UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2019
****

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 52 10

FUEL SYSTEMS PIPING (SERVICE STATION)

11/18

2.3.2 Flange Gaskets, Non-Electrically Isolating
2.3.3 Insulating Flange Kits, (Electrically Isolating)
2.3.4 Flange Protectors
2.3.5 Fuel Piping Flange Bolts, Nuts, and Washers
2.4 PIPE
2.4.1 Carbon Steel Pipe
2.4.2 Stainless Steel Pipe
2.4.2.1 Fittings 65 mm 2-1/2-inch and Larger
2.4.2.2 Fittings 50 mm 2-inch and Smaller
2.4.2.3 Control Tubing
2.4.2.4 Control Tubing Fittings
2.4.3 Flexible Non-Metallic Pipe
2.4.4 Double Wall Carbon Steel Piping
2.4.5 Steel Reinforced Flexible Pipe
2.4.5.1 Steel Reinforced Flexible Pipe Fittings
2.4.6 Copper Piping
2.4.6.1 Fittings and End Connections
2.4.6.2 Solder
2.4.6.3 Brazing Filler Metal
2.5 PIPING COMPONENTS
2.5.1 Welded Nipples
2.5.2 Steel Couplings
2.5.3 Threaded Unions
2.5.4 Joint Compound
2.5.5 Flexible Connector
2.5.6 Strainer
2.5.7 Thermometers
2.5.8 Pressure Gauge
2.5.9 Pipe Supports
2.5.9.1 Pipe Protection Shields
2.5.9.2 Low Friction Supports
2.5.10 Escutcheon
2.5.11 Flexible Ball Joint
2.5.12 Bellows Expansion Joint
2.5.13 Flow Meter
2.6 MANUAL VALVES
2.6.1 Ball Valves
2.6.1.1 Materials
2.6.1.2 V-Port Ball Valve
2.6.1.3 Electric Valve Actuator
2.6.2 Plug (Double Block and Bleed) Valves
2.6.2.1 Valve Operation
2.6.2.2 Integral Cavity Valves
2.6.2.3 Bleed Valves
2.6.2.4 Electric Valve Actuator
2.6.3 Swing Type Check Valves
2.6.4 Wafer Type Check Valve
2.6.5 Globe Valve
2.6.6 Thermal Relief Valve
2.6.6.1 Valve Materials
2.6.6.2 Thermal Relief Valve (ASME Type)
2.6.6.3 Thermal Relief Valve (Balanced Type)
2.6.7 Pressure\Vacuum Relief Valve
2.6.8 Foot Valve
2.6.9 Tank Overfill Prevention Valve (Gravity Fill)
2.6.10 Tank Overfill Prevention Valve (Pumped Fuel Receipt)
2.6.11 Anti-Siphon Valves
2.6.11.1 Solenoid Controlled Anti-Siphon Ball Valve
2.6.11.2 Anti-Siphon Valve

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEC / NASA | **UFGS-33 52 10 (November 2018)**

Preparing Activity: NAVFAC | **Superseding UFGS-33 52 10 (April 2008)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2019

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SECTION 33 52 10

FUEL SYSTEMS PIPING (SERVICE STATION)
11/18

****

NOTE: This guide specification covers the requirements of interior and exterior fuel piping and accessories for small, non-aviation fueling applications (i.e., gasoline fueling, diesel fueling, fuel oil systems) and service station type aviation fuel systems.

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: Use this UFGS in conjunction with UFC 3-460-01 "Design: Petroleum Fuel Facilities". Include in this specification any additional system components/devices necessary to meet state and local regulations.

Stage I vapor recovery is the process of recovering vapors when a storage tank is filled. Stage I vapor recovery is mandatory on all Army Facilities. Stage II vapor recovery is the process of recovering vapors during vehicle fueling operations. Stage II vapor recovery is optional and will be included if required by state and local clean air regulations.

The specification is written around ASME's standard Class 150 rating. For applications requiring higher pressure ratings (e.g., Class 300), the designer will have to modify this specification appropriately.

****

1.1 SUMMARY

This section defines the requirements for pipe, piping components, and valves as related to small fuel distribution systems (non-aviation type). Provide the entire fuel distribution system as a complete and fully operational system. Size, select, construct, and install system components to operate together as a complete system. Substitutions of functions specified herein will not be acceptable. Coordinate the work of the system manufacturer's service personnel during construction, testing, calibration, and acceptance of the system. Design system components and piping specified herein to handle a working pressure of 1900 kPa 275 psig at 38 deg C 100 deg F. System components specified herein must be compatible with the fuel to be handled. Components must be suitable for outside, unsheltered location, and to function normally in ambient temperatures between [_____] degrees C and [_____] degrees C [_____] degrees F and [_____] degrees F.

1.1.1 Related Sections

1.1.1.1 Welding

****

NOTE: Use Section 33 52 23.15 POL SERVICE PIPING WELDING to define all welding requirements for pressure piping. Edit Section 33 52 23.15 POL SERVICE PIPING WELDING around the requirements of ASME B31.3.

Within Section 33 52 23.15 POL SERVICE PIPING WELDING, require 100 percent radiographic testing on all underground steel piping as well as all piping downstream of pumps (See UFC 3-460-01). For all other piping, require random radiographic testing per ASME B31.3, Category M fluid service (20 percent).

****

Welding activities for pipe and piping components must be in accordance with Section 33 52 23.15 POL SERVICE PIPING WELDING.

1.1.1.2 Earthwork

****

NOTE: Require backfill for aluminum, stainless steel, or carbon steel pipe to be sand.

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.

Suggest horizontal sections of belowground piping be

installed with a minimum of 915 mm 36 inch of backfill between the top of the pipe and the ground surface.

****

Excavate and backfill piping as specified in [Section 31 00 00 EARTHWORK] [Section 31 23 00.00 20 EXCAVATION AND FILL].

1.1.1.3 Cathodic Protection

Provide buried metallic components including pipe, anchors, and conduit with a cathodic protection system as specified in [Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [Section 26 42 13.00 20 CATHODIC PROTECTION BY GALVANIC ANODES] [and] [Section 26 42 17.00 10 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)] [Section 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT]. Cathodic protection for metal components that attach to a tank must be coordinated and compatible with the tank corrosion control system.

1.1.1.4 Concrete Manholes

****

NOTE: The design of manholes including size, reinforcing, arrangement, penetrations, system components and piping within the valve manholes is the responsibility of the designer. Design manholes to provide proper venting and drainage and adequate room for maintenance without stepping on or over any piping/system components. When electric manhole sump pumps are used, the electrical distribution and tie in points must be designed and shown on the drawings.

Require in the referenced section below that concrete be 30 MPa 4000 psi minimum 28-day compressive strength, air-entrained admixture (133 grams per cubic meter 3.6 ounces per cubic yard), with water-reducing admixture (814 grams per cubic meter 22 ounces per cubic yard), reinforced with deformed steel bars. Require manhole sides to be constructed by one monolithic pour. Require cast-iron steps with nonslip surfaces, spaced 300 to 400 mm 12 to 16 inches on centers to be firmly embedded in the concrete walls for access to bottom of manholes.

