
USACE / NAVFAC / AFCEC

UFGS-33 56 10 (May 2019)

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2025

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SECTION 33 56 10

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 33 56 10

FACTORY-FABRICATED FUEL STORAGE TANKS
05/19, CHG 1: 11/20

NOTE: This guide specification covers the requirements for factory-fabricated fuel storage tanks. Tanks associated with equipment like generators but not integral to the equipment are also covered by this specification. Generator base tanks or belly tanks are not covered by this specification and must meet the requirements of Section 26 32 15 ENGINE-GENERATOR SET STATIONARY 15-2500 KW, WITH AUXILIARIES.

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 specification is intended for systems using factory-fabricated storage tanks with capacities less than or equal to 200,000 L. For larger tank sizes, contact Service Headquarters. Additional system components/devices necessary to meet state and local regulations must be added by the designer. Design and install tank storage applications in accordance with UFC 3-460-01

"Design: Petroleum Fuel Facilities."

The design and installation of all aboveground and underground factory-fabricated fuel storage tanks must be coordinated with Base Environmental.

1.1 SUMMARY

This section defines the requirements for factory-fabricated fuel storage tanks.

1.1.1 Related Sections

1.1.1.1 Earthwork

NOTE: For underground tank installations, the designer developing the earthwork specifications will evaluate the need for a filter fabric to be installed between the native soil and the new backfill material. The intent of a filter fabric would be to prevent the displacement of new backfill material with native soil due to a high water table. If the new backfill material is displaced, it could affect the structural integrity of the tank specifically if the new tank(s) is the FRP type. If a filter fabric is determined to be necessary, include the requirements for the new fabric in the excavation and backfilling specifications.

Require backfill for Fiberglass Reinforced Plastic (FRP) tanks to be pea gravel or crushed stone. Require backfill for steel tanks to be pea gravel, crushed stone, or sand.

Require pea gravel to be between 3 and 20 mm in diameter. Require crushed stone to be between 3 and 13 mm in diameter. Require sand to be a fine aggregate that is washed and thoroughly dried, contains no more than 500 ppm chlorides, contains no more than 500 ppm sulfates, and has a pH greater than 7.

Excavation and backfilling for tanks must be as specified in Section 31 00 00 EARTHWORK.

1.1.1.2 Leak Detection

Leak detection must be as specified in Section 33 01 50.31 LEAK DETECTION FOR FUELING SYSTEMS.

1.1.1.3 Cathodic Protection

Provide buried metallic components including pipe, anchors, conduit, etc., with a cathodic protection system as specified in [Section 26 42 13 GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM] [and] [Section 26 42 17 IMPRESSED CURRENT CATHODIC PROTECTION (ICCP) SYSTEM].

Cathodic protection for metal components that attach to a tank must be coordinated and compatible with the tank corrosion control system.

1.2 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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO HB-17 (2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges

AMERICAN PETROLEUM INSTITUTE (API)

API MPMS 2.2A (1995; R 2017) Manual of Petroleum Measurement Standards Chapter 2-Tank Calibration Section 2A-Measurement and Calibration of Upright Cylindrical Tanks by the Manual Tank Strapping Method

API MPMS 2.2E (2004; Errata 2009; R 2009) Petroleum and Liquid Petroleum Products - Calibration of Horizontal Cylindrical Tanks - Part 1: Manual Methods

API RP 540 (1999; R 2004) Electrical Installations in Petroleum Processing Plants

API RP 652 (2014; ERTA 1 2016) Linings of Aboveground Petroleum Storage Tank Bottoms

API RP 1110 (2013; R 2018) Recommended Practice for the Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum

Gas, Hazardous Liquids, Highly Volatile
Liquids, or Carbon Dioxide

API RP 1615	(2011) Installation of Underground Petroleum Storage Systems
API Spec 5L	(2018; 46th Ed; ERTA 2018) Line Pipe
API Spec 6D	(2021; Addendum 1 2025) Specification for Pipeline and Piping Valves
API Spec 6FA	(1999; R 2006; Errata 2006; Errata 2008; R 2011) Specification for Fire Test for Valves
API Std 594	(2017) Check Valves: Flanged, Lug, Wafer and Butt-Welding
API Std 610	(2010; Errata 2011) Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries
API Std 1631	(2001; R 2010) Interior Lining and Periodic Inspection of Underground Storage Tanks
API RP 2003	(2015; 8th Ed) Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C209	(2019) Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fitting for Steel Water Pipelines
AWWA C215	(2022) Extruded Polyolefin Coatings for Steel Water Pipe
AWWA C216	(2022) Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C217	(2023) Microcrystalline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe and Fittings

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS BRH	(2007; 5th Ed) Brazing Handbook

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2024) Unified Inch Screw Threads (UN, UNR, and UNJ Thread Form)
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ASME B16.11	(2022) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2021) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2021) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2024) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2025) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2024) Factory-Made Wrought Buttwelding Fittings
ASME B18.2.1	(2012; R 2021) Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
ASME B18.2.2	(2022) Nuts for General Applications: Machine Screw Nuts, and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B31.3	(2024) Process Piping
ASME B40.100	(2022) Pressure Gauges and Gauge Attachments
ASME B40.200	(2008; R 2013) Thermometers, Direct Reading and Remote Reading
ASME BPVC SEC VIII D1	(2023) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A27/A27M	(2020) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel

ASTM A48/A48M	(2022) Standard Specification for Gray Iron Castings
ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A105/A105M	(2023) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A182/A182M	(2024) Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A193/A193M	(2025) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2024) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A216/A216M	(2021) Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A234/A234M	(2024) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A269/A269M	(2024) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A276/A276M	(2025) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2023) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A312/A312M	(2022a) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A351/A351M	(2024; E 2025) Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM A356/A356M	(2016) Standard Specification for Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines
ASTM A358/A358M	(2024a) Standard Specification for

	Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications
ASTM A403/A403M	(2025) Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A436	(2024) Standard Specification for Austenitic Gray Iron Castings
ASTM A563	(2021; E 2022a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A733	(2016; R 2022) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A743/A743M	(2021) Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM B26/B26M	(2018; E 2018) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B687	(1999; R 2023) Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
ASTM B813	(2024) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM D229	(2019) Standard Test Methods for Rigid Sheet and Plate Materials Used for Electrical Insulation
ASTM D3308	(2012; R 2022) Standard Specification for PTFE Resin Skived Tape
ASTM D5677	(2017) Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Pipe

Fittings, Adhesive Bonded Joint Type, for
Aviation Jet Turbine Fuel Lines

ASTM F436

(2011) Hardened Steel Washers

ASTM F844

(2019; R 2024) Standard Specification for
Washers, Steel, Plain (Flat), Unhardened
for General Use

ASTM F1554

(2020) Standard Specification for Anchor
Bolts, Steel, 36, 55, and 105-ksi Yield
Strength

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 142

(2007; Errata 2014) Recommended Practice
for Grounding of Industrial and Commercial
Power Systems - IEEE Green Book

IEEE 1100

(2005) Emerald Book IEEE Recommended
Practice for Powering and Grounding
Electronic Equipment

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

MSS SP-58

(2018) Pipe Hangers and Supports -
Materials, Design and Manufacture,
Selection, Application, and Installation

NACE INTERNATIONAL (NACE)

NACE SP0185

(2024) Extruded Polyolefin Resin Coating
Systems with Soft Adhesives for
Underground or Submerged Pipe

NACE SP0188

(2024) Discontinuity (Holiday) Testing of
New Protective Coatings on Conductive
Substrates

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250

(2020) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NEMA MG 1

(2021) Motors and Generators

NEMA MG 11

(1977; R 2012) Energy Management Guide for
Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30

(2024; ERTA 1 2025) Flammable and
Combustible Liquids Code

NFPA 30A

(2024; ERTA 1 2023) Code for Motor Fuel
Dispensing Facilities and Repair Garages

NFPA 31

(2024; TIA 23-1) Standard for the

	Installation of Oil-Burning Equipment
NFPA 70	(2026) National Electrical Code
NFPA 77	(2024; ERTA 1 2023) Recommended Practice on Static Electricity
NFPA 704	(2022) Standard System for the Identification of the Hazards of Materials for Emergency Response
NFPA 780	(2026) Standard for the Installation of Lightning Protection Systems
SOCIETY FOR PROTECTIVE COATINGS (SSPC)	
SSPC QP 3	(2010) Standard Procedure for Evaluating Qualifications of Shop Painting Applicators
SSPC QS 1	(2015) Standard Procedure for Evaluating a Contractor's Advanced Quality Management System
SSPC PA 1	(2024) Shop, Field, and Maintenance Coating of Metals
SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)	
SAE AMS3275	(2009; Rev C) Sheet, Acrylonitrile Butadiene (NBR) Rubber and Non-Asbestos Fiber Fuel and Oil Resistant
SAE J514	(2012) Hydraulic Tube Fittings
STEEL TANK INSTITUTE (STI)	
STI 020-50-1000	(2010) ACT-100 Specification for External Corrosion Protection of FRP Composite Steel USTs
STI 700-50-5007	(2010) Installation Instructions for Shop Fabricated Aboveground Tanks for Flammable, Combustible Liquids
STI F911	(1998; Reissued 2009) Standard for Diked Aboveground Storage Tanks
STI P3	(2011) Specification and Manual for External Corrosion Protection of Underground Steel Storage Tanks
STI SP001	(2018, 6th Ed) SP001 Standard for The Inspection of Aboveground Storage Tanks
STI SP131	(2014) SP131 Standard for Inspection & Repair Underground Steel Tanks

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-161 (2015; Rev H) Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50561 (Basic) Pumps, Rotary, Power-Driven, Viscous Liquids

UL SOLUTIONS (UL)

UL 58 (2018) UL Standard for Safety Steel Underground Tanks for Flammable and Combustible Liquids

UL 80 (2007; Reprint Oct 2024) Standard for Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids

UL 142 (2019; Reprint Jan 2021) UL Standard for Safety Steel Aboveground Tanks for Flammable and Combustible Liquids

UL 1316 (2018; Reprint Mar 2019) UL Standard for Safety Fiber Reinforced Underground Tanks for Flammable and Combustible Liquids

UL 1746 (2007; Reprint Dec 2014) External Corrosion Protection Systems for Steel Underground Storage Tanks

UL 2085 (1997; Reprint Sep 2010) UL Standard for Safety Protected Aboveground Tanks for Flammable and Combustible Liquids

UL FLAMMABLE & COMBUSTIBLE (2012) Flammable and Combustible Liquids and Gases Equipment Directory

KOREAN INDUSTRIAL STANDARDS (KS)

KS D 8050 (2018; R 2023) Copper Phosphorus Brazing Filler Metals

KS D 8319 (2018; R 2023) Silver Brazing Filler Metals

1.3 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 and Air Force 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 and Air Force 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 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-02 Shop Drawings

Grounding and Bonding

Pipe Hangers and Supports

SD-03 Product Data

Aboveground Storage Tank (Single Wall Steel); G

Aboveground Storage Tank (Double Wall Steel); G

Aboveground Storage Tank (Double Wall, Concrete Encased); G

Underground Storage Tank; G

Tank Protective Coatings; G

Atmospheric Vent; G

Pressure/Vacuum Vent; G

Emergency Vent; G

Independent Level Alarm System; G

Tank Gauges; G

Manhole Containment Sump; G

Tank Mounted Fuel Dispensing Unit; G

Fuel Heaters; G

Tank Anchorage System Materials; G

Carbon Steel Pipe

Stainless Steel Pipe

Fiberglass Reinforced Plastic (FRP) Pipe

Exterior Containment Piping System

Copper Piping

Pressure Gauge

Swing Type Check Valve; G

Wafer Type Check Valve; G

Ball Valve; G

Plug Valve (PTFE Sleeved Tapered Type); G

Globe Valve; G

Pressure Relief Valve; G

Pressure\Vacuum Relief Valve; G

Foot Valve; G

Tank Overfill Prevention Valve; G

Submersible Pump; G

Centrifugal Pump; G

Rotary Pumps; G

Pump Control Panel; G

FRP Containment Sump; G

SD-05 Design Data

Tank Anchorage Calculations; G

SD-06 Test Reports

Aboveground Storage Tank Tightness Tests; G

Underground Storage Tank Tightness Tests; G

Tank Manufacturer's Tests

Tank Fill Tests

Tank Inspection Reports; G

Exterior Coating Holiday Test

Preliminary Pneumatic Test

Final Pneumatic Test

Hydrostatic Test

Exterior Containment Piping Tests

SD-07 Certificates

Contractor Qualifications; G

Manufacturer's Certification; G

State Certification; G

Pollution Liability Insurance

Permitting

Registration

Licensed Personnel

Demonstrations

STI SP001 Inspector's Certification; G

SD-08 Manufacturer's Instructions

Aboveground Storage Tank

Underground Storage Tank

Independent Level Alarm System

Tank Gauges

Fuel Heaters

SD-10 Operation and Maintenance Data

Aboveground Storage Tank; G

Underground Storage Tank; G

Independent Level Alarm System; G

Tank Gauges; G

Fuel Heaters; G

Swing Type Check Valve; G

Wafer Type Check Valve; G

Ball Valve; G

Plug Valve (PTFE Sleeved Tapered Type); G

Globe Valve; G

Pressure Relief Valve; G

Pressure\Vacuum Relief Valve; G

Foot Valve; G

Tank Overfill Prevention Valve; G

Submersible Pump; G

Centrifugal Pump; G

Rotary Pumps; G

1.4 QUALITY ASSURANCE

1.4.1 Contractor Qualifications

NOTE: Include specific local regulatory requirements into the specification as applicable.

Each installation Contractor must have successfully completed at least 5 projects of the same scope, and the same size or larger within the last 3 years and demonstrated specific installation experience in regard to the specific system installation to be performed. Each installation Contractor must have taken, if applicable, manufacturer's training courses on the installation of storage tanks and must meet all applicable licensing requirements in the state. If applicable, state certified installers must be provided by the Contractor. Installers must also be trained and certified by the manufacturer to install the equipment and materials being installed and must be STI certified. Installers must submit certification from the [manufacturer][and][State]. If installing underground storage tanks and piping systems, installation Contractor must have [Pollution Liability Insurance](#). Submit a letter listing prior projects, the date of construction, a point of contact for each prior project, the scope of work of each prior project, and a detailed list of work performed. The letter must also provide evidence of prior manufacturer's training, state licensing, and other related information.

For RFRP pipe installation, certification by the FRP manufacturer as a qualified installer of the product is required. Submit a letter listing prior projects, the date of construction, a point of contact for each prior project, the scope of work of each prior project, and a detailed list of work performed providing in the letter evidence of prior

manufacturer's training and state licensing.

1.4.2 Regulatory Requirements

1.4.2.1 Permitting

Obtain necessary permits in conjunction with the installation of storage tanks as required by federal, state, or local authority.

