication of the top and shell is most common.

****

[Provide a closed top [integrally fabricated with shell] [separately fabricated and laminated to the shell].
]

****

NOTE: Select one of the following two paragraphs for flat-bottom fabrication.

Integral fabrication offers greater strength and does not rely on laminating procedures to join separate sections.

****

Provide a flat-bottom tank fabricated [integrally with the shell] [separately and laminated to the shell].

****
NOTE: Specify additional special surfaces based on accessories and equipment required.
****

Provide a tank with bracketed flat surfaces for [an identification plate] [a certification plate] [a liquid-level gage] [mounting lugs].

2.3 ACCESSORIES

****
NOTE: Accessories specified are common items for general usage. Consult the manufacturer's literature for other standard and special accessories.
****

2.3.1 Flanged Nozzles

****
NOTE: Standard nozzles are suitable for most applications, but specify conically gusseted nozzles when vibratory or thermal stresses are anticipated.
****

Provide [standard] [conically gusseted] nozzles.

Conform the flange diameter and drilling to ISO 7005-2, 1050 kilopascal (150 psi) ASME B16.5, at a pressure of 150 pounds per square inch.

2.3.2 Inlet Nozzles

****
NOTE: Specify double-flanged inlet nozzles when interior pipe connections are desired.
****

Provide [single-] [double-]flanged inlet connections.

2.3.3 Outlet Nozzles

****
NOTE: Specify double-flanged outlet nozzles when interior pipe connections are desired.
****

Provide [single-] [double-]flanged outlet connections for a shell side and top, and a [side-bottom] [full] [siphon] [bottom] drain with a bottom elbow.

2.3.4 Vent

****
NOTE: Select one of the following types of vents for closed-top and removable-top tanks. Show the vent size on drawings.
****

Provide a [v-vent][gooseneck][mushroom][flanged nozzle [breather][combination vacuum break/pressure relief]] vent for tank top.

2.3.5 Flanged Manways

[A manway is not required.][Provide a [top-flanged] [side-flanged] manway.

][Conform the flange diameter and drilling to ISO 7005-2, 1050 kilopascal ASME B16.5, 150 pounds per square inch pressure.

][2.3.6 Removable Cover

[A cover is not required.][Provide a [domed] [dished] [flat] cover, with [a lifting ring at the center of the cover][three lifting lugs spaced 120 degrees apart on the cover.]]

]2.3.7 Tie-Down Lugs

****

NOTE: Indicate quantity of lugs and angular spacing based on manufacturer's recommendations. Specify lugs on tanks subject to vibratory stresses and those erected outdoors. Three to six lugs evenly spaced are standard practice, depending upon tank size.

****

Provide tie-down lugs as indicated.

2.3.8 Tank Lifting Lugs

Provide [three lifting lugs spaced 120 degrees apart at the top portion of the straight shell][one center top lug].

2.3.9 Identification Plate

Provide a phenolic-plastic identification plate with letters at least 50 millimeter 2 inches high, stating the chemical to be stored.

2.3.10 Certification Plate

Provide a stainless-steel certification plate, stating that the tank is designed for the chemical stored and indicating the concentration, specific gravity, [_____], and maximum temperature of the stored chemical.

PART 3 EXECUTION

3.1 INSTALLATION

Install the tank on a foundation in accordance with the manufacturer's instructions for the installation of specified system, including special notices and material safety data sheets, special signage, and data related to impedances, hazards, and safety precautions. Submit equipment foundation data to the Contracting Officer before beginning the foundation work. Ensure that the equipment foundation data includes the equipment weight and operating loads, horizontal and vertical loads, seismic data, wind loads,location and projection of anchor bolts, horizontal and vertical clearances for installation, plan dimensions of foundations and relative elevations, and other installation requirements such as utility

services.

3.1.1 Equipment Location Drawings

3.1.2 Installation Drawings

Submit installation drawings for fiberglass-reinforced polyester storage tanks including all foundation and anchorage details, at least [30] [_____] days before start of construction work begins.