Note that the interior walls of a typical concrete manhole are not fuel resistant. Fuel that is collected within a manhole will eventually, if not removed, wick through the concrete to the surrounding soil. Consider protecting the interior manhole walls with some type of fuel resistant coating.

****

Construct manhole of concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

1.2 REFERENCES

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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 PETROLEUM INSTITUTE (API)

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 2003	(2015; 8th Ed) Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents
API RP 540	(1999; R 2004) Electrical Installations in Petroleum Processing Plants
API STD 600	(2015) Steel Gate Valves-Flanged and Butt-welding Ends, Bolted Bonnets
API STD 608	(2012) Metal Ball Valves - Flanged, Threaded, And Welding End
API Spec 17J	(2016; Errata 2 2017; ADD 1 2017) Specification for Unbonded Flexible Pipe
API Spec 5L	(2018; 46th Ed; ERTA 2018) Line Pipe
API Spec 6D	(June 2018, 4th Ed; Errata 1 July 2018; Errata 2 August 2018) 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 607 (2016) Fire Test for Quarter-turn Valves and Valves Equipped with Non-metallic Seats

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C209 (2013) Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fitting for Steel Water Pipelines

AWWA C215 (2016) Extruded Polyolefin Coatings for Steel Water Pipe

AWWA C216 (2015) Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines

AWWA C217 (2016; Addenda 2017) Microcrystalline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe and Fittings

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding

AWS BRH (2007; 5th Ed) Brazing Handbook

ASME INTERNATIONAL (ASME)

ASME B1.1 (2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form)

ASME B16.11 (2016) Forged Fittings, Socket-Welding and Threaded

ASME B16.18 (2018) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21 (2016) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.22 (2013) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B16.26 (2013) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes

ASME B16.3 (2016) Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.34 (2017) Valves - Flanged, Threaded and Welding End

ASME B16.39	(2014) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B31.3	(2016) Process Piping
ASME B40.200	(2008; R 2013) Thermometers, Direct Reading and Remote Reading
ASME BPVC SEC VIII D1	(2017) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M	(2014) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A182/A182M	(2018) 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	(2017) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2018) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A234/A234M	(2018) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A240/A240M	(2018) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A269/A269M	(2015a) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A312/A312M	(2017) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A358/A358M	(2015) Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A403/A403M	(2018a) Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A436	(1984; R 2015) Standard Specification for Austenitic Gray Iron Castings
ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A733	(2016) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B117	(2016) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B247	(2015) Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B687	(1999; R 2016) Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
ASTM B75/B75M	(2011) Standard Specification for Seamless Copper Tube
ASTM B813	(2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B88	(2016) Standard Specification for Seamless

	Copper Water Tube
ASTM B88M	(2018) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM D229	(2013) Rigid Sheet and Plate Materials Used for Electrical Insulation
ASTM D3308	(2012; R 2017) PStandard Specification for TFE Resin Skived Tape
ASTM F1172	(1988; R 2015; E 2015) Standard Specification for Fuel Oil Meters of the Volumetric Positive Displacement Type
ASTM F436	(2011) Hardened Steel Washers
ASTM F844	(2007a; R 2013) Washers, Steel, Plain (Flat), Unhardened for General Use

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1100	(2005) Emerald Book IEEE Recommended Practice for Powering and Grounding Electronic Equipment
IEEE 142	(2007; Errata 2014) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

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

MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NACE INTERNATIONAL (NACE)

NACE SP0185	(2007) Extruded Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe
NACE SP0188	(1999; R 2006) Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(2018) Flammable and Combustible Liquids Code
NFPA 407	(2017) Standard for Aircraft Fuel Servicing
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2;

	TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17) National Electrical Code
NFPA 77	(2014) Recommended Practice on Static Electricity
NFPA 780	(2017) Standard for the Installation of Lightning Protection Systems

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2016) 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

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-13789	(1999; Rev E; Notice 1 2008; Notice 2 1016) Strainers, Sediment: Pipeline, Basket Type

UNDERWRITERS LABORATORIES (UL)

UL 971	(1995; Reprint Mar 2006) UL Standard for Safety Nonmetallic Underground Piping for Flammable Liquids

1.3 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident

Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" following a submittal item indicates that the submittal is required for the Sustainability eNotebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING. Locate the "S" submittal under the SD number that best describes the submittal item.

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

****

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

SD-02 Shop Drawings

Grounding and Bonding

Pipe Supports

SD-03 Product Data

Insulating Flange Kits; G[, [_____]]

Flange Protectors; G[, [_____]]

Fuel Piping Flange Bolts, Nuts, and Washers; G[, [_____]]

Carbon Steel Pipe; G[, [_____]]

Stainless Steel Pipe; G[, [_____]]

Flexible Non-Metallic Pipe; G[, [_____]]

Double Wall Carbon Steel Piping; G[, [_____]]

Steel Reinforced Flexible Pipe; G[, [_____]]

Copper Piping; G[, [_____]]

Joint Compound; G[, [_____]]

Flexible Connector; G[, [_____]]

Strainer; G[, [_____]]

Thermometers; G[, [_____]]

Pressure Gauge; G[, [_____]]

Flexible Ball Joint; G[, [_____]]

Bellows Expansion Joint; G[, [_____]]

Flow Meter; G[, [_____]]

Ball Valves; G[, [_____]]

Plug (Double Block and Bleed) Valves; G[, [_____]]

Swing Type Check Valves; G[, [_____]]

Wafer Type Check Valve; G[, [_____]]

Globe Valve; G[, [_____]]

Thermal Relief Valve; G[, [_____]]

Pressure\Vacuum Relief Valve; G[, [_____]]

Foot Valve; G[, [_____]]

Tank Overfill Prevention Valve (Gravity Fill); G[, [_____]]

Tank Overfill Prevention Valve (Pumped Fuel Receipt); G[, [_____]]

Anti-Siphon Valves; G[, [_____]]

Submersible Pump; G[, [_____]]

ANSI Type Centrifugal Pump; G[, [_____]]

Sliding Vane Rotary Pump; G[, [_____]]

Self-Priming Centrifugal Pump; G[, [_____]]

Pump Control Panel; G[, [_____]]

FRP Containment Sump; G[, [_____]]

Pipeline Markers; G[, [_____]]

SD-06 Test Reports

Exterior Coating Holiday Test

Preliminary Pneumatic Test

Final Pneumatic Test

Hydrostatic Test

Exterior Containment Piping Tests

SD-07 Certificates

Contractor Qualifications; G[, [_____]]

Licensed Personnel

Stage II Vapor Recovery System

Pipeline Inventory; G[, [_____]]

Demonstrations

SD-08 Manufacturer's Instructions

Flexible Ball Joint

Bellows Expansion Joint

SD-10 Operation and Maintenance Data

Insulating Flange Kits; G[, [_____]]

Flange Protectors; G[, [_____]]

Strainer; G[, [_____]]

Thermometers; G[, [_____]]