1.4.2.2 Registration

**NOTE: The designer must confirm with the DoD
Installation the number of days required to obtain
the permit documentation.**

Obtain and complete all tank registration forms required by federal, state, and local authorities. Submit all completed tank registration forms within [30][_____] days after contract award to the Contracting Officer. The Contracting Officer will ensure the Base Environmental staff for the DoD Installation submits the forms to the proper regulatory agencies.

1.4.2.3 Licensed Personnel

Tank installers must be licensed/certified by the state when the state requires licensed installers.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect system components and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer, upon recommendation by Base Environmental for the DoD Installation. Replace damaged or defective items.

1.6 PROJECT/SITE CONDITIONS

Exposed moving parts, parts that produce high operating temperatures and pressures, parts that may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices so that proper operation of equipment is not impaired. Fuel required for the testing, flushing and cleaning efforts, as specified in this section, will be provided and delivered by the [BCE][DPW]. Do not flush, clean, or test any system with fuel or liquid not intended for final system operation. Fuel used in the system will remain the property of the Government. Fuel shortages not attributable to normal handling losses shall be reimbursed to the Government.

1.7 WARRANTY

All factory-fabricated storage tanks must come with a manufacturer's warranty of a minimum period of 30 years. All warranty paperwork will be completed and submitted by Contractor to both the tank and system component manufacturers, the Contracting Officer, and the Base Environmental for the DoD Installation. This includes all applicable

completed manufacturers' equipment installation checklists.

PART 2 PRODUCTS

2.1 MATERIALS AND SYSTEM COMPONENTS

**NOTE: Include the bracketed information if aviation
fuel will be handled.**

Provide materials and system components that are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship. Provide materials and system components that have been in satisfactory commercial or industrial use for a minimum 3 years prior to bid opening. The 3 year period must include applications of the system components and materials under similar circumstances and of similar size. Provide materials and system components that have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 3 year period.

Internal parts and components of system components, piping, piping components, and valves that could be exposed to fuel during system operation must not be constructed of zinc coated (galvanized) metal [, brass, bronze, or other copper alloys]. Do not install cast iron bodied valves in piping systems that could be exposed to fuel during system operation.

2.2 NAMEPLATES

**NOTE: In a salt water environment, substitute
acceptable non-corroding metal such as, but not
limited to, nickel-copper, 304 stainless steel, or
monel. Aluminum is unacceptable. Nomenclature (or
system identification) should be established by the
designer.**

**Require melamine plastic nameplates for all NAVFAC
projects. Also, for NAVFAC projects, require
nameplates to be associated or keyed to system
charts and schedules.**

Attach nameplates to all specified system components defined herein. List on each nameplate the manufacturer's name, address, [contract number,] [acceptance date,] component type or style, model or serial number, catalog number, capacity or size, and the system that is controlled. Construct plates of [anodized aluminum] [stainless steel] [melamine plastic, 3 mm thick, UV resistance, black with white center core, matte finish surface and square corners] [_____]. Install nameplates in prominent locations with nonferrous screws, nonferrous bolts, or permanent adhesive. Minimum size of nameplates must be 25 by 65 mm. Provide manufacturer's storage tank nameplates as required. [On concrete-encased tanks, provide a minimum smooth flat mounting surface of 300 by 300 mm for attaching nameplates.] Lettering must be the normal block style with a minimum 6 mm height. Accurately align all lettering on nameplates. [For plastic nameplates, engrave lettering into the white

core.] [Key the nameplates to a chart and schedule for each system. Frame charts and schedule under glass, and locate where directed near each system. Furnish two copies of each chart and schedule. Each nameplate description must identify its function.]

2.3 ELECTRICAL COMPONENTS

NOTE: Show electrical characteristics, motor starter type(s), enclosure type, and maximum rpm in the equipment schedules on the drawings.

Where reduced-voltage motor starters are recommended by the manufacturer or required otherwise, specify and coordinate the type(s) required in Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Reduced-voltage starting is required when full voltage starting will interfere with other electrical equipment and circuits and when recommended by the manufacturer. Where adjustable speed drives (ASD) are specified, reference Section 26 29 23 VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS. The methods for calculating the economy of using an adjustable speed drive is described in UFC 3-520-01 DESIGN: INTERIOR ELECTRICAL SYSTEMS.

Coordinate the ignition temperature of the fuel(s) to be handled with the electrical design. Ignition temperatures will be as defined in NFPA 497M. Fuel ignition temperatures will dictate the maximum allowable temperature rating of the electrical equipment.

2.3.1 General

Provide motors, motor starters, controllers, integral disconnects, contactors, controls, and control wiring with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide switches and devices necessary for controlling and protecting electrical equipment. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Controllers and contactors must have a maximum of 120-volt control circuits and must have auxiliary contacts for use with the controls provided. For packaged equipment, the manufacturer must provide controllers including the required monitors and timed restart.

2.3.2 Motors

Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage. Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Provide polyphase, squirrel-cage medium induction motors, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Motors must be rated for continuous duty with the enclosure

specified. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque must be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.

2.3.3 Motor Controllers

[Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Use solid-state variable-speed controllers for motors rated 7.45 kW or less and adjustable frequency drives for larger motors.]
[Provide variable frequency drives for motors as specified in Section 26 29 23 VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS.]

2.3.4 Underground Wiring

Enclose underground electrical wiring in PVC coated conduit.
Dielectrically isolate conduit at any steel storage tank connection.

2.3.5 Grounding and Bonding

Grounding and bonding shall be in accordance with NFPA 70, NFPA 77, NFPA 780, API RP 540, API RP 2003, IEEE 142, and IEEE 1100. Provide jumpers to overcome the insulating effects of gaskets, paints, or nonmetallic components.

2.4 Gaskets

Provide gaskets that are factory cut from one piece of material.

2.4.1 Nitrile Butadiene (Buna-N)

Provide Buna-N material that conforms to SAE AMS3275.

2.4.2 Acrylonitrile Butadiene Rubber (NBR)

Provide NBR material that conforms to SAE AMS3275.

2.5 ABOVEGROUND STORAGE TANK

NOTE: Two types of aboveground storage tanks are defined herein: single wall tanks and double wall tanks.

A single wall steel tank has no inherent integral secondary spill containment and can be mounted either on saddles or skids. Single wall steel tanks are required to be installed within a secondary containment system (e.g. dike area or integral skid mounted containment). For dike or spill containment designs refer to UFC 3-460-01 "Design: Petroleum Fuel Facilities" and/or 40 CFR 112 as applicable. When evaluating the application of a dike, note that a dike offers poor aesthetics and requires extensive maintenance following rainfall. The water and water/fuel mix contained in a diked area must be

evaluated after each rain and then properly disposed.

Double wall tanks are provided from the manufacturer with some type of integral secondary containment. Additional dikes and containment systems are not required for these tanks. Three types of double wall tanks are defined herein: double wall steel tank (non-fire resistant, non-protected), double wall steel tank (fire resistant, protected), and double wall tank (concrete encased).

Note that used or waste oil and hazardous wastes should be stored in aboveground storage tanks. Even though EPA allows the storage of these products below ground, a majority of state and local regulations prohibit underground storage of such products. If a design requires underground storage of used oil, waste oil, or hazardous wastes, confirm that the storage is allowed by state and local regulations. The storage of used or waste oil and hazardous wastes is bound by the same EPA requirements as is the storage of any other petroleum product. Contact the Base Environmental for storage of used oil, waste oil, or hazardous wastes.

2.5.1 Aboveground Storage Tank (Single Wall Steel)

NOTE: UL 80 tanks are typically 60 to 660 gallon storage tanks primarily used to store heating oil. These tanks are not very common in DoD fuel system.

Provide a factory-welded, single wall [stainless] steel tank manufactured to [UL 80][UL 142] and equipped to comply with [NFPA 30 for use as a flammable or combustible liquid storage tank][NFPA 30A for use as a motor vehicle dispensing tank][NFPA 31 for use as a heating oil tank]. Tank must be designed and manufactured for a [horizontal cylindrical] [vertical cylindrical] installation. Tank must be mounted on the tank manufacturer's standard UL listed [tank saddles] [support skid] that elevates the tank above the underlying concrete slab and/or concrete support a maximum of 305 mm. [Support skid must span the entire length of the tank.] Tank assembly must have lifting lugs that allow tank relocation. [Provide tank assembly with the manufacturer's standard [stairway][external ladder] and catwalk assembly, except as modified herein. The [stairway][ladder] and catwalk assembly must be constructed of structural steel and must allow personal access to the top of the entire length of the tank system.] [The catwalk must have protective railings on tanks higher than 1.3 m.] [Provide a minimal 19 L overfill containment box on the tank fill line. The containment box must be lockable and must contain any spillage encountered at the tank during tank filling operations.]

2.5.1.1 Integral Skid Mounted Containment

NOTE: Limit the use of these tanks to locations

with lower amount of rainfall. For other areas, it is recommended that these tanks be installed under a canopy.

The secondary containment reservoir system (diked containment) must be the factory-fabricated, open-top, [stainless] steel type that conforms to STI F911. The primary storage tank must be supported within the containment with steel tank saddles, or other similar supports, fabricated and attached by the tank manufacturer. [The containment must be designed to minimize entry of rainwater or blowing debris.] The secondary containment system reservoir must be equipped with a 75 mm (3 inch) drain that includes a full line size carbon [stainless] steel drain line and a full line size lockable ball valve.

2.5.2 Aboveground Storage Tank (Double Wall Steel)

NOTE: Include one of the double wall tank subparagraphs listed below: double wall steel tank or double wall steel tank (fire-resistant, protected) and delete the others according to the project requirements.

UL 80 tanks are typically 60 to 660 gallon storage tanks primarily used to store heating oil. These tanks are not very common in DoD fuel system.

Provide a factory-assembled unit that includes a factory-fabricated primary storage tank and an integral secondary containment. Tank assembly must be in accordance with [NFPA 30] [NFPA 30A] [NFPA 31] and be designed and manufactured for a [horizontal cylindrical] [rectangular] [vertical cylindrical] installation. Primary storage tank must be factory-welded, [stainless] steel that conforms to [UL 80] [UL 142]. [Tank assembly must be mounted on [the tank manufacturer's standard UL listed support skid that elevates the tank assembly above the underlying concrete slab [or][support saddles] a maximum of 305 mm].] Tank assembly must have lifting lugs that allow tank relocation. [Provide tank assembly with the manufacturer's standard [stairway][external ladder] and platform assembly, except as modified herein.] [The [stairway] [ladder] and platform assembly must be constructed of structural steel and must allow personal access to the top of the tank system.] [Provide [stairway][ladder] and platform as indicated on the drawings.] [Provide a minimal 19 L spill container on the tank fill line. The container must be lockable and must contain any spillage encountered at the tank during tank filling operations.]

2.5.2.1 Double Wall Steel Tank

NOTE: These tanks do not conform to UL 2085. They are not fire-resistant or ballistic/vehicular impact resistant. The UL listing also includes minimum requirements for the assembly supports.

These type tanks should always require a pressure testable and verifiable interstitial space between the primary tank and the secondary containment

(outer) tank.

The secondary containment (outer) tank must be a factory-fabricated, [stainless] steel type that fully-encloses the primary storage (inner) tank. The entire tank assembly must conform to [UL 142](#) and bear the [UL 142](#) label. The interstitial space between the primary tank and the secondary containment tank must be both pressure testable and verifiable. The primary storage tank must be supported within the secondary containment tank reservoir with steel tank saddles, or other similar supports, fabricated and installed by the tank manufacturer.

2.5.2.2 Double Wall Steel Tank (Fire-Resistant, Protected)

NOTE: Tanks that conform to UL2085 are referred to as protected tanks by NFPA 30A (2-hour fire rating when exposed to temperatures up to 1093 degrees C (2000 degrees F)). Manufacturer's typically meet this 2-hour rating by using either concrete or some type of lightweight thermal insulation between the primary tank and the outer containment reservoir. The UL listing also includes minimum requirements for the assembly supports. Delete the bracketed information in this paragraph if a protected type assembly is not required.

These type tanks should always require a pressure testable and verifiable interstitial space between the primary tank and the containment reservoir regardless if the 2-hour rating is specified or not.

The secondary containment (outer) tank must be a factory-fabricated, [stainless] steel, tank that fully-encloses the primary storage tank and must conform to [UL 142](#). The interstitial space between the primary tank and the containment tank must be both pressure testable and verifiable. The entire tank assembly must conform to [UL 2085](#) and bear the [UL 2085](#) label. The primary storage tank must be supported within the containment tank with steel tank saddles, or other similar supports, fabricated and installed by the tank manufacturer.

2.5.3 Aboveground Storage Tank (Double Wall, Concrete Encased)

NOTE: These tanks are fire-resistant and ballistic/vehicular impact resistant conforming to UL 2085. These tanks have a primary (inner) steel tank surrounded by insulation and HDPE liner. The entire assembly is encased in concrete. These tanks are designed and manufactured for a rectangular installation. Per UFC 3-460-01, these tanks are limited to 5,000 gallons and below. Delete this paragraph if these tanks are not being provided.

The primary (inner) storage tank must be a factory-fabricated [stainless] steel tank and must conform to [UL 142](#). The primary storage tank must be insulated. The secondary containment must be a minimum of 30 mil thick

high density polyethylene (HDPE) liner encased in concrete that fully-encloses the primary storage tank. Concrete must have a minimum 27.57 MPa strength, be monolithically poured, and be properly reinforced for the application. The primary storage tank and insulation must be isolated from the exterior concrete encasement. The interstitial space between the primary tank and the containment reservoir must be verifiable for leaks. The entire tank assembly must conform to UL 2085 and bear the UL 2085 label.

2.6 UNDERGROUND STORAGE TANK

NOTE: Include one of the underground storage tank subparagraphs listed below: double wall steel tank (STI P3), double wall tank (steel with non-metallic jacket), and double wall FRP tank and delete the others according to the project requirements.

Provide a concrete anchor pad(s) or deadmen for any tank that will be installed in areas subject to high water tables or flooding. Size the pad(s) or deadmen in accordance with API RP 1615. Buoyant restraint must be obtained by using properly designed hold-down straps in conjunction with a concrete hold-down pad. Assume design conditions with the soil 100% saturated (water table at finished grade) and an empty tank. Design the hold-down pad with a factor of safety of 1.50 for resisting buoyant forces. Require the tank to be connected to the pad(s) or deadmen in accordance with the tank manufacturer's recommendations.

Delete the bracketed sentences if concrete anchor pads or deadmen are not required.