In the coordination drawings submittal, include the processes and structural elements of the work. Indicate where conflicts or clearance problems exist between the various functions. Provide drawings that clearly show equipment and performance data furnished by the storage tank manufacturer and that indicate use life, safety features, and details on automated mechanical features.

[Show structural and fenestration features on the equipment room layout drawings, indicating where a reduction in the available space results from the installation of items. Detail the ductwork and piping.

]3.1.3 Cleaning

After installation has been completed and piping connections have been made, clean the tank and nozzles in accordance with the manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

3.2.1 Inspection

Inspect installed tanks for indications of defective workmanship or improper installation practices. Repair or replace faulty construction and damaged work at no additional cost to the Government.

3.2.2 Hydrostatic Test

After the tank has been installed, and before the piping connections are made and the equipment is attached, block the outlets and fill the straight-shell portion with a chemically compatible fluid. Perform hydrostatic tests to determine if leak-proof storage is provided, and correct deficiencies.

Submit written manufacturer's field reports of test data recorded at the job site for review and final approval no later than [30][_____] calendar days before contract completion. Repair or replace unsatisfactory tanks and retest the tanks at no additional cost to the Government until the tanks are determined to be leak-proof systems.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Operation and Maintenance Manual

Submit [_____] copies of the operation and maintenance manual at least [30][_____] calendar days before testing the system. Update and resubmit data for final approval no later than [30][_____] calendar days before contract completion. Ensure that the manual includes information for the following:

a. Storage tanks

b. Flanged nozzles

c. Inlet nozzles

d. Outlet nozzles

3.3.2 Record Drawings

Submit record drawings of the completed installation no later than [30][_____] days before completion of the project. Ensure that record drawings include civil site developments, such as new facility and land modifications, external structural changes to aboveground structures, and changes to underground structures and utilities external to facilities.

Submission of the completed drawings certifies accuracy and completeness of the documents.

Ensure that record drawings provide the following information:

a. Location of new lines, conduits, valves, fittings, fire hydrants, meters, terminal points using at least two ties to permanent points (manholes, power poles, curbs, or storm water inlets), or GPS coordinates with accuracy to at least 1[_____] meter 3[_____] feet. An acceptable station and offset system may be used for service lines and fittings only.

b. Location of new lines from property easement lines or edges of pavement at 90 meter 300 feet intervals.

c. Utility routing and interface changes, indicated clearly on the drawings, to scale and defined with sufficient dimensions.

****

NOTE: Insert the appropriate form and jurisdictional authority for the respective agency within the appropriate blanks below if other than the Contracting Officer or Government.

****

Provide support for obtaining surveyed coordinates for facility footprint corner and underground structures and utilities external to facilities by submitting [Form [_____][_____]] to the [Contracting Officer] [_____] at least 5 working days before foundation construction or open excavation as notification to the [Government] [_____].

Prepare record drawing prints at a minimum scale of 1 cm equals 100 meters 1 inch equals 100 feet. Enlarge the scale to show areas requiring additional detail.

Provide record drawings in digital format. Provide geospatially referenced files in ESRI GIS Geodatabase, ESRI GIS Shapefile, Microstation DGN, AutoCAD DWG or DXF file format. Provide information in separate layers/levels as specified by GIS in at least the same degree of separation as the design drawings provided. Ensure that sew items are contained in the same level as like items so that the drawings can be easily converted to GIS layers.

Use the following spatial reference:

****
NOTE: Insert appropriate survey reference information, and the date of most recent datum.
****

a. Horizontal accuracy: Reference surveys and drawings to [Regional][_____] Plane Coordinate System,[East Zone] [_____], North American Datum [_____] adjustment based on Second Order Class II horizontal control monument.

b. Vertical accuracy: Reference surveys to the North American Vertical Datum (NAVD) [1988] [_____]. Include a description of the reference benchmarks from which the NAVD has been determined in the survey.

c. Make lines, letters, and details sharp, clean, and fully legible.

d. Submit one reproducible print and one digital copy in an electronic storage media.

-- End of Section --