Flexible Ball Joint; G[, [_____]]

Bellows Expansion Joint; G[, [_____]]

Flow Meter; G[, [_____]]

Ball Valves; G[, [_____]]

Plug (Double Block and Bleed) Valves; G[, [_____]]

Swing Type Check Valves; G[, [_____]]

Wafer Type Check Valve; G[, [_____]]

Globe Valve; G[, [_____]]

Thermal Relief Valve; G[, [_____]]

Pressure\Vacuum Relief Valve; G[, [_____]]

Foot Valve; G[, [_____]]

Tank Overfill Prevention Valve (Gravity Fill); G[, [_____]]

Tank Overfill Prevention Valve (Pumped Fuel Receipt); G[, [_____]]

Anti-Siphon Valves; G[, [_____]]

Submersible Pump; G[, [_____]]

ANSI Type Centrifugal Pump; G[, [_____]]

Sliding Vane Rotary Pump; G[, [_____]]

Self-Priming Centrifugal Pump; G[, [_____]]

Pump Control Panel; G[, [_____]]

1.4 QUALITY ASSURANCE

1.4.1 Contractor Qualifications

****
NOTE: Include any state or local regulatory requirements or certification that must be met by the Contractor.
****

Each installation Contractor must have successfully completed at least 3 projects of the same scope and the same size, or larger, within the last 6-years; demonstrate specific installation experience in regard to the specific system installation to be performed; have taken, if applicable, manufacturer's training courses on the installation of piping; and meet the licensing requirements in the state. 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 Licensed Personnel

Pipe installers must be licensed/certified when the state, city or locality requires licensed installers.

1.4.2.2 Stage II Vapor Recovery System

****
NOTE: Delete this paragraph if stage II vapor recovery is not specified.
****

System must meet the air quality laws of the State of [_____] as well as applicable local regulations. Submit certification of the stage II vapor recovery systems from the California Air Resources Board (CARB). Test and validate the recovery system to be 95 percent efficient in controlling VOC emissions during refueling of motor vehicles.

1.4.3 Design Data

1.4.3.1 Pipeline Inventory

Fuel system volume must be calculated using as constructed pipe lengths, internal diameters, fittings, and components. Totals must be provided for all items containing fuel with the exception of tanks which is covered by other specifications. A certified pipeline inventory with sizes, lengths, quantity, and volumes must be provided for the systems in this project.

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. Replace damaged or defective items.

1.6 PROJECT/SITE CONDITIONS

Fuel required for the testing, flushing and cleaning efforts, as specified in this section, will be provided and delivered by the Contracting Officer. Fuel used in the system will remain the property of the Government. Fuel shortages not attributable to normal handling losses must be reimbursed to the Government.

PART 2 PRODUCTS

2.1 ELECTRICAL WORK

****

NOTE: Show electrical characteristics on the drawings.

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 system components. Coordinate the area classification and the electrical design with UFC 3-460-01.

Coordinate piping, valve, system components and other systems bonding and grounding requirements with UFC 3-460-01. Include also in the design a bonding and grounding plan to relieve and control static electricity buildup as described in UFC 3-460-01.

****

2.1.1 General

Motors, manual or automatic motor control system components except where installed in motor control centers, and protective or signal devices required for the operation specified herein must be provided under this section in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Any wiring required for the operation specified herein, but not shown on the electrical plans, must be provided under this section in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM[, Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION][, Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION].

2.1.2 Grounding and Bonding

Ground and bond in accordance with NFPA 70, NFPA 77, NFPA 407, 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.

2.2 MATERIALS AND SYSTEM COMPONENTS

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 bearing alloys. Do not install cast iron bodied valves in piping systems that could be exposed to fuel during system operation.

2.2.1 Standard Products

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; and that have been in satisfactory commercial or industrial use for a minimum 2-years prior to bid opening. The 2-year period must include applications of the system components and materials under similar circumstances and of similar size. Materials and system components must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.[Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours, exclusive of the manufacturer's factory tests, can be shown.]

2.2.2 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, thermometers, gauges, and valves 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 0.125 inch 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 1 by 2.5 inches. Lettering must be the normal block style with a minimum 6 mm 0.25 inch 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.]

2.2.3 Gaskets

ASME B16.21, composition ring, using a Buna-N, polytetrafluoroethylene (PTFE), or a protein and glycerin binder, 3.175 mm 0.1250-inch thick. Gaskets must be resistant to the effects of aviation and non-aviation hydrocarbon fuels and manufactured of fire-resistant materials. Full-face gaskets must be used for flat-face flanged joints. Ring gaskets must be used for raised-face flanged joints. Gaskets must be of one piece factory cut material.

2.2.3.1 Nitrile Butadiene (Buna-N)

Provide Buna-N material that conforms to SAE AMS3275.

2.2.3.2 Acrylonitrile Butadiene Rubber (NBR)

Provide NBR material that conforms to SAE AMS3275.

2.3 FLANGED END CONNECTIONS

2.3.1 Flanges

Provide flanged end connections on system components, fittings, piping, piping components, adapters, couplers,and valves that conform to ASME B16.5, Class 150.

2.3.1.1 Carbon Steel

Carbon steel flanges must conform to ASTM A105/A105M.

2.3.1.2 Stainless Steel

Stainless steel flanges must conform to ASTM A182/A182M, Grade F304, forged type.

2.3.1.3 Aluminum

Aluminum flanges must conform to ASTM B247, Alloy 6061-T6.

2.3.2 Flange Gaskets, Non-Electrically Isolating

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

2.3.3 Insulating Flange Kits, (Electrically Isolating)

****

NOTE: Use in the following locations to avoid affecting the underground piping cathodic protection system:

a. Where piping transitions from aboveground to underground;

b. Below drain and vent valves in underground pits and valve vaults;

c. On both sides of motorized valves in underground

valve vaults.

Provide weatherproof lightning surge arrester around insulating flange kits where piping transitions from aboveground to underground.

These gaskets are often installed to prevent corrosion between two flanges constructed of dissimilar metals such as carbon steel and stainless steel. Experience in even extremely corrosive marine environments shows them to be of little use in preventing flange to flange corrosion; the corrosion in those cases are usually the flange face and/or fasteners corroding to themselves. Before using to prevent flange to flange corrosion, contact Base personnel and try and determine what kind of corrosion they have and how severe it is.

Provide flange protectors where indicated and at cathodic protection insulating flanges.