Provide a factory-fabricated, double wall type storage tank that conforms to NFPA 30, NFPA 30A, or NFPA 31. Tank must be designed and manufactured for an underground, horizontal installation. The exterior tank walls must be separated from the interior tank walls by standoffs; thus creating an open or interstitial space (Type II). The entire interstitial space must be monitorable for leaks. [For tanks requiring concrete anchor pads or concrete deadmen, provide holddown straps and accessories as recommended by the tank manufacturer. Use filler strips between the tank shell and any metal holddown straps that conform to the tank manufacturer's requirements.]

2.6.1 Double Wall Steel Tank (STI P3 Tank)

Tank must be constructed of steel and must conform to UL 58 Type II, UL 1746 Part I, and STI P3. Tanks must be cathodically protected and allow on-going monitoring of corrosion protection. Tanks constructed with lap welded shell or head joints must be continuous fillet welded; on both the interior and exterior surfaces. The UL 58 and STI P3 label must be affixed to the exterior surface of the tank.

2.6.2 Double Wall Tank (Steel with Non-Metallic Jacket)

The primary tank must be constructed of steel and jacketed with a

non-metallic secondary containment tank. The entire tank assembly must conform to [UL 58](#) Type II and [UL 1746](#) Part III. The [UL 58](#) label must be affixed to the exterior surface of the tank.

2.6.3 Double Wall FRP Tank

Tank must be constructed of fiberglass reinforced plastic (FRP) and must conform to [UL 1316](#). The [UL 1316](#) label must be affixed to the exterior surface of the tank.

2.7 TANK PROTECTIVE COATINGS

[For tanks coated in California and where required by the State or local regulations, provide tank coating system in accordance with California Air Resources Board (CARB).]

2.7.1 Interior Surfaces

NOTE: Delete this paragraph if FRP tanks are the only type tanks specified. E-85 tanks must not be internally coated.

**For Air Force projects, reference Section [09 97 13.17](#).
For Army projects handling aviation fuel, reference Section [09 97 13.17](#) as applicable.**

For miscellaneous use tanks, consider using standard manufacturer's coating system.

For all products, except for stainless steel tanks, tank interiors must be 100 percent coated. Tanks containing E85 are not to be coated internally unless otherwise approved by Service Headquarters. For all products, coat the interior of 3 inch and larger carbon steel piping and exterior of all carbon steel piping located inside the tank, and steel appurtenances inside all tanks. Carbon steel piping, and carbon steel appurtenances located inside of tanks containing E85 are not to be coated internally unless otherwise approved by Service Headquarters.

Coat 100 percent of a metal tank's interior surfaces including all metal piping and metal appurtenances as specified in [Section [09 97 13.17](#) THREE COAT EPOXY INTERIOR COATING OF WELDED STEEL PETROLEUM FUEL TANKS][with the manufacturer's standard coating system] as modified herein. [This requirement shall be applied for both underground and aboveground Tanks and [API Std 1631](#) and [API RP 652](#)] shall be referenced respectively.

2.7.1.1 Certifications of Coating Contractors

All Contractors and Subcontractors that perform surface preparation or coating application must be certified to [SSPC QP 3](#) and [SSPC QS 1](#) prior to contract award, and must remain certified while accomplishing any surface preparation or coating application. Painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor or subcontractor certification expires, the firm is not

allowed to perform any work until the certification is reissued. Requests for extension of time due to delay as a result of an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in certification status. Notify the Contracting Officer of all scheduled or unannounced on site audits from SSPC and furnish a copy of all audit reports.

2.7.2 Exterior Surfaces, Aboveground Tanks

**NOTE: For Navy and Air Force projects, reference
Section 09 97 13.27.**

**For miscellaneous use tanks, consider using standard
manufacturer's coating system.**

Protect the exterior surfaces of each aboveground tank [as specified in Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES] [with the manufacturer's standard coating system as modified herein] [as specified in Section 09 90 00 PAINTS AND COATINGS] as modified herein.

2.7.2.1 Certifications of Coating Contractors

All Contractors and Subcontractors that perform surface preparation or coating application must be certified to SSPC QP 3 and SSPC QS 1 prior to contract award, and must remain certified while accomplishing any surface preparation or coating application. Painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor or subcontractor certification expires, the firm is not allowed to perform any work until the certification is reissued. Requests for extension of time due to delay as a result of an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in certification status. Notify the Contracting Officer of all scheduled or unannounced on site audits from SSPC and furnish a copy of all audit reports.

2.7.3 Exterior Surfaces, Underground Tanks

**NOTE: Delete this paragraph if FRP tanks are the
only type tanks specified.**

Provide steel tanks with one of the following corrosion protection systems.

2.7.3.1 FRP Coating System

**NOTE: Steel tanks using an FRP coating system do
not require any additional cathodic protection
systems.**

Coating system must be in accordance with UL 1746 Part IV and UL 58. The integrity of the coating must be certified by the manufacturer as meeting the thickness requirements and having no flaws prior to shipment. The UL label must be affixed and visible on the exterior surface of each coated tank.

2.7.3.2 STI P3 Coating System

NOTE: This system provides an exterior protective coating, cathodic protection, and electrical isolation for corrosion protection. Electrical designer will verify that standard STI P3 protection is adequate for the site.

Exterior tank must be coated with a dielectric coating system, cathodically protected, and electrically isolated. Coating system must be in accordance with STI P3, [UL 1746](#) Part I, and [UL 58](#). Tank manufacturer must be licensed by the Steel Tank Institute as an applicator of the [STI P3](#) system. The STI label must be affixed and visible on the exterior surface of each coated tank.

2.7.4 Tank Labeling

NOTE: Applicable to aboveground storage tanks (ASTs) only.

Tank must be labelled with the following information at a minimum:

- a. Product Stored and Tank Capacity (Per [MIL-STD-161](#)).
- b. Tank Number and Facility Number.
- c. [NFPA 704](#) Diamond Hazmat Label.
- d. "No Smoking" on Class 1 tanks.
- e. "Confined Space" on tanks with manhole/ladder hatch.

2.8 TANK COMPONENTS

NOTE: The following tank components are for aboveground and underground storage tanks, unless specifically stated otherwise.

2.8.1 Tank Manhole

NOTE: Indicate the number, size, and location of each tank manhole required.

Provide tanks [18,900 L](#) and smaller with a minimum of one [760 mm](#) tank manhole to allow for internal tank access. Provide tanks larger than [18,900 L](#) with a minimum of two [915 mm](#) tank manholes (one manhole for access). Diesel and bio-diesel tanks at military service stations are to be provided with a [813 mm](#) (32 inch) access manhole. Piping will not penetrate through access manholes.

Tank manholes must have an internal diameter of [760 mm] [813 mm] [915 mm]. Provide each manhole with a matching flanged watertight manhole cover. Manhole covers must be UL listed, be constructed of pressed or mild steel, and include a UL listed gasket. [Frame and cover assembly must be rated to withstand H-20 highway loading as defined by AASHTO HB-17.]

2.8.2 Tank Piping Penetrations

NOTE: For underground storage tanks, use tank manholes as the primary point of entry for piping penetrations unless unfeasible. Pipe penetrations into an underground storage tank are the most likely place for a leak to occur. Designing pipe penetrations to enter through a tank manhole allows each of the penetrations to be contained in a manholecontainment sump. The piping that penetrates the manhole must be flanged on both sides of the manhole hatch. This will allow the piping to be removed from the manhole and allow removal of the manhole without having to cut the piping. Note the aboveground piping may be required to be a spool piece.

Where stand alone tank piping penetrations are required, indicate on the drawings the required number, size, and location of each penetration.

Flanged nozzles must be installed in locations with ISO Corrosivity Categories C3, C4, and C5 while threaded nozzles can be installed in locations with ISO Corrosivity Categories C1 and C2.

Provide a welded-in-place [double tapered National Pipe Thread (NPT) coupling] [flanged pipe nozzle] for each tank piping connection. All unused or spare tank piping penetrations must be sealed with [malleable iron plugs] [steel plugs] [steel flanges] [or] [as indicated].

2.8.3 Tank Striker/Impact Plates

NOTE: Striker plates under all openings used for manual gauging in steel tanks and all openings in fiberglass tanks.

Provide an interior striker/impact plate under each tank manhole and pipe connection. Each plate must be a minimum of 6 mm in thickness, be larger in diameter than the tank penetration, fit the curvature of the tank bottom, and be completely coated in the same fashion as the interior tank bottom coating. Each plate must be welded to the tank bottom at the factory (full circumference connection). The welds must be non-destructive tested using the appropriate means.

2.8.4 Manual Gauging/Sampling Hatch

Provide a combination gauging and sampling hatch assembly. The assembly must include a bronze top-seal type adapter with a corresponding locking type cap (adapter and cap both externally-mounted to the top of the tank) [and a [steel] or [aluminum] stilling well pipe.] [The stilling well pipe must be a minimum 100 mm in size and extend downward through the top of the tank to within 75 mm of the tank bottom. Provide the entire length of pipe inside the tank with 13 mm wide by 300 mm long slots at alternate locations. Coat the pipe in the same fashion as the interior tank bottom coating.]

2.8.5 Tank Ladder

NOTE: Coordinate the need of an internal ladder with the user. Recommend providing tanks larger than 18,900 L with an internal tank ladder. Internal ladders may not be appropriate on smaller tanks with only one manhole. Indicate on the drawings which tank manhole is to be provided with an internal ladder.

Provide interior tank ladders constructed of either fiberglass or steel. If steel, coat the ladder in the same fashion as the tank interior. The two stringers must be a minimum 10 mm thick and a minimum 50 mm wide. The rungs must be a minimum 20 mm rod on 300 mm centers. Members of the ladder must be securely affixed. Ladder must be of sufficient length to extend from the bottom of the tank to the top surface of the tank. Ladder must be rigidly connected to the tank bottom in accordance with the tank manufacturer's standard. Ladder must be connected to the top of the tank with pipe guides or slip bars to accommodate expansion of the two stringers.

2.8.6 Tank Venting

NOTE: The aboveground termination point of a storage tank's vent piping will be provided with either an atmospheric vent or a pressure/vacuum vent. The decision on which item to use will be based upon the characteristics of the fuel to be handled (refer to NFPA 30, 30A and UL 142 as applicable). Delete paragraphs as required.

2.8.6.1 Atmospheric Vent

Provide atmospheric, updraft type cap. Cap must be constructed of aluminum or carbon steel. Cap must have an internal brass or bronze insect screen, minimum 40-mesh. Cap must prevent rain, snow, or ice from entering the vent piping.

2.8.6.2 Pressure/Vacuum Vent

Tank vent outlet must be equipped with pressure-vacuum breather vent, aluminum construction with weather hood and with fluoroelastomer (FKM, Viton) pallet seat inserts, high density screens, stainless steel

internals, with pressure relief setting, vacuum relief setting, and venting/vacuum capacity per tank manufacturer.

2.8.6.3 Emergency Vent

NOTE: Delete this paragraph if underground storage tanks are specified. Emergency venting is not required for underground tanks. Refer to NFPA 30, UL 142, and API Std 2000 for vent sizing. The use of long-bolt manhole covers is not permitted for emergency venting.

Vent must be the normally-closed, UL listed type that vents outward and upward. Vent must conform with NFPA 30 and UL 142 and must be sized by the tank manufacturer. Provide vent with the Liters per second (L/s) rating permanently labeled on the vent's exterior. [For double wall or protected type tanks, provide a second emergency vent to protect the interstitial space.] [This second emergency vent is not to be provided on concrete encased tanks.]

2.9 INDEPENDENT LEVEL ALARM SYSTEM

NOTE: UFC 3-460-01 requires an automatic level alarm system for both aboveground and underground tanks. Include the first bracketed sentence if multiple tanks are to be monitored as part of the design. Alarms for tanks less than 112,500 L must be provided by an automatic tank gauging system. Alarms for tanks equal to or greater than 112,500 L must be provided by an independent level alarm system (see below) in addition to an automatic tank gauging system.

Coordinate the use of overfill valves with Section 33 57 55 or Section 33 52 10 as applicable.

Provide an independent level alarm system that will monitor 4 programmable liquid level setpoints. The system must delineate between each individual setpoint [as well as each individual tank]. The system must produce an audible and visible alarm in the event of monitoring an alarm condition. Mechanically-actuated float assemblies must be field adjustable. The system must be totally independent of the tank gauging system.

2.9.1 Setpoints

NOTE: For underground tanks, require the high and high-high setpoints to be 90 and 95 percent tank capacity respectively. For aboveground tanks, require the high and high-high setpoints to be 95 and 98 percent tank capacity respectively. Since horizontal tanks fill extremely fast in the last 5 percent of their volume, closely consider choosing lower setpoints based upon actual filling rates, tank size, and time needed to react.

The suggested low level alarm setpoint for both aboveground and underground tanks is 15 percent tank capacity. Modify this level accordingly in order to insure that air will not be drawn into the piping system.

Configure the alarm system's 4 setpoints in accordance with the following.

- a. High Level Setpoint. Produce an alarm condition when a tank's liquid level rises above [90] [95] [_____] percent capacity.
- b. High-High Level Setpoint. Produce an alarm condition when a tank's liquid level rises above [95] [98] [_____] percent capacity.
- c. Low Level Setpoint. Produce an alarm condition when a tank's liquid level drops below [15] [_____] percent capacity.
- d. Low-Low Level Setpoint. Produce an alarm condition when a tank's liquid level drops below [the minimum pump submergence level at] [_____] percent capacity.

2.9.2 Independent Level Alarm Control Panel

NOTE: Indicate on the drawings the location of the system control panel. Panels located outdoors will require NEMA 4 enclosures. Panels located indoors will only require a standard industrial enclosure. Explosion-proof enclosures are typically unavailable.

Install the control panel for the alarm system in a [NEMA 4 rated enclosure in accordance with NEMA 250] [standard industrial enclosure]. Panel doors must swing left or right.

2.9.2.1 Audible Alarm

NOTE: If speakers external to the panel are necessary, indicate their location on the drawings. Alarms must actuate in a manned area responsive to the alarm.

Panel must have [internal] [external] speakers that produce a buzzer sound of [70] [_____] decibels or greater in the event of a detected alarm condition.

2.9.2.2 Visual Alarm

Panel must have a visual alarm that illuminates in the event of a detected alarm condition. The visual alarm must include either individual lights for each alarm condition or must include a single light and a liquid crystal display (LCD) panel that displaces information regarding each alarm condition.

2.9.2.3 Acknowledge Switch

Panel must have a manual acknowledge switch that will deactivate the audible alarm. The acknowledge switch must not deactivate subsequent audible alarms unless depressed manually again for each occurrence. Under no circumstance must this acknowledgement switch extinguish the visual alarms until the alarm condition has been corrected. The acknowledge switch must be an integral component located on the front of the control panel. The switch must be either a key switch or push button.

2.9.2.4 Test Pushbutton

Panel must have a manual test pushbutton that will enable operators to verify that the panel is powered, and the visual and audible alarms are working properly.

