
USACE / NAVFAC / AFCEC / NASA UFGS-43 41 16.16 40 (August 2014)

Preparing Activity: NASA Superseding
UFGS-43 41 16.16 40 (February 2011)
UFGS-43 41 16.16 (August 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2016

SECTION TABLE OF CONTENTS

DIVISION 43 - PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE
EQUIPMENT

SECTION 43 41 16.16 40

VERTICAL ATMOSPHERIC TANKS AND VESSELS

08/14

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY CONTROL
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 PROJECT/SITE CONDITIONS
 - 1.5.1 Record Drawing of Existing Conditions

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Fabrication Drawings
 - 2.1.2 Equipment Room Drawings
 - 2.1.3 Installation Drawings
 - 2.1.4 Loading Conditions
 - 2.1.5 Chemical Storage Requirements
 - 2.1.6 Capacity and Dimensional Requirements
 - 2.1.6.1 Liquid Level Gauge
- 2.2 ASSEMBLY
- 2.3 ACCESSORIES
 - 2.3.1 Flanged Nozzles
 - 2.3.2 Inlet Nozzles
 - 2.3.3 Outlet Nozzles
 - 2.3.4 Vent
 - 2.3.5 Flanged Manways
 - 2.3.6 Removable Cover
 - 2.3.7 Tie-down Lugs
 - 2.3.8 Tank Lifting Lugs
 - 2.3.9 Identification Plate
 - 2.3.10 Certification Plate

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Cleaning
- 3.2 FIELD QUALITY CONTROL
 - 3.2.1 Hydrostatic Test
 - 3.2.2 Inspection
- 3.3 CLOSEOUT ACTIVITIES
 - 3.3.1 Operation and Maintenance Manual
 - 3.3.2 Record Drawings

-- End of Section Table of Contents --

USACE / NAVFAC / AFCEC / NASA UFGS-43 41 16.16 40 (August 2014)

Preparing Activity: NASA Superseding
UFGS-43 41 16.16 40 (February 2011)
UFGS-43 41 16.16 (August 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2016

SECTION 43 41 16.16 40

VERTICAL ATMOSPHERIC TANKS AND VESSELS 08/14

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:

Cast-in-place concrete

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

Plastic pipe

Acid-resistant pipe

Chemical valves

Liquid level gages

As a minimum, show on drawings:

The physical location of each tank

The location of all accessories to be furnished with each tank

Concrete-foundation details for each tank

Anchoring details for each tank to the foundation

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 all accessories and their locations shown on drawings.

NOTE: If Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS is not included in the project specification, applicable requirements thereof should be inserted and the following paragraph deleted.

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS 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 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.

ASME INTERNATIONAL (ASME)

ASME B16.5 (2013) Pipe Flanges and Flanged Fittings:
NPS 1/2 Through NPS 24 Metric/Inch Standard

ASTM INTERNATIONAL (ASTM)

ASTM C581 (2003; E 2008; R 2008) 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 (2008; AMD 2012; AMD 2011) 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 to reflect only the submittals
required for the project.

The Guide Specification technical editors have
designated 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 submittals requiring Government approval on Army

projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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.

An "S" following a submittal item indicates that the submittal is required for the Sustainability Notebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

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" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Record Drawing of Existing Conditions[; G[, [____]]]

Material, Equipment, and Fixture Lists[; G[, [____]]]

Construction Equipment Lists[; G[, [____]]]

Listing of Product Installation[; 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[; G[, [____]]]

Equipment Foundation Data[; G[, [____]]]

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[; G[, [____]]]

Tank Integrity[; G[, [____]]]

Verification of Liquid Level Indication Results[; G[, [____]]]

Verification of Relief Device Results[; G[, [____]]]

Hydrostatic Tests[; G[, [____]]]

SD-07 Certificates

Certificates of Conformance[; G[, [____]]]

Installers[; G[, [____]]]

SD-08 Manufacturer's Instructions

Manufacturer's Instructions[; G[, [____]]]

SD-09 Manufacturer's Field Reports

Manufacturer's Field Reports[; G[, [____]]]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manual[; G[, [____]]].

SD-11 Closeout Submittals

Record Drawings[; G[, [____]]].

1.3 QUALITY CONTROL

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

Submit certificates of conformance 30 [_____] days prior to commencement of work, verifying compliance with the standards and specifications for the following items:

- a. Storage tanks
- b. Installer

1.4 DELIVERY, STORAGE, AND HANDLING

Handle and store tanks per manufacturer's guidelines to prevent damage. Deliver each tank in compliance with specifications and provide verification of no damage, surface defects, or poor quality laminates.

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

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

1.5 PROJECT/SITE CONDITIONS

1.5.1 Record Drawing of Existing Conditions

Submit record drawing of existing conditions, including any underground utilities, [30] [_____] days prior to start of construction work.

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, [30] [_____] days prior to start of construction work.

Submit manufacturer's standard color charts for laminates for visual inspection of surface finish and color.

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

2.1.2 Equipment Room Drawings

Show on drawings of equipment room layout structural and fenestration features, and items requiring installation that could reduce the available space. Detail all ductwork and piping.

2.1.3 Installation Drawings

Submit installation drawings for fiberglass-reinforced polyester storage tanks including all foundation and anchorage details [30] [_____] days prior to start of construction work. Also submit equipment foundation data including equipment weight and operating loads, horizontal and vertical loads, seismic data, [wind loads][hurricane force windloads], 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.