****

Provide ASTM D229 electrical insulating material of 1,000 ohms minimum resistance; material must be resistant to the effects of aviation and non-aviation hydrocarbon fuels. Provide full face insulating gaskets between flanges with fluoroelastomer (FKM), commonly referred to as Viton, O-ring sealing surfaces. Provide full surface 0.76 mm 0.03-inch thick wall thickness, spiral-wound mylar insulating sleeves between the bolts and the holes in flanges; bolts may have reduced shanks of a diameter not less than the diameter at the root of threads. Provide 3.18 mm 0.125-inch thick high-strength phenolic insulating washers next to flanges and provide flat circular stainless steel washers over insulating washers and under bolt heads and nuts. Provide bolts 12 mm 0.5-inch longer than standard length to compensate for the thicker insulating gaskets and the washers under bolt heads and nuts. Above grade flanges separated by electrically insulating flange kits must be provided with weatherproof lightning surge arrester devices. The surge arrester must bolt across flanges separated by insulating gasket kits per detail on contract drawings. Provide with flange protector as described in this section. The arrestor must have the following features:

a. Weatherproof NEMA 6P enclosure.

b. Bidirectional and bipolar protection.

c. Constructed of solid state components, no lights, fuses or relays and used without required maintenance or replacement.

d. Withstand unlimited number of surges at 50,000 Amperes.

e. Maximum clamping voltage of 700 Volts based on a IEEE C62.41.2 8x20 microsecond wave form at 50,000 Amperes peak measured at the device terminals (zero lead length).

f. A UL listed arrester for installation in Class 1, Division 1 or Class 1, Division 2, Group D, hazardous areas.

Install the mounting bracket and leads on the flange side of the bolt insulating sleeve and washer, and size in accordance with this schedule:

Line Size	Bolt Size
50.8 mm 2 inch	16 mm 5/8 inch
63.5 mm 2.5 inch	16 mm 5/8 inch
76 mm 3 inch	16 mm 5/8 inch
102 mm 4 inch	16 mm 5/8 inch
152 mm 6 inch	19 mm 3/4 inch
203 mm 8 inch	19 mm 3/4 inch
254 mm 10 inch	22 mm 7/8 inch
305 mm 12 inch	22 mm 7/8 inch
356 mm 14 inch	25 mm 1 inch
406 mm 16 inch	25 mm 1 inch
Note: Make allowance for the 0.79 mm 1/32-inch thickness of the insulating sleeve around the bolts when sizing the mounting lugs.	

2.3.4 Flange Protectors

****

NOTE: Provide flange protectors at all cathodic protection insulating flanges to prevent from shorting out due to debris collecting in/on flange. Use stainless steel flange protector bands. Caution should be used when installing stainless steel bands to avoid "grounding out" the insulating flanges.

Use in tropics and waterfront locations for all size flanges to minimize/prevent water migration between the flange faces and prevent corrosion.

****

Protectors must protect the bolts, studs, nuts, and gaskets of a flanged end connection from corrosion or damage due to exposure to the environment. Protectors must be weather and ultraviolet (UV) resistant and constructed with stainless steel bands and rubber lining. Protectors must allow for quick and easy removal and re-installation by maintenance personnel. Provide grease filled bolt caps. Corrosion Prevention grease must be non-expansive and designed for the service.[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.]

2.3.5 Fuel Piping Flange Bolts, Nuts, and Washers

a. Bolts and nuts for pipe flanges, flanged fittings, valves and

accessories must conform to ASME B18.2.1 and ASME B18.2.2, except as otherwise specified.

b. Bolts must be of sufficient length to obtain full bearing on the nuts and must project no more than three full threads and no less than two full threads beyond the nuts with the bolts tightened to the required torque.

c. Bolts must be regular hexagonal bolts conforming to ASME B18.2.1 with material conforming to ASTM A193/A193M, Class 2, Grade B8, stainless steel, when connections are made where a stainless steel flange is involved, and Grade B7, chromium molybdenum alloy, when only carbon steel flanges are involved. Bolts and nuts chosen must have sufficient strength to seat gasket types chosen. Bolts must be threaded in accordance with ASME B1.1, Class 2A fit, Coarse Thread Series, for sizes one inch and smaller and Eight-Pitch Thread Series for sizes larger than one inch.

d. Nuts must conform to ASME B18.2.2, hexagonal, heavy series with material conforming to ASTM A194/A194M, Grade 8, stainless steel for stainless steel bolts, and Grade 7, chromium molybdenum allow for chromium molybdenum alloy bolts. Nuts must be threaded in accordance with ASME B1.1, Class 2B fit, Coarse Thread Series for sizes one inch and smaller and Eight-Pitch Thread Series for sizes larger than one inch.

e. Provide washers under bolt heads and nuts. Use chromium molybdenum alloy washers dimensioned to ASTM F436 flat circular for chromium molybdenum bolts. Stainless steel washer dimensioned similar to ASTM A436 flat circular, use material the same as the bolt.

f. Use torque wrenches to tighten all flange bolts to the torque recommended by the gasket manufacturer. Tighten in the pattern recommended by the gasket manufacturer. Use anti-seize compound on stainless steel bolts.

2.4 PIPE

****

NOTE: Indicate on the drawings all piping configurations, slopes, sizes, and piping materials (i.e. carbon steel, stainless steel, or double walled flexible piping) 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 must meet the material, fabrication and operating requirements of ASME B31.3, except as modified herein.

2.4.1 Carbon Steel Pipe

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

a. Pipe must conform to ASTM A53/A53M, Type E or S, Grade B, seamless or electric welded. Pipe smaller than 65 mm 2-1/2 inches must be Schedule 80. Pipe 65 mm 2-1/2 inches and larger must be Schedule 40.

b. Pipe must 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 2-1/2 inches must 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 2-1/2 inches and larger must be buttweld 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.]

2.4.2 Stainless Steel Pipe

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

a. Pipe must conform to ASTM A312/A312M, Type TP304L, seamless only. Pipe smaller than 200 mm 8 inches must be Schedule 40S. Pipe 200 mm 8 inches or larger must be Schedule 10S.

b. Pipe must 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 must be 6 mm 0.25 inch for pipe 300 mm 12 inches and smaller; 8 mm 0.312 inch for pipe larger than 300 mm 12 inches.

2.4.2.1 Fittings 65 mm 2-1/2-inch and Larger

Provide buttwelded 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.

2.4.2.2 Fittings 50 mm 2-inch and Smaller

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

2.4.2.3 Control Tubing

Piping must 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) 1/2-inch tubing, provide a minimum 1.3 mm (0.049 in) 0.049 inch tubing wall thickness.

2.4.2.4 Control Tubing Fittings

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

2.4.3 Flexible Non-Metallic Pipe

****
NOTE: Standard commercial service station piping used for a flowrate of 100 GPM or less.
****

Piping must conform to UL 971. Piping must be installed in manufacturers supplied corrugated, flexible, access piping. Size is limited to 76.2 mm 3-inch diameter or less. For piping larger than 76.2 mm 3 inches use the carbon steel piping system described in Section 33 52 40 FUEL SYSTEMS PIPING (NON-HYDRANT).

2.4.4 Double Wall Carbon Steel Piping

****
NOTE: Use this piping for a flowrate of greater than 100 GPM and if required by State or Local regulations.
****

Piping system must be of pre-engineered double-wall construction with both the internal pipe (primary product pipe) and the exterior pipe (containment pipe) of carbon steel. The exterior containment piping must allow for complete inspection of the primary piping before the exterior piping is sealed. The exterior piping for the secondary containment system for underground piping must be:

a. Pipe material must be carbon steel as specified.

b. Capable of withstanding a minimum 5 psi 35 kPa air pressure.

c. Evenly separated from the primary pipe using pipe spacers which are designed based on pipe size, pipe and fuel weight, and operating conditions. The supports must be constructed of non-metallic and non-conductive material and must be designed so that no point loading occurs on the primary or exterior pipe. The exterior piping and supports must allow for the installation of any necessary leak detection equipment or cables.

d. Externally coat primary product pipe and containment pipe as specified in Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEMS.