2.10 TANK GAUGES

NOTE: Provide each tank with a stick gauge and tank calibration chart. Provide a minimum of one additional gauge for each tank. The additional gauge can be either the analog, or digital type. Indicate on the drawings the location of each gauge display.

Provide tank gauges that meet federal, state and local requirements for aboveground and underground tanks. Provide tank gauging to comply with UFC 3-460-01 and STD 123-335-03. Automatic tank gauges may be used as the primary alternative for meeting the regulatory requirements; however, for small fueling systems (i.e. single building's heating system) where a digital tank gauge and panel are not economical, analog should be used. For underground tanks, new tank gauge alternatives must follow the requirements of 40 CFR 280.

2.10.1 Stick Gauge

For each tank, provide 2 wooden stick gauges. Gauge length must allow the measurement of the entire level of fuel in the corresponding tank. Gauges must be compatible with the fuel to be measured (no swelling or damage from fuel contact). Provide gauge with non-sparking caps on each end. Mark gauges in **m** and **mm**. The smallest unit of measure on the gauge must be **1 mm**.

2.10.2 Tank Strapping Table

NOTE: Choose the reference API MPMS 2.2E for horizontal tank applications. Choose API MPMS 2.2A for vertical tank applications. For tanks smaller than **19,000 L**, choose tank manufacturer certified strapping tables.

Provide [2][_____] [**API MPMS 2.2E**][**API MPMS 2.2A**][tank manufacturer]

certified strapping tables (calibration charts) for each tank. One of the tables must indicate the liquid contents in **L** for each **1 mm** of tank depth. Strapping table volumes for all tanks **19,000 L** and larger must be determined using physical measurements and not calculated values. For each tank, provide an electronic media file of each strapping table.[For tanks larger than **19,000 L** tank strapping must be performed after installation at the site.]

2.10.3 Mechanical Clock Gauge

Gauge must be the level sensing, mechanically actuated type that provides the tank level readout in a sealed glass cap contained in a gauge box. Gauge must be accurate to plus or minus **6 mm** and must measure the liquid level over the full range of a tank's height. Gauge must have vapor tight seals to prevent condensation from fogging the viewing glass.

2.10.4 Automatic Tank Gauge System (ATG)

NOTE: The digital readout provided by a digital tank system can be sent to a stand-alone electronic panel or the signal can be sent to the same panel that is used for leak detection monitoring.

If both leak detection monitoring and digital tank gauge systems are to be used in the same project, then require the digital readout from both systems be sent to the same electronic monitoring/alarm panel provided under Section **33 01 50.31**.

If a leak detection system is not required as part of the project, then require a stand-alone electronic panel to present the digital readout from the gauge system. Indicate the location of the panel on the drawings. Panels located outdoors will require NEMA 4 enclosures. Panels located indoors will only require a standard industrial enclosure.

For DLA capitalized fuels, select **1 mm** accuracy option. **2 mm** may be used for non-DLA capitalized fuels.

For tanks storing product for DLA-Energy, refer to current DLA-Energy ATG Installation Policy for additional product specific requirements.

Gauge system must be the mechanically or electronically actuated type that can continuously monitor a tank's usable liquid level storage capacity. The system must provide a digital readout of a tank's liquid level in terms of **mm** and **L**. The system must be accurate to plus or minus **2 mm**. The system must measure water accumulation in **mm** from **20 to 125 mm** off the bottom of a storage tank. Construct system components to be chemically compatible with the fuel to be handled. For each tank monitored, provide a sending unit that transmits the digital readout from a tank to [the electronic monitoring/alarm panel defined in Section **33 01 50.31** LEAK DETECTION FOR FUELING SYSTEMS] [an electronic display panel. Panel must be [a NEMA 4 enclosure as defined by **NEMA 250**] [standard industrial enclosure]. Panel doors must swing left or right. The panel must display

the digital readout of each monitored tank on an LCD mounted exterior to the panel. The panel must also have external controls to allow operators to toggle between information on the LCD without having to open the panel.]

2.11 MANHOLE CONTAINMENT SUMP

NOTE: Delete this paragraph if underground storage tanks are not specified.

Require on the drawings a containment sump to be installed directly above each tank manhole. Do not require the sump to be connected in any way to the surfaces above (e.g., street manhole cover, concrete, etc.).

Typical installations include a street manhole cover to be installed directly above each sump in order to allow access to the sump and the tank manhole below. Size the manhole cover large enough to allow the removal of the sump access cover below.

Sump must be the factory-fabricated, direct-buried type that provides a watertight connection either directly to the exterior of the tank or to a flanged manhole opening. Sump must be constructed of fiberglass reinforced plastic. Sump construction must be chemically compatible with the type of products being handled within the connecting tank. Sump must allow access to a tank manhole cover without disturbing surrounding backfill. Sump must be larger in diameter than the connecting tank manhole. Sump must be designed to withstand the underground burial loads. Sump assembly must prevent the influx of rainfall drainage or ground water.

2.11.1 Piping Penetrations

Sump sides must allow the penetration of carrier pipes, exterior containment pipes, conduits, and vapor pipes as required. Sump penetrations must be booted or sealed to ensure that liquid will not escape from the sump in the event that the liquid level within the sump rises above the pipe penetration. Boots and seals used must be compatible with the fuel to be handled. Boots and seals must be water resistant to the influx of water from outside the sump. Boots and seals must be designed and installed to accommodate the anticipated amount of thermal expansion and contraction in the piping system.

2.11.2 Access Cover

NOTE: Require watertight covers if high ground water is a problem and frequent access to the manhole below is not necessary. Watertight covers are generally bolted or strapped down. Strapped down covers provide easy access to the sumps without the use of tools. Friction fit covers will prevent the influx of rainwater and are easily removable by hand.

Where indicated, the entire top of a containment sump must be capped with a [friction fit] [bolted down, watertight] [strapped down, watertight] access cover that allows water to flow away from the manhole. Cover must be constructed of the same material as the sump. Cover must have a larger diameter than the tank manhole cover below. Cover must be lightweight and not exceed 16 kilograms.

2.12 TANK MOUNTED FUEL DISPENSING UNIT

NOTE: Tank mounted dispensing units are optional systems that are typically provided directly from the tank manufacturer. The units are mounted directly to aboveground storage tank assemblies and are intended for use in low-volume, simple fueling applications where detailed fuel metering is not a concern.

Per NFPA 30A, only specify these type dispensing units if they are used in conjunction with a protected aboveground tank that conforms to UL 2085 (fully-enclosed concrete contained aboveground tank or fully-enclosed steel contained aboveground tank). These type dispensing units will not be used with any other type storage tank.

Provide fuel dispensing unit with integral UL labeled suction pump as supplied by the tank manufacturer. Unit must include all necessary appurtenances for operation. Unit must include a visible register to indicate individual deliveries up to 999.9 liters with a reset meter. Pump must have a delivery capacity of 0.95 liters/sec. Hose must be a minimum 20 mm inside diameter, 4.6 meters long, and fuel resistant. The dispensing nozzle must be of the automatic shutoff type with graduated notches for various delivery speeds. Dispensing unit must provide a means for locking of the nozzle to the pump when the pump is shutoff. [Diesel fuel dispensing unit cabinet must be painted yellow from the manufacturer.] [Gasoline dispensing unit must be painted red from the manufacturer.] Units must be clearly marked for the fuel they are dispensing.

2.13 FUEL HEATERS

NOTE: Indicate on the drawings the maximum temperature fuel is to be heated as well as the recovery rate required of the fuel heater. If steam or hot water are to be used as the heating medium, indicate their corresponding supply temperature, pressure, and flow rate on the drawings.

Electric type heaters are typically mounted at the bottom level of a tank. Require the tank manufacturer to provide a properly sized pipe nozzle at the bottom end of a tank to accommodate the heater.

2.13.1 In-Tank Heater

2.13.1.1 Fintube Type

Provide a vertical, manhole-mounted, fintube immersion heater. Construct entire assembly to be compatible with the product to be heated. Entire assembly must be removable as a unit. Construct heater's coil of [carbon steel] [stainless steel] tubes and fins. Construct heater to work with a heating medium of [steam] [hot water] supplied at [_____] degrees C and [_____] kPa (gage). Construct heater's tank mounting flange of steel with a bolt pattern to match the corresponding tank manhole. Provide ASME B16.5, Class 150 flanges on the heating medium inlet and outlet. Extend assembly within 150 mm of the tank bottom.

2.13.1.2 Electric Type

Provide a flanged, horizontally-mounted, immersion type electric heater. Heater must be UL listed and be compatible with the product to be heated. Construct heater's mounting flange of steel with a bolt pattern to match the corresponding tank nozzle. Heating element must be non-coking for the intended application. Entire assembly must be removable as a unit. If support brackets are required internally in a tank to mount the heating element above the tank bottom, provide heater manufacturer's standard support brackets. Install support brackets directly on a tank's internal striker plates. Mounting a heater's support brackets directly to a tank's bottom will not be allowed.

2.13.2 Tank Suction Heater

2.13.2.1 Shell-and-Tube Type

Provide a vertical, manhole-mounted, shell-and-tube type suction heater. Construct heater in accordance with ASME BPVC SEC VIII D1 with a rated working pressure of 1034 kPa (gage). Assembly must be compatible with the product to be heated. Entire assembly must be removable as a unit. Construct heater's shell and tube bundle of [carbon steel] [stainless steel]. Construct heater to work with a heating medium of [steam] [hot water] supplied at [_____] degrees C and [_____] kPag. Construct heater's tank mounting flange of steel with a bolt pattern to match the corresponding tank manhole. Provide ASME B16.5, Class 150 flanges on the heating medium inlet and outlet as well as the suction discharge piping. Extend assembly within 150 mm of the tank bottom. Provide heater with drain, vent, thermometer, and pressure gage.

2.13.2.2 Electric Type

Provide a flanged, horizontally-mounted, electric type suction heater. Heater must be UL listed and be compatible with the product to be heated. Construct heater's mounting flange of steel with a bolt pattern to match the corresponding tank nozzle. Heating element must be non-coking for the intended application. Entire assembly must be removable as a unit. Provide ASME B16.5, Class 150 flanges on the suction discharge piping. Provide heater with drain, vent, thermometer, and pressure gage. If support brackets are required internally in a tank to mount the heating element up off the tank bottom, provide heater manufacturer's standard support brackets. Install support brackets directly on a tank's internal striker plates. Mounting a heater's support brackets directly to a tank's bottom will not be allowed.

2.13.3 Pipe In-Line Heater

Provide a horizontal, shell-and-tube type in-line heater. Construct heater in accordance with ASME BPVC SEC VIII D1 with a rated working pressure of 1034 kPa (gage). Construct entire assembly to be compatible with the product to be heated. Construct heater's shell and tube bundle of [carbon steel] [stainless steel]. Construct heater to work with a heating medium of [steam] [hot water] supplied at [_____] degrees C and [_____] kPag. Provide ASME B16.5, Class 150 flanges on the heating medium inlet and outlet as well as the fuel inlet and outlet connections. Provide heater with manufacturer's standard support brackets. Provide heater with drain, vent, thermometer, and pressure gage.

2.13.4 Temperature Controls

Provide heater with automatic temperature controls that can regulate the discharge product temperature as indicated. Provide necessary sensors and wiring needed for a fully functional control system. Construct controls to allow for adjustable discharge product temperatures. Provide an automatic high limit safety heater shutoff that is field adjustable. Provide a manual "on-off" switch in series with the automatic temperature controls in order to allow manual shutdown/startup. Provide temperature control components in a mountable and prewired NEMA 4 enclosure that conforms to NEMA 250.

2.14 INSPECTION WELL

NOTE: Delete this paragraph if underground storage tanks are not included in the project. Each site should have a maximum of two inspection wells located at opposing corners of the storage tank site. Sites with one storage tank should only require one inspection well. Inspection wells will not be used as monitoring wells. Inspection wells can serve as an inexpensive means of providing secondary verification of a leak as well as serving as a pump-out well for contaminated sites.

Inspection well must be constructed of Schedule 40 PVC pipe that is 150 mm in diameter. Pipe must be factory slotted from the bottom to within 300 mm of grade. With the pipe installed vertically, slots must be horizontal and have a width of 0.5 mm with not less than 30 slots per 300 mm. Slots must encompass at least 80 percent of the pipe's 360 degree perimeter with the pipe maintaining its structural integrity. Slots must allow fluid within the soil to infiltrate into the pipe without allowing sediment to fill the pipe. Each well must extend down 600 mm below the deepest buried storage tank. Well must have a permanently fixed bottom cap. Well must have a removable top cap that is protected from traffic with a watertight street manhole and cover as indicated. Well must have a 10 mm vent hole located directly below the top cap to vent the well. The top cap of each well must be accessible from the surface through a 300 mm diameter manhole. The manhole ring must be constructed of steel, cast iron, or fiberglass, have a cast iron cover, be a minimum of 300 mm deep, and withstand H-20 highway loading as defined by AASHTO HB-17. Each manhole cover must have the words "DO NOT FILL - INSPECTION WELL" cast permanently into the top. The letters must be a minimum of 13 mm in size. Each manhole cover must have a white circle with a black triangle painted on

the surface.

2.15 ACCESSORIES

2.15.1 Concrete Anchor Bolts

Concrete anchors must conform to [ASTM F1554](#), hot-dipped galvanized.

2.15.2 Bolts and Studs

Carbon steel bolts and studs must conform to [ASTM A307](#), Grade B, hot-dipped galvanized. Stainless steel bolts and studs that conform to [ASTM A193/A193M](#), Grade 8.

2.15.3 Nuts

Carbon steel nuts must conform to [ASTM A563](#), Grade A, hex style, hot-dipped galvanized. Stainless steel nuts must conform to [ASTM A194/A194M](#), Grade 8.

2.15.4 Washers

Provide flat circular washers under each bolt head and each nut. Washer materials must be the same as the connecting bolt and nut. For [ASTM F1554](#) concrete anchors, use [ASTM F436](#), Type 1, hot-dipped galvanized washers. For [ASTM A307](#) bolts and studs, carbon steel washers must conform to [ASTM F844](#), hot-dipped galvanized. Stainless steel washers must conform to [ASTM A194/A194M](#), Grade 8.

2.15.5 Polytetrafluoroethylene (PTFE) Tape

Tape must conform to [ASTM D3308](#).

2.15.6 Street Manhole Assembly

NOTE: Delete this paragraph if street manhole assemblies are address in the Civil specifications.

Style A frames are for manholes up to 760 mm in diameter. Style B frames are for manholes between 915 and 1070 mm in diameter.