Also include in submittal coordination drawings showing the processes, structural, and architectural elements of the work. Indicate where conflicts or clearance problems exist between the various functions. Clearly show on drawings:

- a. Manufacturer's certification that storage tanks are suitable for storage of specified chemicals,
- b. Signed statements providing confirmation that installers have knowledge of the requirements of the applicable standards, including NASA RCBEA GUIDE, and specifically RCBEA 2.63, and installation practices to ensure installation in a sound, undamaged condition,
- c. Material, equipment, and fixture lists including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site,
- d. Equipment and performance data by the storage tank manufacturer indicating use life, safety features, and mechanical automated details.
- e. Construction equipment lists consisting of proposed construction equipment to be used in the project, including descriptive data.
- f. Manufacturer's instructions describing the installation of specified system, including special notices and material safety data sheets, special signage and data relating to impedances, hazards, and safety precautions.

2.1.4 Loading Conditions

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

Provide tanks conforming to loading conditions specified in project requirements.

2.1.5 Chemical Storage Requirements

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

NOTE: 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 laminates are representative of the tanks specified for this project.

2.1.6 Capacity and Dimensional Requirements

NOTE: Capacities vary from approximately 40 liter
to 300 kiloliter 10 to 75,000 gallons.

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

NOTE: Diameters vary from approximately 0.6 to 5
meter 2 to 16 feet. Wall heights vary from
approximately 0.3 to 14 meter 1 to 47 feet.

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

2.1.6.1 Liquid Level Gauge

Provide tank with liquid level armored gauge glass sight tube [with flanges], indicating 10 to 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 meter 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 contact-molded tank, conforming to BS EN 13121-3 ASTM D5948.

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

]

NOTE: Select one of the following for tank top.

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

] [Provide tank with a closed top.

]

NOTE: Select one of the following types if tank is to have 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 tank with a [dome] [dished] [flat] type closed top.

]

NOTE: Select one of the following for top fabrication.

Separate fabrication of top and shell is most common.

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

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

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

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

2.3 ACCESSORIES

NOTE: Accessories specified are common items for
general usage. Consult 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 flange diameter and drilling to ISO 7005-2, 1050 kilopascal (150 psi) ASME B16.5, 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 side shell and top, [side-bottom] [full] [siphon] [bottom] type drain[s], with bottom elbow.

2.3.4 Vent

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

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

2.3.5 Flanged Manways

[Manway not required.][Provide [top-flanged] [side-flanged] manway.

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

]2.3.6 Removable Cover

[Cover not required.][Provide [domed] [dished] [flat] style cover, with [lifting ring at center of cover][three lifting lugs at 120 degrees apart on 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 top portion of straight shell][one center top lug].

2.3.9 Identification Plate

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

2.3.10 Certification Plate

Provide stainless-steel certification plate, stating tank is designed for chemical to be stored, concentration, specific gravity, and maximum temperature.

PART 3 EXECUTION

3.1 INSTALLATION

Install tank on foundation in accordance with recommended manufacturer's instructions. Submit equipment foundation data to the Contracting Officer prior to commencement of foundation work.

3.1.1 Cleaning

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

3.2 FIELD QUALITY CONTROL

3.2.1 Hydrostatic Test

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

Submit written manufacturer's field reports of all test data made at the job site for review and final approval no later than [30][_____] calendar

days prior to contract completion. Repair or replace unsatisfactory tanks and retest at no additional cost to the Government until leak proof systems are obtained.

3.2.2 Inspection

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

3.3 CLOSEOUT ACTIVITIES

3.3.1 Operation and Maintenance Manual

Submit [_____] copies of the operation and maintenance manual [30][_____] calendar days prior to testing the system involved. Update and resubmit all data for final approval no later than [30][_____] calendar days prior to contract completion. Ensure manual includes information for:

- a. Storage Tanks
- b. Flanged Nozzles
- c. Inlet Nozzles
- d. Outlet Nozzles

3.3.2 Record Drawings

Submit record drawings of completed installation no later than [30][_____] days prior to final completion. Include in record drawings all civil site developments such as new facility and/or land modifications, external structural changes to aboveground structures, and changes to underground structures and utilities external to facilities located on lands owned by or held in leasehold interest of the federal government.

Submission of the completed drawings certifies accuracy and completeness of the documents. Nonconformity with any of the following requirements will result in withholding of vendor payments.

Mandatory information required in record drawings is, but not limited to:

- a. Location of all 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, or better if more stringent accuracy requirements are specified in other sections of this subcontract. 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 intervals of 90 meter 300-feet.
- c. All 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 your respective agency**

within the appropriate blanks below if other than
the Contracting Officer or Government.

- d. 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 five (5) working days prior to foundation construction or open excavation as notification to the [Government] [____].
- e. Prepare record drawing prints at a minimum scale of 1 cm equals 100 meters 1-inch equals 100-feet. Enlarge scale as necessary all areas requiring additional detail.
- f. 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. Contain in the same levels any new like items to permit easy conversion to GIS layers.
- g. Use spatial reference as:

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

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

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

- h. Make all lines, letters, and details sharp, clean, and fully legible.
- i. Submit one reproducible print and one digital copy in an electronic storage media.

-- End of Section --