[2.4.5 Steel Reinforced Flexible Pipe

****
NOTE: Service Headquarters must approve use of HDPE steel reinforced flexible pipe. Do not use HDPE steel reinforced flexible pipe aboveground. Use this piping for a flowrate of greater than 100 GPM only.

The use of steel reinforced flexible pipe in lieu of traditional double-walled underground piping on projects in states that require double-walled underground piping needs to be coordinated between the system designer and the state agency that regulates underground piping. The test protocol to be used for testing the integrity of steel reinforced flexible pipe will need to be provided by the piping supplier and be accepted by the state regulatory agency as equivalent to the traditional double-walled underground piping test protocol required by that agency.

****

Steel Reinforced High Density Polyethylene (HDPE) flexible piping must be manufactured in accordance with API Spec 17J and consist of an inner layer of HDPE material, a steel reinforcing layer and an outer HDPE protective layer.

2.4.5.1 Steel Reinforced Flexible Pipe Fittings

End connections and mid-line connections for steel reinforced high density polyethylene (HDPE) flexible pipe must be of stainless steel swaged onto the pipe ends.

End connections must terminate in flanged end or weld ends as indicated. Mid-line connections must terminate in flanged fittings if they are in a pit or double swage type if they are not.

]2.4.6 Copper Piping

****

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

****

Pipe and tubing must conform to ASTM B88M ASTM B88, Type K or L.

2.4.6.1 Fittings and End Connections

Wrought copper and bronze solder-joint pressure fittings must conform to ASME B16.22 and ASTM B75/B75M. Cast copper alloy solder-joint pressure fittings must conform to ASME B16.18. Cast copper alloy fittings for flared copper tube must 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 system components. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

2.4.6.2 Solder

Solder must conform to ASTM B32, grade Sb5, tin-antimony alloy for service pressures up to 1034 kPa 150 psig. Solder flux must be liquid or paste form, non-corrosive and conform to ASTM B813.

2.4.6.3 Brazing Filler Metal

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

2.5 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 must be Class 150 as defined in ASME B16.5.

2.5.1 Welded Nipples

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

2.5.2 Steel Couplings

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

2.5.3 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 2 inches or less in size.

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

****

Unions must conform to ASME B16.39, Class 150. Unions materials must conform to ASTM A312/A312M, Grade 304 or 316. Dielectric unions must conform to dimensional, strength, and pressure requirements of ASME B16.39, Class 150. Steel parts must be galvanized or plated. Union must 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 must be able to withstand a 600-volt breakdown test.

2.5.4 Joint Compound

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

2.5.5 Flexible Connector

****

NOTE: Identify on the drawings the nominal pipe size and required length for each flexible pipe connector. Connectors smaller than 65 mm 2-1/2 inches are typically not available with flanged end connections. If small connectors are required, specifically indicated the location of the threaded

connections on the drawings.
****

Flexible connectors for fueling pumps must have ANSI Class 300 or 150 flanges to mate directly to the pump and Class 150 flanges to the system flanges. Flanges must be stainless steel and must conform to ASME B16.5. These units must have an inner stainless steel or Inconel, corrugated tube with external stainless steel braid, and all components must be rated for not less than 275 psig @ 100°F. Face by Face dimension must be as recommended by the manufacturer. Use Inconel 625 inner bellows in coastal environments or where chlorides are present in the atmosphere.

For sizes larger than 152 mm 6 inches, connectors must incorporate the use of Lo-corr, multi-ply bellows, without external braid, with bellows rating of 300 psig and overall rating consistent with the flange ANSI class. Flanges must be plate type, Vanstone design, with axial movement control rods.

Fabricate piping to measurements established on the project site and position into place without springing or forcing. Make provisions for absorbing expansion and contraction without undue stress in any part of the system. The use of flexible connectors in permanently mounted pump suction and discharge lines as a method of compensating for piping misalignment is not acceptable.

2.5.6 Strainer

****
NOTE: Duplex strainers have at least two 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 must be single, basket type, arranged in a [simplex] [duplex] configuration as indicated in compliance with MIL-PRF-13789, except as specified otherwise. Strainer end connections must be designed in accordance with ASME B16.5, Class 150. Strainer body material must be the same as the material specified for manual valves. Strainers must have removable baskets of [7][40][60][100][_____] mesh wire screen with larger wire mesh reinforcement; wire must be stainless steel, Type 316. Pressure drop for clean strainer must not exceed 3 psig at maximum design flow rate. The ratio of net effective strainer area to the area of the connecting pipe must be not less than three to one. Each strainer must be provided with a suitable drain at the bottom, equipped with a ball valve. The strainer must be equipped with a direct-reading, piston type differential pressure gauge that measures the differential pressure across the basket as per Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

2.5.7 Thermometers

****
NOTE: Used for Burner Fuel Oils and Lubricating Oils that require heating before pumping. Indicate the scale range for each thermometer on the drawings.
****

Analog, dial-type bimetallic actuated type that conforms to ASME B40.200.

Thermometer must have a 125 mm 5 inch 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 must be within one percent of the scale range.

2.5.8 Pressure Gauge

See Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

2.5.9 Pipe Supports

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

Supports must 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.

2.5.9.1 Pipe Protection Shields

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

2.5.9.2 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 must be 0.06 from initial installation for both vertical and horizontal loads and deformation must not exceed 51 micrometers 0.002 inch under allowable static loads. Bonds between material and steel must 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 0.09 inch thick. Provide hot-dipped galvanized steel supports. Provide supports that are factory designed and manufactured.

2.5.10 Escutcheon

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

2.5.11 Flexible Ball Joint

****
NOTE: Indicate the location and details of each pipe expansion joint, amount of pipe movement, and pipe anchors on the drawings.
****

Flexible ball joints must be [stainless steel] [carbon steel with electroless nickel-plating to a minimum of 3 mils thickness], capable of 360-degree rotation plus 15-degree angular flex movement, ASME B16.5, Class 150 flanged end connections. Provide either pressure molded composition, PEEK, or polytetrafluoroethylene (PTFM) gaskets designed for continuous operation temperature of 275 degrees F. Joints must be designed for minimum working pressure of ANSI Class 150. Injectable packing will not be allowed.

2.5.12 Bellows Expansion Joint

****

NOTE: Indicate the location and details of each pipe expansion joint, amount of pipe movement, and pipe anchors on the drawings.

Where joints are to be installed on piers or anywhere in direct contact with salt water is a possibility, then require the bellows to be constructed of inconel.