Round street manhole frames and covers must be the straight traffic type. Frames and covers must be constructed of [cast steel in accordance with [ASTM A27/A27M](#), grade 60-30 as a minimum] [cast iron in accordance with [ASTM A48/A48M](#)] [aluminum in accordance with [ASTM B26/B26M](#)] [or] [a engineered lightweight laminate material]. [Covers must be the solid plate type with a checker pattern.] Covers must form a watertight seal with the manhole frame to prevent surface water inflow. Frame and cover assembly must be rated to withstand H-20 highway loading as defined by [AASHTO HB-17](#).

2.16 PIPE FLANGED END CONNECTIONS

2.16.1 Flanges

Provide flanged end connections on equipment, fittings, piping, piping

components, adapters, couplers, and valves that conform to ASME B16.5, Class 150.

2.16.1.1 Carbon Steel

Carbon steel flanges shall conform to ASTM A105/A105M.

2.16.1.2 Stainless Steel

Stainless steel flanges shall conform to ASTM A182/A182M, Grade F304 or F304L, forged type.

2.16.2 Flange Gaskets, Non-Isolating

Provide flange gaskets that are 3.2 mm (1/8 in) thick and that conform to ASME B16.21, raised-face type unless otherwise indicated. Gaskets shall be constructed of Buna-N.

2.16.3 Flange Gaskets, Electrically Isolating

NOTE: Indicate the location of each electrically isolating connection on drawings.

Flange gaskets shall conform to ASTM D229 and shall provide an electrical insulating material of 1000 ohms minimum resistance. Provide gasket material that is chemically compatible with the fuel to be handled. Provide gaskets that are the full face type. Provide flanges that have a full surface 762 micrometers (0.03 in) thick, spiral-wound mylar insulating sleeves between the bolts and the holes in the flanges. Bolts may have reduced shanks of a diameter not less than the diameter at the root of the threads. Provide high-strength 3.2 mm (1/8 in) thick phenolic insulating washers next to the flanges with flat circular stainless steel washers over the insulating washers and under bolt heads and nuts. Provide bolts long enough to compensate for the insulating gaskets and stainless steel washers.

2.16.4 Flange Protectors

NOTE: Use flange protectors to minimize the exposure of flanged end connections to corrosive environments and thus extend the maintenance life of the connections. Flange protectors also help prevent foreign matter from shorting out or bridging over an insulating gasket within an electrically isolating flange. Delete this paragraph if not applicable.

Protectors shall protect the bolts, studs, nuts, and gaskets of a flanged end connection from corrosion or damage due to exposure to the environment. Protectors shall be weather and ultraviolet (UV) resistant. Protectors shall allow for quick and easy removal and re-installation by maintenance personnel. [Provide protectors that allow visual inspection of the flange gasket without requiring removal.] [For electrically isolating flange connections, provide protectors with grease fittings that allow the injection of grease into the flange cavity.]

2.16.5 Flange Bolts, Nuts, and Washers

Bolts and nuts for pipe flanges, flanged fittings, valves and accessories shall conform to [ASME B18.2.1](#) and [ASME B18.2.2](#), except as otherwise specified. Bolts shall be regular hexagonal type. Bolts shall be threaded in accordance with [ASME B1.1](#), Class 2A fit, Coarse Thread Series, for sizes [25 mm](#) and smaller and Eight-Pitch Thread Series for sizes larger than [25 mm](#). Nuts shall be the hexagonal, heavy series type. Nuts shall be threaded in accordance with [ASME B1.1](#), Class 2B fit, Coarse Thread Series for sizes [25 mm](#) and smaller and Eight-Pitch Thread Series for sizes larger than [25 mm](#). Bolts shall be of sufficient length to obtain full bearing on the nuts and shall project no more than two full threads beyond the nuts with the bolts tightened to the required torque.

2.16.5.1 Stainless Steel Materials

Bolts shall conform to [ASTM A193/A193M](#), Class 2, Grade 8. Nuts shall conform [ASTM A194/A194M](#), Grade 8. Washers shall conform to [ASTM A436](#), flat circular of the same material as the bolt.

2.16.5.2 Carbon Steel Materials

Bolts shall conform to [ASTM A307](#), Grade B, hot-dipped galvanized. Nuts shall conform to [ASTM A563](#), Grade A, hex style, hot-dipped galvanized. Washers shall conform to [ASTM F436](#) Type 1 (carbon steel), flat circular for carbon steel bolts.

2.17 FUEL PIPE

NOTE: Indicate on the drawings all piping configurations, slopes, sizes, and piping materials (i.e. carbon steel, stainless steel, or FRP) permitted for each piping system. Coordinate these requirements with UFC 3-460-01.

As stated in UFC 3-460-01, use threaded end connections only where unavoidable. Never require a threaded end connection to be direct buried. Specifically indicate the location of each threaded end connection on the drawings.

Pipe shall meet the material, fabrication and operating requirements of [ASME B31.3](#), except as modified herein.

2.17.1 Carbon Steel Pipe

Provide carbon steel pipe that complies with one of the following:

- a. Pipe shall conform to [ASTM A53/A53M](#), Type E or S, Grade B, seamless or electric welded. Pipe smaller than [65 mm](#) shall be Schedule 80. Pipe [65 mm](#) and larger shall be Schedule 40.
- b. Pipe shall conform to [API Spec 5L](#), Product Specification Level (PSL) 1, Grade B, [submerged-arc welded or gas metal-arc welded] [seamless or electric welded].

End connections for pipe or fittings smaller than 65 mm shall be forged, socket weld type conforming to ASTM A182/A182M and ASME B16.11, unless indicated otherwise. End connections for pipe or fittings 65 mm and larger shall be butt welded type conforming to ASTM A234/A234M, Grade WPB and ASME B16.9 of the same wall thickness as the adjoining pipe. [Where threaded end connections are indicated, provide connections that conform to ASME B16.3, Class 150 or ASME B16.11.]

2.17.2 Stainless Steel Pipe

Provide stainless steel pipe that complies with one of the following:

- a. Pipe shall conform to ASTM A312/A312M, Type TP304L, seamless only. Pipe smaller than 200 mm shall be Schedule 40S. Pipe 200 mm or larger shall be Schedule 10S.
- b. Pipe shall conform to ASTM A358/A358M, Grade 304L, Class 1 or 3, longitudinally welded. Radiographically inspect 100 percent of factory longitudinal welds in accordance with ASME BPVC SEC VIII D1. Minimum pipe wall thickness shall be 6 mm for pipe 300 mm and smaller; 8 mm for pipe larger than 300 mm.

2.17.2.1 Fittings 65 mm (2-1/2 in) and Larger

Provide butt welded type fittings that complies with one of the following:

- a. Stainless steel conforming to ASTM A403/A403M, Class WP-S, Grade WP 304L, seamless only and ASME B16.9 of the same thickness as the adjoining pipe.
- b. Stainless steel conforming to ASTM A403/A403M, Class WP-XX, Grade WP 304L, of wall thickness as indicated. Do not fabricate starting material by the fusion welding process without addition of filler metal. Forming will not be allowed using fusion welding process without addition of filler metal. Radiographically inspect all factory longitudinal welds in accordance with ASME BPVC SEC VIII D1.

2.17.2.2 Fittings 50 mm (2 in) and Smaller

Socket welded type fittings, unless indicated otherwise, shall conform to ASME B16.11. Fitting materials shall be stainless steel that conforms to ASTM A182/A182M, Type F304L.

2.17.2.3 Control Piping

Piping shall be seamless, fully annealed stainless steel tubing conforming to ASTM A269/A269M, Grade TP316, with a hardness number not exceeding 80 HRB. For 15 mm (1/2 in) tubing, provide a minimum 1.3 mm (0.049 in) tubing wall thickness.

2.17.2.4 Control Piping Fittings

Fittings shall be the flareless, Type 316 stainless steel type conforming to SAE J514.

2.17.3 Fiberglass Reinforced Plastic (FRP) Pipe

NOTE: Use of FRP piping must be approved by Service

Headquarters. Do not require FRP piping to be installed aboveground.

Pipe shall be listed in **UL FLAMMABLE & COMBUSTIBLE** and be chemically compatible with the fuel to be handled. Fittings, end connections and adhesives shall be listed in **UL FLAMMABLE & COMBUSTIBLE** and be chemically compatible with the fuel to be handled. Use only adhesives that have not exceeded the manufacturer's recommendations for shelf life and pot life.

2.17.4 Exterior Containment Piping System

NOTE: Exterior containment piping for product piping greater than 150 mm is not readily available. Containment piping this large would have to be specially constructed and in most cases would be cost prohibitive.

Refer to UFC 3-460-01 and UFGS 33 58 00 for leak detection requirements.

An alternative to using factory designed secondary containment piping would be to use single-wall piping inside a sealed, watertight, 360 degree secondary containment barrier (liner). The construction of the liner would have to meet the requirements of 40 CFR 280.

Piping system shall be the factory fabricated, double-wall type that conforms to **ASME B31.3** and **NFPA 30**. Product pipe shall be as indicated on the drawings and as specified herein. The exterior containment pipe shall be fiberglass reinforced plastic (FRP) that conforms to **ASTM D5677** except as modified herein. Containment pipe shall be chemically compatible with the type of fuel to be handled, be non-corrosive, dielectric, non-biodegradable, and resistant to attack from microbial growth. Containment piping shall be capable of withstanding a minimum **35 kPa** air pressure. Containment piping and supports shall be designed to allow for drainage of liquids. Containment piping shall allow for complete inspection of the product piping before the containment piping is sealed.

Containment piping shall be evenly separated from the product piping with pipe supports that are designed based on pipe size, pipe and fuel weight, and operating conditions. Pipe supports shall be constructed of [the same material as the product pipe] [FRP]. Design supports so that no point loading occurs on the primary or exterior pipe. Supports shall be permanently attached to the product pipe either by tack welding or by an adhesive. Supports shall be designed and installed to allow for pipe movement of both the product piping and the exterior containment piping without causing damage to either.

2.17.5 Copper Piping

NOTE: Specify copper piping only for small fuel oil applications, lubricating oil applications, etc.. Copper alloy piping materials shall not be used within a boiler plant structure.

Pipe and tubing must conform to **ASTM B88M**, Type K or L.

2.17.5.1 Fittings and End Connections

Wrought copper and bronze solder-joint pressure fittings shall conform to **ASME B16.22** and **ASTM B75/B75M**. Cast copper alloy solder-joint pressure fittings shall conform to **ASME B16.18**. Cast copper alloy fittings for flared copper tube shall conform to **ASME B16.26** and **ASTM B62**. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

2.17.5.2 Solder

Solder shall conform to **ASTM B32**, grade Sb5, tin-antimony alloy for service pressures up to **1034 kPa**. Solder flux shall be liquid or paste form, non-corrosive and conform to **ASTM B813**.

2.17.5.3 Brazing Filler Metal

Filler metal shall conform to **AWS A5.8/A5.8M** or **KS D 8319**, Type BAg-5 with AWS Type 3 flux, except **AWS A5.8/A5.8M** or **KS D 8050**, Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.18 PIPING COMPONENTS

Provide piping components that meet the material, fabrication and operating requirements of **ASME B31.3**, except as modified herein. Pressure design class for piping components shall be Class 150 as defined in **ASME B16.5**.

2.18.1 Welded Nipples

Nipples shall conform to **ASTM A733** or **ASTM B687** and be constructed of the same material as the connecting pipe.

2.18.2 Steel Couplings

Couplings shall conform to **API Spec 5L**, seamless, extra heavy, wrought steel with recessed ends.

2.18.3 Threaded Unions

NOTE: Avoid threaded unions if possible. Threaded unions may be used in certain aboveground applications if specifically indicated on the drawings. As stated previously, never required a threaded end connection to be direct buried. Typically, threaded end connections are only to be used on piping **50 mm** or less in size.

NOTE: Indicate the locations of each electrically isolating connection on the drawings.

Unions shall conform to ASME B16.39, Class 150. Unions materials shall conform to ASTM A312/A312M, Grade 304 or 316. Dielectric unions shall conform to dimensional, strength, and pressure requirements of ASME B16.39, Class 150. Steel parts shall be galvanized or plated. Union shall have a water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint. When dry, union shall be able to withstand a 600-volt breakdown test.

2.18.4 Joint Compound

Joint compounds shall be resistant to water and be suitable for use with fuel containing 40 percent aromatics.

2.18.5 Flexible Pipe Connector

NOTE: Identify on the drawings the nominal pipe size and required length for each flexible pipe connector. Connectors smaller than 65 mm are typically not available with flanged end connections. If small connectors are required, specifically indicated the location of the threaded connections on the drawings.

Connector shall be the flexible, close pitch, metal hose type that is constructed with exterior annular corrugations and provided with a single layer of braided wire sheath covering. Connectors shall be constructed entirely of stainless steel and be rated for the system working pressure and temperature. [Connectors shall have flanged end connections.] [Provide threaded end connections for connectors smaller than 65 mm. Provide flanged end connections for connectors 65 mm and larger.]

2.18.6 Strainer

NOTE: Duplex strainers have at least 2 basket or element chambers separated by a valve that permits continuous flow of fluid through one chamber while the other is accessible of cleaning.

Strainer shall be the in-line, cleanable, [simplex] [duplex] basket type configured in either an "S" or "T" pattern. Strainer body shall be fabricated of [cast steel or brass] [Type 304 or 316 stainless steel]. Provide strainer with a drain and with drain piping that is inclusive of a [flanged] ball valve. Strainer shall be equipped with a removable cover, flanged end connections, an air eliminator, ports for connection of differential pressure sensor tube, and arrows clearly cast on the strainer sides that indicate the direction of flow. Strainers shall have a removable, 60 mesh, Type 316 stainless steel wire sediment screen. The ratio of net effective strainer area to the area of the connecting pipe shall be not less than 3 to 1.

2.18.7 Thermometers

NOTE: Indicate the scale range for each thermometer

on the drawings.

Thermometer shall be the analog, dial-type bimetallic actuated type that conforms to ASME B40.200. Thermometer shall have a 125 mm diameter dial, a hermetically sealed stainless steel case, a stainless steel stem, a safety glass face, a fixed threaded connection, and a scale range as indicated. Thermometer accuracy shall be within one percent of the scale range.

2.18.8 Pressure Gauge

NOTE: Indicate the scale range for each gauge on the drawings.

Gauge shall be the single style type that conform to ASME B40.100. Gauge shall have a 110 mm dial, a stainless steel case and tube, a stainless steel ball valve, pressure snubbers, and a scale range as indicated. Gauge shall be liquid-filled with [glycerin] [or] [silicone]. [Provide gauge with an adjustable marker arrow that allows a user to mark a specific pressure for future reference.]

2.18.9 Pipe Hangers and Supports

NOTE: Indicate installation details (including anchorage and spacing) of all hangers and supports on the drawings. Include applicable seismic zone design requirements.