****

The expansion joints must be for axial compression and extension with capacity as per the design documents. Units must be[of the externally pressurized design with internal and external integral guides, and] manufactured by an Expansion Joint Manufacturers Association certified manufacturer. They must incorporate multi-ply, Lo-corr bellows of [ASTM A240/A240M 321-304 stainless steel][Inconel 625] if chlorides are present in the atmosphere. Unit must be equipped with travel limit stops, and internal guides vented to reduce the effects of sudden pressure changes. Flanges and housing must be stainless steel or carbon steel to match piping materials. Flanges must conform to ASME B16.5. Dual Expansion Joints must incorporate an intermediate anchor base. Housing must include lifting lug and drain port. Joints must be capable of 10,000 cycles over a period of 20-years.

Cold set joints to compensate for the temperature at the time of installation. Provide initial alignment guides on the connecting piping no more than 4 pipe diameters from the expansion joint. Provide additional alignment guides on the connecting piping no more than 14 pipe diameters from the first guide.

2.5.13 Flow Meter

****

NOTE: Flow 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 that conforms to ASTM F1172, except as modified herein. Meter must indicate the fuel oil flow rate in L/s gpm. Meter must be provided with overspeed protection and a water escape hole. If meter is not mounted in-line with the piping, then an appropriate pedestal for mounting must be provided. Install meter in accordance with manufacturer's recommendations. Meter must be capable of providing a 4-20 mA analog output signal for the fuel flow rate.[The

output signals must be compatible with the base's existing Energy Monitoring and Control, System (EMCS).]

2.6 MANUAL VALVES

****

NOTE: Per Service Headquarters or officially designated alternate for marine environment, provide stainless steel valves on exterior (aboveground and in pits) piping.

****

All portions of a valve coming in contact with fuel must be of noncorrosive material. Valves in stainless steel pipe lines or epoxy lined carbon steel pipe lines must be Type 304 or Type 316 stainless steel or carbon steel internally plated with chromium or nickel or internally electroless nickel plated. Valves in unlined carbon steel pipelines must have carbon steel body. Stem and trim must be stainless steel for all valves. Manually operated valves 150 mm 6 inches and larger must be worm-gear operated and valves smaller than 150 mm 6 inches must be lever operated or handwheel operated. Valves smaller than 50 mm 2 inches must have lever-type handles. Handles installed more than 1.5 m 6 feet above finished floor must have chain operators. Valve indicators installed higher than 5 feet must have a position indicator visible from ground level. Sprocket wheel for chain operator must be aluminum.

2.6.1 Ball Valves

Ball valves must be fire tested and qualified in accordance with the requirements of API Std 607 and API STD 608. Seal material for the fire test must be graphite, seal material for the project must be as indicated below. Ball valves must be nonlubricated valves that operate from fully open to fully closed with 90 degree rotation of the ball. Valves 2 inches and larger must conform to applicable construction and dimension requirements of API Spec 6D, ANSI Class 150 and must have flanged ends. Valves smaller than 50 mm 2 inches must be ANSI class 150 valves with flanged ends, unless noted otherwise. The balls in valves 250 mm 10 inches and larger full port and 300 mm 12 inch and larger regular port and larger must have trunnion type support bearings. Except as otherwise specified or indicated, reduced port or full port valves may be provided at the Contractor's option. Balls must be solid, not hollow cavity.

2.6.1.1 Materials

Ball must be stainless steel. Ball valves must have polytetrafluoroethylene (PTFM) or fluoroelastomer (FKM), commonly referred to as Viton seats, body seals and stem seals. Valves 100 mm 4 inches and smaller must have a locking mechanism.

2.6.1.2 V-Port Ball Valve

****

NOTE: Primarily used on Truck Offloading System to set minimum offload flow rate.

****

Valve must conform to requirements as specified for BALL VALVES paragraph in this section. Valve must be provided with characterized linear v-port for flowrate control, and with infinite position lever bracket with locking

bolt for set position.

2.6.1.3 Electric Valve Actuator

Electric valve actuator must be as indicated for Plug (Double Block and Bleed) Valves, electric valve actuator.

2.6.2 Plug (Double Block and Bleed) Valves

API Spec 6D, API Spec 6FA, ANSI Class 150, non-lubricated, resilient, double seated, trunnion mounted, tapered lift plug capable of two-way shutoff. Valve must have tapered plug of steel or ductile iron with chrome or nickel plating and plug supported on upper and lower trunnions. Sealing slips must be steel or ductile iron, with Viton seals which are held in place by dovetail connections. Valve design must permit sealing slips to be replaced from the bottom with the valve mounted in the piping. Valves must operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valves must have weatherproof operators with mechanical position indicators. Indicator shaft must be stainless steel. Minimum bore size must be not less than 65 percent of the internal cross sectional area of a pipe of the same nominal diameter unless bore height of plug equals the nominal pipe diameter and manufacturer can show equal or better flow characteristics of the reduced bore size design.

2.6.2.1 Valve Operation

Rotation of the handwheel toward open must lift the plug without wiping the seals and retract the sealing slips so that during rotation of the plug clearance is maintained between the sealing slips and the valve body. Rotation of the handwheel toward closed must lower the plug after the sealing slips are aligned with the valve body and force the sealing slips against the valve body for positive closure. When valve is closed, the slips must form a secondary fire-safe metal-to-metal seat on both sides of the resilient seal. Plug valves located in Isolation Valve Pits or vaults must be provided with handwheel extensions.

2.6.2.2 Integral Cavity Valves

ANSI Class 150. Provide plug valves with automatic thermal relief valves to relieve the pressure build up in the internal body cavity when the plug valve is closed. Relief valves must open at 172 kPa 25 psi differential pressure and must discharge to the throat of, and to the upstream side, of the plug valve.

2.6.2.3 Bleed Valves

ANSI Class 150, stainless steel body valve. Provide manually operated bleed valves that can be opened to verify that the plug valves are not leaking when in the closed position.

2.6.2.4 Electric Valve Actuator

****

NOTE: Maximum available temperature ranges for a regular actuator is minus 30 degrees C to 70 degrees C minus 22 degrees F to 158 degrees F. A lower temperature rating than that will result in an actuator encapsulated in insulation making access to manual controls and the handwheel difficult.

****

The actuator, controls and accessories must be the responsibility of the valve-actuator supplier for sizing, assembly, certification, field-testing and any adjustments necessary to operate the valve as specified. The electric valve actuator must include as an integral unit the electric motor, actuator unit gearing, limit switch gearing, position limit switches, torque switches, drive bushing or stem nut, declutch lever, wiring terminals for power, remote control indication connections and handwheel. The electrically actuated plug valve must be set to open and close completely in 30 to 60 seconds against a differential pressure of 275 PSIG. The actuator settings of torque and limit contacts must be adjustable. The valve actuator must be suitable for mounting in a vertical or horizontal position and be rated for 30 starts per hour. The valve actuator must be capable of functioning in an ambient environment temperature ranging from minus 30 degrees C to 70 degrees C [minus 22 to 158] [_____]degrees F.

a. The electrical enclosure must be specifically approved by UL or Factory Mutual for installation in Class I, Division 1, Group D locations.

b. The electric motor must be specifically designed for valve actuator service and must be totally enclosed, non-ventilated construction. The motor must be capable of complete operation at plus or minus 10 percent of specified voltage. Motor insulation must be a minimum NEMA Class F. The motor must be a removable subassembly to allow for motor or gear ratio changes as dictated by system operational requirements. The motor must be equipped with an embedded thermostat to protect against motor overload and also be equipped with space heaters. It must de-energize when encountering a jammed valve.

c. The reversing starter, control transformer and local controls must be integral with the valve actuator and suitably housed to prevent breathing or condensation buildup. The electromechanical starter must be suitable for 30 starts per hour. The windings must have short circuit and overload protection. A transformer, if needed, must be provided to supply all internal circuits with 24 VDC or 110 VAC may be used for remote controls.

d. The actuator gearing must be totally enclosed in an oil-filled or grease-filled gearcase. Standard gear oil or grease must be used to lubricate the gearcase.

e. The actuator must integrally contain local controls for Open, Close and Stop and a local/remote three position selector switch: Local Control Only, Off, and Remote Control plus Local Stop Only. A metallic handwheel must be provided for emergency operation. The handwheel drive must be mechanically independent of the motor drive. The remote control capability must be to open and close. Rim pull to operate valve manually must not exceed 36 kg 80 pounds.

f. Position limit switches must be functional regardless of main power failure or manual operation. Four contacts must be provided with each selectable as normally open or normally closed. The contacts must be rated at 5A, 120 VAC, 30 VDC.

g. Each valve actuator must be connected to a PLC supplied by "others".

h. The actuator must have a local display of position even when power has

been lost.

i. The actuator must be supplied with a start-up kit comprising installation instruction, electrical wiring diagram and spare cover screws and seals.

j. The actuator must be performance tested and a test certificate must be supplied at no extra charge. The test should simulate a typical valve load with current, voltage, and speed measured.

2.6.3 Swing Type Check Valves

****
NOTE: limited to 50 mm 2 inch size and below. Used in underground PRT fill line.
****

Swing check valves must conform to API STD 600, regular type, ANSI Class 150 with flanged end connections. Discs and seating rings must be renewable without removing the valve from the line. The disc must be guided and controlled to contact the entire seating surface.

2.6.4 Wafer Type Check Valve

Spring assisted, wafer/tapped lug pattern, butterfly check or globe type with FKM or PTFE seat ring, designed to prevent flow reversal slamming of valve, dual plate, and must conform to ASME B16.34, API Std 594, except face to face dimensions may deviate from standard. Valves must be suitable for installation in any orientation. Valve body and trim material must be as previously indicated herein.

2.6.5 Globe Valve

Valve must conform to ASME B16.34, Class 150.

2.6.6 Thermal Relief Valve

****
NOTE: Indicate on the drawings the operating pressure required for each valve. Thermal 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.
****

2.6.6.1 Valve Materials

Valves must have carbon steel bodies (stainless steel on stainless steel pipelines) and bonnets with stainless steel springs and trim. Valves must be Class 150 flanged end connections.

2.6.6.2 Thermal Relief Valve (ASME Type)

Thermal relief valves must be the fully enclosed, spring loaded, angle pattern, single port, hydraulically operated type with plain caps, and must be labeled in accordance with ASME BPVC (GPM). Valve stems must be fully

guided between the closed and fully opened positions. The valves must be factory-set to open at pressures indicated on the drawings. Operating pressure must be adjustable by means of an enclosed adjusting screw. The valves must have a minimum capacity of 20 GPM at 10 percent overpressure. Valves must have a replaceable seat. Relief valves that do not relieve to a zone of atmospheric pressure or tank must be a balanced type relief valve.

2.6.6.3 Thermal Relief Valve (Balanced Type)

Thermal relief valves that do not relieve to a zone of atmospheric pressure or atmospheric tank must be a balanced type relief or regulator valve.

Thermal relief valves must be the fully enclosed, spring loaded, angle pattern, single port, fully balanced type (back pressure must not affect relief pressure) back pressure regulator/relief valve. Set valve at pressure indicated on drawings. Valve body must have 25 mm 1 inch (minimum) raised face flange connections unless otherwise indicated. Orifice must have a minimum orifice size of 15 millimeter .500 inch in diameter. Valve must have bubble-tight piston and seat design with stainless steel piston and Viton seat. Valve must be selected for the nominal flow condition of: pass a minimum of [18] liters per minute [5] gallons per minute, at a differential pressure of [380] kPa [55] psig, with a nominal set pressure of [345] kPa [50] psig. Valve must be factory configured to open at required set pressure but must be field adjustable by means of an enclosed adjusting screw.

2.6.7 Pressure\Vacuum Relief Valve

****

NOTE: 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 12 oz per in^2. A valves's typical operating vacuum is 215 Pa 0.5 oz per in^2.

****

Valve must be the pressure\vacuum vent relief type that conforms to NFPA 30. Valve pressure and vacuum relief settings must be set at the factory. Pressure and vacuum relief must be provided by a single valve. Valve body must be constructed of either cast steel or aluminum. Valve trim must be stainless steel. Inner valve pallet assemblies must have a knife-edged drip ring around the periphery of the pallet to preclude condensation collection at the seats. Pallet seat inserts must be of a material compatible with the fuel specified to be stored. Valve intake must be covered with a 40 mesh stainless steel wire screen.

2.6.8 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 must be the self-activating, double-poppet, shutoff type that prevents fuel flow from reversing. Valve must conform to NFPA 30. Valve body must be constructed of either cast steel or aluminum. Valve must be provided with a minimum 20 mesh stainless steel screen on the intake. Valve seats must be the replaceable type. Valve must be capable of passing through a 75 mm 3 inch pipe or tank flange.

2.6.9 Tank Overfill Prevention Valve (Gravity Fill)

****

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.

****

Valve must be the two-stage, float-activated, shutoff type that is an integral part of the drop tube used for gravity filling. The first stage must restrict the flow of fuel into the tank to approximately 0.3 L/s 5 gpm when the liquid level rises above 87.5 percent of tank capacity. The second stage must completely stop the flow of fuel into the tank when the liquid level rises above 92.5 percent of tank capacity. Valve must be constructed of the same material as the fill tube.

2.6.10 Tank Overfill Prevention Valve (Pumped Fuel Receipt)

****

NOTE: Specify these valves when used for pressure filled tanks (e.g.in combination with any type of unloading pump that feeds an aboveground storage tank). For aboveground storage tanks, set the overfill valve to actuate at 96.5 percent tank volume. Refer to DoD Military Service Station and Factory Fabricated Tank Standard, STD 123-335-03.

****

Valve must be the two-stage, float-activated, shutoff type that is an integral part of the drop tube used for pressurized fill systems. The valve must completely stop the flow of fuel into the tank, when the liquid level rises above [96.5 percent][_____] of tank capacity. Valve must be constructed of the same material as the fill tube.