Hangers and supports shall be the adjustable type conforming to MSS SP-58, except as modified herein. Provide hot-dipped galvanized finish on rods, nuts, bolts, washers, hangers, and supports. [Provide Type 316 stainless steel nuts, bolts, washers, and screws when located under a pier.] Provide miscellaneous metal that conforms to ASTM A36/A36M, standard mill finished structural steel shapes, hot-dipped galvanized.

2.18.9.1 Pipe Protection Shields

Shields shall conform to MSS SP-58, Type 40, except material shall be Type 316 stainless steel. Provide shields at each slide type pipe hanger and support.

2.18.9.2 Low Friction Supports

Supports must have self-lubricating anti-friction bearing elements composed of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates, prebonded to appropriate backing steel members. The coefficient of static friction between bearing elements shall be 0.06 from initial installation for both vertical and horizontal loads and deformation shall not exceed 51 micrometers under allowable static loads. Bonds between material and steel shall be heat cured, high temperature epoxy. Design pipe hangers and support elements for the loads applied. Provide anti-friction material with a minimum of 2.3 mm thick. Provide hot-dipped galvanized steel supports. Provide supports that are factory designed and manufactured.

2.18.10 Escutcheon

Escutcheon must be the chrome plated, stamped steel, hinged, split ring type. Inside diameter shall closely fit pipe outside diameter. Outside diameter shall completely cover the corresponding floor, wall, or ceiling opening. Provided each escutcheon with necessary set screws.

2.18.11 Sight Flow Indicator

Indicator shall be constructed of [stainless steel] [carbon steel] and be provided with flanged end connections. Indicator shall include an internal rotating propeller to provide visual flow indication. Indicator housing shall include a tempered glass observation port for viewing the rotating propeller. Indicator shall have Buna-N seals.

2.18.12 Fuel Oil Meter

NOTE: Fuel oil meters are mandatory for all Air Force fuel oil projects. For each meter indicate the maximum flow rate to be metered as well as the allowable pressure drop at the maximum flow rate.

Provide volumetric positive displacement type meter, except as modified herein. Meter shall indicate the fuel oil flow rate in **L/s**. Meter shall be provided with overspeed protection. If meter is not mounted in-line with the piping, then an appropriate pedestal for mounting shall be provided. Install meter in accordance with manufacturer's recommendations. Meter shall be capable of providing a 4-20 mA analog output signal for the fuel flow rate. [The output signals shall be compatible with the base's existing Energy Monitoring and Control, System (EMCS).]

2.18.13 Vent Cap

NOTE: The aboveground termination point of a storage tank's vent piping will be provided with either a pressure/vacuum relief valve or a vent cap. The decision on which item to use will be based upon the characteristics of the fuel to be handled (refer to NFPA 30, 30A, and UL 142 as applicable).

Provide atmospheric, updraft type cap. Cap shall be constructed of aluminum or carbon steel. Cap shall have an internal brass or bronze insect screen, minimum 40-mesh. Cap shall prevent rain, snow, or ice from entering the vent piping.

2.19 GENERAL VALVES

Provide valves that meet the material, fabrication and operating requirements of **ASME B31.3**, except as modified herein. Valves shall have flanged end connections and conform to **ASME B16.34**, Class 150 except as modified herein. Provide stainless steel stem and trim for each valve. Valves shall have a weatherproof housing. Seats, body seals, and stem

seals shall be Viton or Buna-N.

- a. Carbon Steel Piping. Provide valves with bodies, bonnets, and covers constructed of cast steel conforming to [ASTM A216/A216M](#).
- b. Stainless Steel Piping. Provide valves with bodies, bonnets, and covers constructed of stainless steel conforming to [ASTM A743/A743M](#), Type 304 or 316; or cast steel conforming to [ASTM A216/A216M](#), Grade WCB internally plated with nickel or internally electrodeless nickel plated.

2.19.1 Swing Type Check Valve

Valve shall be the full-opening, tilting disc, non-slam, swing type that conforms to [API Spec 6D](#). Discs and seating rings shall be renewable without removing from the line. The disc shall be guided and controlled to contact the entire seating surface.

2.19.2 Wafer Type Check Valve

Valve shall be the dual-plate, double flanged, wafer type that conforms to [API Std 594](#). Wafer type check valves may be provided in lieu of swing check valves in piping sizes larger than [100 mm](#). Valve disc shall be constructed of [ASTM A351/A351M](#), Grade CF8M stainless steel. Valve spring, hinge pin, stop pin, and radial-thrust bearing materials shall be constructed of Type 316 stainless steel.

2.19.3 Ball Valve

Valve shall be the non-lubricated, double seated, ball type that conforms to [API Spec 6D](#). [Valve shall meet the fire test requirements of [API Spec 6FA](#).] Valve shall operate from fully open to fully closed with 90 degree rotation of the ball. Valve shall be capable of 2-way shutoff. Valve ball shall be constructed of stainless steel. For valves [50 mm](#) and larger, provide full bore type. Valves smaller than [50 mm](#) shall have one piece bodies and shall have a minimum bore not less than 55 percent of the internal cross sectional area of a pipe of the same nominal diameter. Balls shall be provided with trunnion type support bearings for valves [350 mm](#) and larger. Provide valves with worm gear operators, except valves [150 mm](#) and smaller may be lever operated with a minimum 10 adjustable positions between fully opened and fully closed. [Provide valves with body cavity drain and factory-installed drain valve.]

2.19.4 Globe Valve

Conform to [ASME B16.34](#), Class 150.

2.19.5 Plug Valve (PTFE Sleeved Tapered Type)

Valve must be the non-lubricated, PTFE sleeved tapered plug type that conforms to [API Spec 6D](#). Valve shall have 360 degree port defining lips to retain the sleeve against deforming into the flow passages. Valve shall provide abrasion protection and shall prevent fuel entry behind the sleeve. Plug shall operate with a 90 degree turn for closure. For valves installed in loop or distribution piping, provide valve body with a body cavity drain connection.

2.19.6 Pressure Relief

Provide plug valve with an automatic thermal relief valve(s) to relieve pressure buildup in the internal body cavity when the plug valve is closed. Relief valve shall open at a 172 kPa differential pressure, and discharge to the throat of and to the upstream side of the plug valve.

2.19.7 Bleed Valve

Provide a manually operated bleed valve for each plug valve in order to verify that the plug valve is not leaking when in the closed position. Provide discharge piping so that released liquid from each bleed valve can be contained.

2.19.8 Pressure Relief Valve

NOTE: Indicate on the drawings the operating pressure required for each valve. Require a sight flow indicator to be installed downstream of each relief valve.

Relief valves will typically be placed down stream of control valves to relieve the pressure buildup created when the control valve is closed. Relief valves are also used to relieve possible thermal expansion in a pipe line if no other provisions exist.

Valve shall be the fully enclosed, spring loaded, angle pattern, ball seated type with lift lever. Valve shall have corrosion-resistant valve seats. Valve stem shall be fully guided between the fully opened and fully closed positions. Valve shall be factory set to open at the indicated pressure (plus or minus ten percent deviation). Valve setpoint shall be field adjustable within a minimum range of plus or minus 20 percent of the indicated setpoint.

2.19.9 Pressure\Vacuum Relief Valve

NOTE: Provide the aboveground termination point of a storage tank's vent piping with either a pressure\vacuum relief valve or a vent cap. The decision on which item to use will be based upon the characteristics of the fuel to be handled (refer to NFPA 30, 30A, and UL 142 as applicable).

Indicate on the drawings the pressure and vacuum settings that each valve will be required to operate. A valve's typically operating pressure is 5.2 kPa. A valves's typical operating vacuum is 215 Pa.

Valve shall be the pressure\vacuum vent relief type that conforms to NFPA 30. Valve pressure and vacuum relief settings shall be set at the factory. Pressure and vacuum relief shall be provided by a single valve. Valve body shall be constructed of either cast steel or aluminum. Valve

trim shall be stainless steel. Inner valve pallet assemblies shall have a knife-edged drip ring around the periphery of the pallet to preclude condensation collection at the seats. Pallet seat inserts shall be of a material compatible with the fuel specified to be stored. Valve intake shall be covered with a 40 mesh stainless steel wire screen.

2.19.10 Foot Valve

NOTE: Foot valves are most commonly used in conjunction with small underground storage tanks and remote pumping systems (e.g., the pump is not located within the tank). The function of the valve is to hold prime in the suction line following a pump shutdown. Foot valves are typically located at the termination of the suction line within a tank.

Valve shall be the self-activating, double-poppet, shutoff type that prevents fuel flow from reversing. Valve shall conform to NFPA 30. Valve body shall be constructed of either cast steel or aluminum. Valve shall be provided with a minimum 20 mesh stainless steel screen on the intake. Valve seats shall be the replaceable type. Valve shall be capable of passing through a 75 mm pipe or tank flange.

2.19.11 Tank Overfill Prevention Valve

NOTE: Specify these valves only in combination with a gravity unloading system that feeds an underground storage tank. Do not specify these valves in combination with any type of unloading pump (including truck mounted pumps). Do not specify these valves in conjunction with aboveground storage tanks. For pressure filled tanks, refer to UFC 3-460-01 for guidance on overfill protection.

Valve shall be the two-stage, float-activated, shutoff type that is an integral part of the drop tube used for gravity filling. The first stage shall restrict the flow of fuel into the tank to approximately 0.3 L/s when the liquid level rises above 90 percent of tank capacity. The second stage shall completely stop the flow of fuel into the tank when the liquid level rises above 95 percent of tank capacity. Valve shall be constructed of the same material as the fill tube.

2.20 PUMPS

NOTE: Indicate the control sequences for pumps on the drawings.

Pumps shall be driven by an explosion-proof motor for Class I, Division 1, Group D hazardous locations as defined in NFPA 70. Pump assemblies shall be statically and dynamically balanced for all flow rates from no flow to 120 percent of design flow. Pump motors shall be non-overloading throughout their entire pump curve.

2.20.1 Submersible Pump

NOTE: Delete this paragraph if dispenser suction pumps are used in place of submersible pumps. Submersible pumps may be used for both above and belowground tanks. Check manufacturer's data since these type pumps may only be capable of handling gasoline or diesel fuels.

Pump shall be the [single-][multi-]stage, vertical type. Pump and motor combination shall operate totally submerged in the product of the storage tank. Pump shall extend within 150 mm of the storage tank bottom. Pump fuel inlets shall be horizontal. Pump mounting shall completely support both the weight and vibration of the pump. Pump shall include a steel lifting lug capable of supporting the weight of the entire pump and motor assembly. Pump shall include a vertical solid shaft motor, base mounting flange, horizontal pump discharge, low net positive suction head (NPSH) first stage impellers, and dynamic and thrust balancing of impellers. Pump shall be accessible for servicing without disturbing connecting piping. Pump baseplate, casing, and bearing housing shall be of cast iron construction. Pump shall be provided with a stainless steel one piece pump shaft. Internal pump components in direct contact with the fuel to be handled shall be of compatible construction. Pump bearings shall be selected to give a minimum L-10 rating life of 25,000 hours in continuous operation. Provide pump with [threaded][flanged] end piping connections.

2.20.2 Centrifugal Pump

NOTE: Appendix A of API Std 610 allows lesser tolerances for pumps. These type pumps are well suited for small applications at a substantial cost savings. The type of pumps specified should be evaluated by the designer.

Pump shall be the in-line, split-case, double suction, single stage, self-priming, centrifugal type. Pump motor shall be mounted horizontal to the pump housing and be provided with flanged end connections. Pump shall conform to API Std 610, [Appendix A,] except as modified herein. Mechanical seals within the pump shall be Buna-N or Viton. Pump casing, bearing housing, and impeller shall be [close grained cast iron] [stainless steel ASTM A743/A743M GR CF8M or GR CA6NM or aluminum ASTM A356/A356M GR T6]. Pump shaft shall be stainless steel ASTM A276/A276M Type 410 or 416. Pump baseplate shall be of cast iron construction. Internal pump components in direct contact with the fuel to be handled shall be of compatible construction. Pump bearings shall be selected to give a minimum L-10 rating life of 25,000 hours in continuous operation. Pump shall be accessible for servicing without disturbing connecting piping.

2.20.3 Rotary Pumps

NOTE: Specify rotary pumps for fuel oil applications, lubricating oil applications, etc. Maximum suction lift for rotary pump will not exceed

34 kPa.

Type I refers to electric motor driver. Type II refers to steam turbine driver. Style A refers to the pump shaft in the vertical position. Style B refers to the pump half in the horizontal position.

Pump shall conform to CID A-A-50561, Type [I] [II], Style [A] [B]. Mount pump and driver on extended base plate. Motor starters on pumps shall be lockable.

2.20.4 Pump Control Panel

Panel shall include on and off indication lights for each pump. Panel shall contain an adjustable control logic for pump operation in accordance with the indicated operation. Panel shall also have a manual override switch for each pump to allow for the activation or deactivation of each pump.

2.21 FRP CONTAINMENT SUMP

NOTE: FRP sumps will be used as a leak collection point in belowground secondarily contained piping systems. In this application, sumps will be used in combination with leak sensors to makeup the belowground pipe monitoring system.

Sumps may also be used at low drain points, high vent points, and at aboveground to belowground transitions. In addition, sumps may also be used to house belowground valves or equipment.

Indicate on the drawings the size, location, and depth required for each FRP containment sump.

Sump shall be constructed of fiberglass reinforced plastic (FRP) that is chemically compatible with the fuels to be handled. Do not connect sump in any way to the manway cover or concrete above. Cap the top of each containment sump with a [friction fit] [watertight] access cover. Construct cover of the same material as the sump. Cover shall have a minimum diameter of 550 mm. Cover shall be easily removable through the manway above.

- a. Rainfall drainage shall not drain into a sump. Sump shall be capable of withstanding underground burial loads to be encountered. Container shall have a minimum 19 L fuel storage capacity. Container shall not contain any type of drain.
- b. The sides of a containment sump shall allow the penetration of carrier pipes, exterior containment pipes, conduits, and vapor pipes as required. Boot or seal penetrations in the containment sump sides to ensure that liquid will not escape from the sump in the event that the liquid level within the sump rises above the pipe penetration. Provide boots and seals that are chemically compatible with the fuel to be handled and that are water resistant to the influx of ground water. Boots and seals shall be designed and installed to accommodate

the anticipated amount of thermal expansion and contraction in the piping system.

2.22 ACCESSORIES

2.22.1 Concrete Anchor Bolts

Concrete anchors shall conform to [ASTM A307](#), Grade C, hot-dipped galvanized.

2.22.2 Bolts and Studs

Carbon steel bolts and studs shall conform to [ASTM A307](#), Grade B, hot-dipped galvanized. Stainless steel bolts and studs shall conform to [ASTM A193/A193M](#), Class 2, Grade 8.

2.22.3 Nuts

Carbon steel nuts shall conform to [ASTM A563](#), Grade A, hex style, hot-dipped galvanized. Stainless steel nuts shall conform to [ASTM A194/A194M](#), Grade 8.

2.22.4 Washers

Provide flat circular washers under each bolt head and each nut. Washer materials shall be the same as the connecting bolt and nut. Carbon steel washers shall conform to [ASTM F844](#), hot-dipped galvanized. Stainless steel washers shall conform to [ASTM A194/A194M](#), Grade 8.

2.22.5 Polytetrafluoroethylene (PTFE) Tape

Tape shall conform to [ASTM D3308](#).

2.22.6 Pipe Sleeves

Provided sleeves constructed of [hot-dipped galvanized steel, ductile iron, or cast-iron pipe] [uncoated carbon steel pipe, conforming to [ASTM A53/A53M](#), [Schedule 30] [Schedule 20] [Standard weight]].

2.22.7 Buried Utility Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in minimum [75 mm](#) width rolls, color coded for the utility involved, with warning identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning identification shall be at least [25 mm](#) high and shall state as a minimum "BURIED JET FUEL PIPING BELOW". Provide permanent code and letter coloring that is unaffected by moisture and other substances contained in trench backfill material.

2.23 FINISHES

Ship, store, and handle coating materials as well as apply and cure coatings in accordance with [SSPC PA 1](#).

2.23.1 Exterior Coating, Direct Buried Piping

2.23.1.1 Factory Coating

Provide direct buried pipe and piping components with a factory-applied, adhesive undercoat and continuously extruded plastic resin coating in accordance with **NACE SP0185** or **AWWA C215**; minimum thickness of plastic resin shall be 36 mils for pipe sizes **150 mm** and larger.

2.23.1.2 Girth Welds

Coat girth welds using one of the following processes.

- a. Heat shrink sleeves in accordance with **AWWA C216**
- b. Wax tape coatings in accordance with **AWWA C217**
- c. Cold applied tape coatings in accordance with **AWWA C209**

2.23.1.3 Damaged Coatings

Repair damaged coating areas using one of the following processes.

- a. Wax tape coatings in accordance with **AWWA C217**
- b. Cold applied tape coatings in with **AWWA C209**

2.23.1.4 Rock Shield

NOTE: Specify rock shields where select fill is not available and the possibility of damage from rock fill exists. Delete this paragraph if not applicable.

Provide a minimum **10 mm** thick perforated rock shield around buried piping. Rock shield shall consist of a polyethylene outer surface bonded to a closed cell foam substrate with uniform perforations intended for use with cathodic protection systems. Rock shield shall overlap on itself no less than **150 mm**. Secure rock shield tightly to the pipe using either strapping tape or plastic ties. Air filled cell type rock shields are prohibited.

2.23.2 Exterior Coating, Aboveground Piping

NOTE: Piping identification as required by the using agency will be developed and inserted in either Section **09 97 13.27 or **09 90 00** as applicable.**

For Air Force Installations, piping will be color-coded in accordance with Attachment 4 of AFM 88-15.

Specify exterior, aboveground coatings per Section **09 97 13.27 if SSPC QP 1 contractor certification is required for any other coatings on the project. Specify Section **09 97 13.27** if more than 500 square**

feet of piping is to be coated. Section 09 90 00 may be specified for other situations. If Section 09 90 00 is specified, consider choosing the option for the contractor to be certified to SSPC QP 1, as certified contractors are likely to have more experience working around fuel facilities.

Coat the exterior of aboveground steel piping, flanges, fittings, nuts, bolts, washers, valves, and piping components, as defined in this specification, in accordance with [Section 09 97 13.27 EXTERIOR COATING OF STEEL STRUCTURES][Section 09 90 00 PAINTING, GENERAL].

2.23.3 New Equipment and Components

2.23.3.1 Factory Coating

NOTE: For all Navy projects (regardless of location), the 500 hour salt spray test is required and must be specified.

For Army projects, a salt spray test is optional. The 125 hour test is suggested for mild or noncorrosive environments. The 500 hour test is suggested for extremely corrosive environments.

Unless otherwise specified, provide equipment and components fabricated from ferrous metal with the manufacturer's standard factory finish. [Each factory finish shall withstand [125] [500] hours exposure to the salt spray test specified in ASTM B117. For test acceptance, the test specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 3 mm on either side of the scratch mark immediately after completion of the test.] For equipment and component surfaces subject to temperatures above 50 degrees C, the factory coating shall be appropriately designed for the temperature service.

2.23.3.2 Field Painting

NOTE: Specify exterior, aboveground coatings per Section 09 97 13.27 if SSPC QP 1 contractor certification is required for any other coatings on the project. If Section 09 90 00 is specified, consider choosing the option for the contractor to be certified to SSPC QP 1, as certified contractors are likely to have more experience working around fuel facilities.

Painting required for surfaces not otherwise specified shall be field painted as specified in [Section 09 97 13.27 EXTERIOR COATING OF STEEL STRUCTURES][Section 09 90 00 PAINTING, GENERAL]. Do not paint stainless steel and aluminum surfaces. Do not coat equipment or components provided with a complete factory coating. Prior to any field painting, clean surfaces to remove dust, dirt, rust, oil, and grease.

PART 3 EXECUTION

3.1 INSTALLATION

NOTE: During design, layout system components to allow adequate access for routine maintenance. Do not rely solely on the Contractor to make these judgments. Show access doors where applicable for maintenance.

Install work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Handle storage tanks with extreme care to prevent damage during placement and install in accordance with the manufacturer's installation instructions and NFPA 30, NFPA 30A, or NFPA 31 as applicable. Inspect the exterior surface of each tank for obvious visual damage prior to and during the placement of each storage tank. Repair surface damage to a storage tank according to manufacturer's requirements before proceeding with the system installation. Provide the termination of fill lines within a tank with an antisplash deflector. Provide nylon dielectric bushings on pipe connections to a steel tank.

Where anchors are required (either aboveground or underground), provide submittals for tank anchorage system materials and tank anchorage calculations.

3.1.1 Underground Storage Tank

Install underground storage tanks in accordance with API RP 1615 except as modified herein. Place tank on a 3 mm per 30 mm slope with the fill point at the low end and the vent connection at the high end. Locate tank so that the fuel discharge pipes slope up uniformly toward the fuel outlet. Install containment sumps prior to any backfill being added above the storage tanks.

3.1.1.1 Steel Underground Storage Tank Handling

Store, handle, and place externally coated steel tanks with care and in a manner that will minimize damage to the coating and will not reduce its protective value. Place coated tanks in position carefully and with a minimum of handling. Prior to backfilling a tank, visually inspect the tank exterior protective coating for damage. Repair any damaged tank coating in accordance with the appropriate UL or STI standard (UL 1746, STI 020-50-1000, or UL 58).

3.1.1.2 Steel Underground Storage Tank Installation Procedures

NOTE: Provide straps and anchors designed to prevent flotation of underground tanks located in areas with high groundwater level or subject to flooding. Provide electrical isolation strips between hold-down straps and metal tanks. Anchors may be concrete anchor slab under the tank or concrete deadmen. Tailor paragraph to suit design. Underground storage tanks occasionally rely on backfill and top slab to hold the tank in place in addition to the hold down straps and concrete

deadman. When new or existing USTs are exposed, the contractor must take steps to ensure the tank remains safely in place without damage. Manufacturer's suggestions for installation of new tanks must be followed (ballast added to the tank etc.) and used on existing tanks until the tank is safe from damage due to a sudden or slow influx of water. Existing hold down straps must be inspected to assure they are adequate for holding the tank in place and compromised hold downs reported to the Resident Engineer with a suggested solution. The recommendations of API 1615 must also be followed.

[Set tank on a minimum of 150 mm of backfill material.] [Anchor tank to a reinforced concrete anchor pad as indicated using manufacturer's supplied holddown straps. Separate tank from an anchor pad by a minimum of 300 mm of backfill material. Coat metal straps, turnbuckles, anchors, and accessories to resist corrosion.] Uniformly place backfill material around the entire tank and extend to grade level. Inspect tank cathodic protection anodes, if applicable, to ensure integrity during backfill operations.

3.1.1.3 FRP Underground Storage Tank Handling

Handle tank with extreme care to prevent damage during installation and transportation to the site. Any damaged tank must be replaced or repaired and tested under direct supervision and advice of the tank manufacturer, using the manufacturer's written procedures.

3.1.1.4 FRP Underground Storage Tank Installation Procedures

NOTE: Provide straps and anchors designed to prevent flotation of underground tanks located in areas with high groundwater levels or subject to flooding. Anchors may be a concrete anchor slab under the tank or concrete deadmen. Tailor paragraph to suit design. Underground storage tanks occasionally rely on backfill and top slab to hold the tank in place in addition to the hold down straps and concrete deadman. When new or existing USTs are exposed, the contractor must take steps to ensure the tank remains safely in place without damage. Manufacturer's suggestions for installation of new tanks must be followed (ballast added to the tank etc.) and used on existing tanks until the tank is safe from damage due to a sudden or slow influx of water. Existing hold down straps must be inspected to assure they are adequate for holding the tank in place and compromised hold downs reported to the Resident Engineer with a suggested solution. The recommendations of API 1615 must also be followed.

[Set tank on a minimum of 150 mm of backfill material.] [Anchor tank to a reinforced concrete anchor pad as indicated through the use of manufacturer's supplied holddown straps. Separate tank from an anchor pad

by a minimum of 300 mm of backfill material.]

3.1.2 Aboveground Storage Tank

Install aboveground storage tanks in accordance with STI 700-50-5007 (STI R912) except as modified herein. Place tank that is equal to or greater than 18,900 L on a 3 mm per 30 mm slope with the fill point at the low end and the vent connection and issue pump at the high end. [Place tank that is less than 18,900 L on a level surface.]

3.1.2.1 Steel Aboveground Storage Tank Handling

Store, handle, and place externally coated steel tanks with care and in a manner that will minimize damage to the coating and will not reduce its protective value. Place coated tanks in position carefully and with a minimum amount of handling. Repair any damaged tank coating in accordance with the appropriate UL or STI standard (UL 1746, STI 020-50-1000, or UL 58). Do not move the tank unless it is empty.

[3.1.2.1.1 Concrete Encased Aboveground Storage Tank Handling

Store, handle, and place concrete encased aboveground storage tanks with care and in a manner that will minimize damage to the tank. Place tanks in position carefully and with a minimum of handling. Do not move the tank unless it is empty.

]3.1.2.2 Steel Aboveground Tank Installation Procedures

**NOTE: Provide anchors designed to prevent flotation
of tanks located in areas subject to flooding and in
high seismic areas. Tailor paragraph to suit design.**

Tanks should be secured to the associated tank pad per tank manufacturer's recommendations using fasteners installed through the tank saddle base plate.

[3.1.2.2.1 Concrete Encased Aboveground Storage Tank Installation Procedures

**NOTE: Concrete encased tanks are not typically
anchored. Tailor paragraph to suit design.**

Concrete encased tanks do not need to be secured.

]3.1.3 System Components

Properly level, align, and secure system components in place in accordance with manufacturer's instructions. Provide supports for system components, appurtenances, and pipe as required. Install anchors, bolts, nuts, washers, and screws where required for securing the work in place. Sizes, types, and spacings of anchors and bolts not indicated or specified must be as required for proper installation.

3.2 PIPE AND PUMP INSTALLATION

NOTE: Show belowground valves, flanges, air vents and drains to be installed in a containment sump or manhole as required. Never require these items to be direct buried.

During design, layout equipment and components to allow adequate access for routine maintenance. Do not rely solely on the Contractor to make these judgments. Show access doors where applicable for maintenance.

Indicate all metal-to-FRP connection points on the drawings. Show flanged connections between FRP pipe and metal pipe with the metal pipe anchored within **1.5 m** of the connection. Metal-to-FRP connections should not be direct buried, but should be housed in a containment sump.

Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with **ASME B31.3** and **NFPA 30**, except as modified herein. Safety rules as specified in **NFPA 30** shall be strictly observed. Never direct bury threaded connections, socket welded connections, unions, flanges, valves, air vents, or drains. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.

3.2.1 Pumps

Properly level, align, and secure pumps in place in accordance with manufacturer's instructions. Support, anchor, and guide so that no strains are imposed on a pump by weight or thermal movement of piping. [Provide floor-mounted pumps with mechanical vibration isolators or a vibration isolation foundation.]

3.2.2 Piping

NOTE: For belowground piping, indicate on the drawings the minimum required piping slope for each piping run (suggest using **25 mm per 15 m**).

3.2.2.1 General

Thoroughly clean pipe of all scale and foreign matter before the piping is assembled. Cut pipe accurately to measurements established at the jobsite, and worked into place without springing or forcing. Cut pipe square and have burrs removed by reaming. Install pipe to permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval.

- a. Use reducing fittings for changes in pipe sizes. Install equipment and piping into space allotted and allow adequate acceptable

clearances for installation, replacement, entry, servicing, and maintenance. Provide electric isolation fittings between dissimilar metals. Install piping straight and true to bear evenly on supports. Piping shall be free of traps, shall not be embedded in concrete pavement, and shall drain as indicated. Make changes in direction with fittings, except that bending of pipe 100 mm and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted.

- b. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. When work is not in progress, securely close open ends of pipe and fittings with an expandable pipe plug so that water, earth, or other substances cannot enter the pipe or fittings. For belowground piping, the full length of each pipe shall rest solidly on the underlying pipe bed.

3.2.2.2 FRP Piping

Install FRP pipe in accordance with manufacturer's instructions.

3.2.2.3 Exterior Containment Piping System

Install exterior containment piping in accordance with manufacturer's instructions. Do not assemble joints in an exterior containment piping system until the successful completion of the tests defined in paragraph FIELD QUALITY CONTROLS.

3.2.2.4 Welded Connections

Unless otherwise indicated on the drawings, pipe joints shall be welded. Construct branch connections with welding tees or forged welding branch outlets. Do not weld stainless steel pipe to carbon steel pipe.

3.2.2.5 Threaded End Connections

NOTE: As stated previously, avoid threaded end connections if possible. Threaded end connections may be used in certain aboveground applications if specifically indicated on the drawings. As stated previously, never required a threaded end connection to be direct buried.

Provide threaded end connections only on piping 50 mm in nominal size or smaller and only where indicated on the drawings. Provide threaded connections with PTFE tape or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is tighten.

3.2.2.6 Brazed Connections

Provide brazing in accordance with AWS BRH, except as modified herein. During brazing, fill pipe and fittings with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, clean both the outside of the tube and the inside of the fitting with a wire fitting brush until the entire joint surface is bright

and clean. Do not use brazing flux. Remove surplus brazing material at all joints. Support piping prior to brazing and do not be spring or force piping.

3.2.2.7 Existing Piping Systems

NOTE: Delete this paragraph if connections to existing piping systems are not required. Indicate on the drawings the approximate location of each connection point between new and existing piping systems.

No interruptions or isolation of an existing fuel handling service or system shall be performed unless the actions are approved by the Contracting Officer. Perform initial cutting of existing fuel pipe with a multiwheel pipe cutter, using a nonflammable lubricant. After cut is made, seal interior of piping with a gas barrier plug. Purge interior of piping with carbon dioxide or nitrogen prior to performing any welding process.

3.2.3 Bolted Connections

For each bolted connection of stainless steel components (e.g., pipes, piping components, valves, and equipment) use stainless steel bolts or studs, nuts, and washers. For each bolted connection of carbon steel components, use carbon steel bolts or studs, nuts, and washers. Extend bolts, or studs, no less than two full threads beyond their corresponding nut when tightened to the required torque. Prior to installing nuts, apply a compatible anti-seize compound to the male threads.

3.2.4 Flanges and Unions

Except where threaded end connections and/or unions are indicated, provide flanged joints in each line immediately preceding the connection to a piece of equipment or material requiring maintenance such as pumps, general valves, control valves, strainers, and other similar items and as indicated. Assemble flanged joints square and tight with matched flanges, gaskets, and bolts. [Use flanged connections between FRP pipe and metal pipe with the metal pipe anchored within 1.5 m of the connection.] For flanges, provide washers under each bolt head and nut. Torque wrenches shall be used to tighten all flange bolts to the torque recommended by the gasket manufacturer. Tightening pattern shall be as recommended by the gasket manufacturer. Use anti-seize compound on threads for stainless steel bolts.

3.2.5 Flange Protectors

Provide flange protectors [on each electrically isolating flange connection][on each flanged end connection, including valves and equipment][where indicated on the drawings]. [Fill the flange cavity of electrically isolating flange connections with a corrosion inhibitor type grease.]

3.2.6 Valves

Install isolation plug or ball valves on each side of each piece of equipment, at the midpoint of looped mains, and at any other points

indicated or required for draining, isolating, or sectionalizing purpose. Install valves with stems vertically up unless otherwise indicated. Provide individual supports and anchors for each valve.

3.2.7 Air Vents

Provide [_____] [50 mm] air vents at all high points and where indicated to ensure adequate venting of the piping system.

3.2.8 Sight Flow Indicator

Mount indicator rolled one bolt hole to prevent freeze damage from rainwater accumulation on viewing window. Install a sight flow indicator downstream of each relief valve.

3.2.9 Drains

Provide [_____] [40 mm] drains at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.2.10 Flexible Pipe Connectors

NOTE: Flexible pipe connectors will be provided where required to absorb expansion and contraction, isolate vibration, absorb noise, compensate offset motion, absorb continuous flexing, and relieve equipment from piping stresses. Where flexible pipe connectors are needed to correct lateral, parallel, and angular misalignment, their use will be limited to maximum offset as recommended, in writing, by the manufacturer.

Attach connectors to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.

3.2.11 Thermometers

Provide thermometers with separable sockets. Install separable sockets in pipe lines in such a manner to sense the temperature of flowing fluid and minimize obstruction to flow.

3.2.12 Pipe Sleeves

Provide a pipe sleeve around any pipe that penetrates a wall, floor, or crosses under a roadway. Do not install sleeves in structural members except where indicated or approved. Install pipe sleeves in masonry structures at the time of the masonry construction. Sleeves shall be of such size as to provide a minimum of 12 mm all-around clearance between bare pipe and the sleeve. Align sleeve and piping such that the pipe is accurately centered within the sleeve by a nonconductive centering element. Securely anchor the sleeve to prevent dislocation. Closure of the space between the pipe and the pipe sleeve shall be by means of a

mechanically adjustable segmented elastomeric seal. The seal shall be installed so as to be flush. For wall or floor penetrations, extend each sleeve through its respective wall or floor and cut flush with each surface. For roadway crossings, pipe sleeves shall be continuous for the entire crossing as well as extend a minimum of 150 mm beyond both sides of the crossing. Seal around sleeves that penetrate through valve or fuel related pits with a Buna-N casing seal. Seal around sleeves that penetrate through non-fire-rated walls and floors in accordance with Section 07 92 00 JOINT SEALANTS. Seal around sleeves that penetrate through fire-rated walls and floors as specified in Section 07 84 00 FIRESTOPPING.

3.2.13 Escutcheons

Except for utility or equipment rooms, provide finished surfaces where exposed piping pass through floors, walls, or ceilings with escutcheons. Secure escutcheon to pipe or pipe covering.

3.2.14 Pumps

Properly level, align, and secure pumps in place in accordance with manufacturer's instructions. Support, anchor, and guide so that no strains are imposed on a pump by weight or thermal movement of piping. [Provide floor-mounted pumps with mechanical vibration isolators or a vibration isolation foundation.]

3.2.15 Access Panels

Provide access panels for all concealed valves, vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.2.16 Buried Utility Tape

Bury tape with the printed side up at a depth of 300 mm below the top surface of earth or the top surface of the subgrade under pavements.

3.2.17 Framed Instructions

Framed instructions shall include equipment layout, wiring and control diagrams, piping, valves, control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. Frame under glass or laminated plastic the framed instructions and post where directed by the Contracting Officer. Post the framed instructions before the system performance tests.

3.3 PIPE HANGERS AND SUPPORTS

Install hangers with a maximum spacing as defined in Table 1 below, except where indicated otherwise. In addition to meeting the requirements of Table 1, provide additional hangers and supports where concentrated piping loads exist (e.g., valves).

Table 1. Maximum Hanger Spacing									
Nominal Pipe Size (mm)	25 and Under	40	50	80	100	150	200	250	300
Maximum Hanger Spacing (m)	2	2.75	3	3.5	4.25	5	5.75	6.50	7

3.3.1 Seismic Requirements

NOTE: Include applicable seismic design requirements on the drawings. Delete this paragraph if there are no specific seismic design requirements.

Support and brace piping and attach valves to resist seismic loads as specified under Sections 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS and [23 05 48.19 [SEISMIC] BRACING FOR HVAC] and as shown on the drawings. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.3.2 Structural Attachments

Provide attachments to building structure concrete and masonry by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Apply inserts and anchors with a safety factor not less than 5. Do not attach supports to metal decking. Construct masonry anchors for overhead applications of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support shall be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.4 FIELD QUALITY CONTROL

3.4.1 Aboveground Storage Tank Tightness Tests

Perform tightness tests on each aboveground storage tank prior to making piping connections. Perform testing in accordance with STI 700-50-5007 (STI R912) except as modified herein. Gauges used to monitor the tests must have a scale with a maximum limit of 103 kPa. Repair leaks discovered during the tightness tests in accordance with tank manufacturer's instructions. Following any repair, re-test the tank until the tank successfully passes the testing requirements of this paragraph.

3.4.2 Underground Storage Tank Tightness Tests

NOTE: Pneumatic tests are the preferred type of

tightness tests. Brine level tests will only be specified for FRP tanks. Delete the inapplicable tests.

Perform a tightness test on each underground storage tank on-site just prior to their placement into the ground. Pneumatically pressurize each storage tank's primary chamber to 35 kPa and monitor for a drop in pressure over a 2-hour period during which there must be no drop in pressure in the tank greater than that allowed for thermal expansion and contraction. Following the successful completion of the primary chamber test, bleed the pressure from the primary chamber into the interstitial space. Maintain this pressure while applying soapsuds or equivalent material over the exterior of the tank. While applying the soapsuds, visually inspect the entire tank, including the bottom surfaces, for leaks (bubble formations). Inspection of the bottom surfaces of a tank may be performed by rotating the tank; however, a tank must only be rotated in strict accordance with the manufacturer's recommendations. Do not rotate a tank more than 90 degrees from the upright position. During testing, install a pressure relief device that relieves at the tank manufacturer's suggested pneumatic pressure limit. Gauges used in pneumatic tests must have a scale with a maximum limit of 103 kPa.

3.4.2.1 Brine Level Test

In lieu of the pneumatic testing procedures described above, a brine level test may be performed on the interstitial space of double-walled FRP tanks (not applicable to steel tanks). For a brine level test, completely fill a FRP tank's interstitial space with a brine solution. Connect a riser pipe to the interstitial space that will allow the solution to rise within the riser at least 300 mm. After filling the interstitial space, the tank must set approximately 3 hours. Following the 3-hour period, measure and record the level of solution within the riser. After a subsequent 4-hour period, again measure and record the level of solution within the riser. If the level of solution within the interstitial decreases anytime during the test, the tank is considered leaking and therefore fails the test.

3.4.2.2 Repairs

Repair leaks discovered in either the primary chamber or the interstitial space in accordance with the tank manufacturer's instructions. Following any tank repairs, re-test the tank until the tank successfully passes the testing requirements defined herein.

3.4.3 Tank Manufacturer's Tests

In addition to the tests required herein, perform any additional tests (i.e., leak tests, cathodic protection verification tests, etc.) on each storage test that is required by the tank manufacturer's written test procedures. Manufacturer's tests that are redundant to tests already required by this specification will only be performed once per tank. Repair all leaks discovered during the tests in accordance with manufacturer's instructions. Following tank repairs, re-test the tank until the tank successfully passes the manufacturer's testing requirements.

3.4.4 Pipe Tests

Furnish labor, materials, equipment, electricity, repairs, and retesting

necessary for any of the tests required herein. Perform piping test in accordance with the applicable requirements of ASME B31.3 except as modified herein. To facilitate the tests, various sections of the piping system may be isolated and tested separately. Where piping sections terminate at flanged valve points, close the line by means of blind flanges in lieu of relying on the valve. Provide tapped flanges to allow a direct connection between the piping and the air compressor and/or pressurizing pump. Use tapped flanges for gauge connections. Taps in the permanent line will not be permitted. Gauges will be subject to testing and approval. Provide provisions to prevent displacement of the piping during testing. Keep personnel clear of the piping during pneumatic testing. Only authorized personnel shall be permitted in the area during pneumatic and hydrostatic testing. Isolate equipment such as pumps, tanks and meters from the piping system during the testing. Do not exceed the pressure rating of any component in the piping system during the testing. Following satisfactory completion of each test, relieve the test pressure and seal the pipe immediately. Piping to be installed underground shall not receive field applied exterior coatings at the joints or be covered by backfill until the piping has passed the final pneumatic tests described herein.

3.4.4.1 Exterior Coating Holiday Test

Following installation, test the exterior coating of direct buried piping for holidays using high-voltage spark testing in accordance with NACE SP0188. Repair holidays and retest to confirm holiday-free coating. Text shall include all existing underground piping exposed for this project.

3.4.4.2 Preliminary Pneumatic Test

Apply a 170 kPa pneumatic test to product piping. Maintain the pressure while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, visually inspect the entire run of piping, including the bottom surfaces, for leaks (bubble formations). If leaks are discovered, repair the leaks accordingly and retest.

3.4.4.3 Final Pneumatic Test

Following the preliminary pneumatic test, apply a 345 kPa pneumatic test to all product piping and hold for a period not less than 2 hours. During the test period, there shall be no drop in pressure in the pipe greater than that allowed for thermal expansion and contraction. Disconnect the pressure source during the final test period. If leaks are discovered, repair the leaks accordingly and retest.

3.4.4.4 Hydrostatic Test

Hydrostatically test product piping with the fuel to be handled to the lesser of 1-1/2 times operating pressure or 1,896 kPa in accordance with API RP 1110. Maintain the pressure within the piping for 4 hours with no leakage or reduction in gauge pressure. If leaks are discovered, repair the leaks accordingly and retest.

3.4.4.5 Exterior Containment Piping Tests

NOTE: Delete this paragraph if exterior containment piping is not specified.

Apply a minimum pneumatic pressure of 35 kPa to the exterior containment piping. Maintain the pressure for at least 1 hour while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, visually inspect the entire run of piping, including the bottom surfaces, for leaks (bubble formations). Repair leaks discovered in accordance with manufacturer's instructions and retest. Perform testing in compliance with the manufacturer's published installation instructions.

3.4.5 System Commissioning

System commissioning must conform to [Section 33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT)] [Section 33 08 53 AVIATION FUEL DISTRIBUTION SYSTEM START-UP].

3.4.6 Tank Inspection Reports

**NOTE: Underground storage tanks must be inspected
in accordance with STI SP131.**

Prior to system commissioning, a STI SP001 certified inspector must inspect the completed [aboveground] [underground] tank in accordance with [STI SP001] [STI SP131] and deliver a full report to the Contracting Officer. The report must include a record of ultrasonic thickness measurements (UTMs), exclusive of the coating, of each single wall [aboveground] [underground] tank shell. The report must include the tank dataplate information and photograph of the tank data plate. Provide electronic copies of the tank inspection reports to Service Headquarters, Service Control Points, and DLA-Energy. The paper and electronic copies of the report and UTMs must be provided to the Contracting Officer for filing with the tank's "as-built drawings." Refer to Section 01 45 00 QUALITY CONTROL for STI SP001 Inspector's Certification requirements.

3.5 SYSTEM PERFORMANCE TESTS

**NOTE: If applicable, edit Section 33 08 55 to
include the following.**

- a. Verify vent piping is clear of debris and each pressure/vacuum relief vent is operating properly.
- b. Vapor recovery systems performs as designed.
- c. Dispensing units are operational and performs as designed.

Conform tests to Section 33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT).

3.6 DEMONSTRATIONS

Conduct a training session for designated Government personnel in the operation and maintenance procedures related to the system components and

systems specified herein. Include pertinent safety operational procedures in the session as well as physical demonstrations of the routine maintenance operations. Furnish instructors who are familiar with the installation/system components and systems, both operational and practical theories, and associated routine maintenance procedures. The training session must consist of a total of [_____] hours of normal working time and must start after the system is functionally completed, but prior to final system acceptance. Submit a letter, at least 14 working days prior to the proposed training date, scheduling a proposed date for conducting the onsite training.

3.7 Tank Fill Tests

Tank fill tests must not be performed until after the flushing, cleaning, and adjusting requirements defined in Section 33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT). For the tank fill tests, initially fill each storage tank with fuel in order to verify the tank level alarm system operates properly and the tank overfill protection device functions as designed. Stop filling each tank immediately once the overfill devices operates. Do not overfill any storage tank more than the 98 percent level. Drain the system below the low liquid level setpoint to verify operation of the low level alarm. Correct and retest any problems with the level alarm system or the overfill device until each operate as specified herein. During the tests, verify that all tank gauges are calibrated and operating appropriately.

3.8 FIELD PAINTING

Painting required for surfaces not otherwise specified must be field painted as specified in [Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES][Section 09 90 00 PAINTING, GENERAL]. Do not paint stainless steel and aluminum surfaces. Do not coat system components or components provided with a complete factory coating. Prior to any field painting, clean surfaces to remove dust, dirt, rust, oil, and grease.

-- End of Section --