2.6.11 Anti-Siphon Valves

2.6.11.1 Solenoid Controlled Anti-Siphon Ball Valve

Anti-siphon valves must be solenoid controlled, normally closed, spring loaded valves. Solenoid must be housed in an integral, watertight, explosion proof housing and suitable for installation in Class I, Division I hazardous area locations. Valve body and trim material must be as previously indicated herein.

2.6.11.2 Anti-Siphon Valve

Anti-siphon valves must be normally closed, spring loaded, angle pattern type valves. Valves must be suitable for installation in any orientation and compatible with suction or pressurized systems. Valve must be UL listed. Valve body and trim material must be as previously indicated herein.

2.7 PUMPS

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

2.7.1 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.
****

See Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

2.7.2 ANSI Type Centrifugal Pump

See Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

2.7.3 Sliding Vane Rotary Pump

****
NOTE: Specify sliding vane rotary pumps for fuel oil applications, lubricating oil applications, etc. Maximum suction lift for rotary pump will not exceed 34 kPa 10 inches Hg.
****

See Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

2.7.4 Self-priming Centrifugal Pump

See Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

2.7.5 Pump Control Panel

Panel must include on and off indication lights for each pump. Panel must contain an adjustable control logic for pump operation in accordance with the indicated operation. Panel must also have a manual override switch for each pump to allow for the activation or deactivation of each pump. See Section 33 09 52 FUEL PUMP CONTROL AND ANNUNCIATION SYSTEM (NON-HYDRANT).

2.8 FRP CONTAINMENT SUMP

See Section 33 57 55 FUEL PUMP CONTROL AND ANNUNCIATION SYSTEM

(NON-HYDRANT).

2.9 ACCESSORIES

2.9.1 Concrete Anchor Bolts

Concrete anchors must conform to ASTM A307, Grade C, hot-dipped galvanized.

2.9.2 Bolts and Studs

Carbon steel bolts and studs must conform to ASTM A307, Grade B, hot-dipped galvanized. Stainless steel bolts and studs must conform to ASTM A193/A193M, Class 2, Grade 8.

2.9.3 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.

2.9.4 Washers

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

2.9.5 Polytetrafluoroethylene (PTFE) Tape

Tape must conform to ASTM D3308.

2.9.6 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]].

2.9.7 Buried Utility Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape for warning and identification of buried piping. Tape must be detectable by an electronic detection instrument. Provide tape in minimum 75 mm 3 inches 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 must be at least 25 mm 1 inch high and must 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.

2.9.8 Pipeline Markers

Provide pipeline markers constructed of 150 mm 6 inches diameter, one-half inch thick bronze disk with a 75 mm 3 inch long bronze headed bolt welded to the back of the disk. Engrave the front of the disk with the words "UNDERGROUND FUEL LINE" in the case of one line and "UNDERGROUND FUEL LINES" in the case of multiple fuel lines.

2.10 FINISHES

Ship, store, and handle coating materials as well as apply and cure

coatings in accordance with SSPC PA 1.

2.10.1 Exterior Coating, Direct Buried Piping

2.10.1.1 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 must be 36 mils for pipe sizes 150 mm 6 inches and larger.

2.10.1.2 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.

2.10.1.3 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.

2.10.1.4 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 3/8 inch thick perforated rock shield around buried piping. Rock shield must 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 must overlap on itself no less than 150 mm 6 inches. Secure rock shield tightly to the pipe using either strapping tape or plastic ties. Air filled cell type rock shields are prohibited.

2.10.2 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 EXTERIOR COATING OF STEEL STRUCTURES or Section 09 90 00 PAINTS AND COATINGS 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 EXTERIOR COATING OF STEEL STRUCTURES if SSPC QP 1 contractor certification is required for

any other coatings on the project. Specify Section 09 97 13.27 EXTERIOR COATING OF STEEL STRUCTURES if more than 500 square feet of piping is to be coated. Section 09 90 00 PAINTS AND COATINGS may be specified for other situations. If Section 09 90 00 PAINTS AND COATINGS 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 PAINTS AND COATINGS].

2.10.3 New System Components

2.10.3.1 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 system components fabricated from ferrous metal with the manufacturer's standard factory finish.[Each factory finish must withstand [125] [500] hours exposure to the salt spray test specified in ASTM B117. For test acceptance, the test specimen must show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 3 mm 1/8 inch on either side of the scratch mark immediately after completion of the test.] For system component surfaces subject to temperatures above 50 degrees C 120 degrees F, the factory coating must be appropriately designed for the temperature service.

2.10.3.2 Field Painting

****

NOTE: Specify exterior, aboveground coatings per Section 09 97 13.27 EXTERIOR COATING OF STEEL STRUCTURES if SSPC QP 1 contractor certification is required for any other coatings on the project. If Section 09 90 00 PAINTS AND COATINGS 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 must be field painted as specified in [Section 09 97 13.27 EXTERIOR COATING OF STEEL STRUCTURES][Section 09 90 00 PAINTS AND COATINGS]. Do not paint aboveground stainless steel and aluminum surfaces. Do not coat system

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: 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 system components to allow for 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 steel reinforced flexible pipe connection points on the drawings.

****

Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing must be in accordance with ASME B31.3 and NFPA 30, except as modified herein. Safety rules as specified in NFPA 30 must 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.

3.1.1 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.]

3.1.2 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 1 inch per 50 feet.

****

3.1.2.1 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 system components 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 must be free of traps, must not be embedded in concrete pavement, and must drain as indicated. Make changes in direction with fittings, except that bending of pipe 100 mm 4 inches 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 must 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 must rest solidly on the underlying pipe bed.

3.1.2.2 Double-Wall Flexible Non-Metallic Piping

Install double-wall flexible non-metallic piping in accordance with manufacturer's instructions.

3.1.2.3 Pipeline Markers

Provide above underground fuel piping spaced every 90 meters 300 feet, at tees, and at changes in direction. For sections of underground piping less than 90 meters 300 feet long, place at midpoint. Provide directly above pipe for single lines and between pipes where pipes run in pairs. Provide additional marker over each mid-line fitting connections for steel reinforced flexible pipe. Cast marker into 457 mm 18-inch diameter, 305 mm 12-inch thick concrete plug unless it is set in an area with concrete paving in which case it must be cast into the concrete paving.

3.1.2.4 Steel Reinforced Flexible Pipe

****
NOTE: Steel reinforced flexible pipe comes in reels. To the extent possible, design piping system such that the entire length of underground piping can be accommodated with one reel.
****

Connections between steel pipe and steel reinforced flexible pipe and between separate lengths of steel reinforced flexible pipe must not be made aboveground but must be made either inside a pit or vault, or direct bury them. Where practicable, end-line and mid-line connections must be located inside pit type enclosures of an appropriate size. Where it is not practicable to locate mid-line connections inside pit type enclosures, mid-line connections may be wrapped with a suitable waterproof protective substance and direct buried underground. The location of direct buried mid-line connections must be indicated on the final drawings and provided with a pipeline marker.

3.1.2.5 Welded Connections

Unless otherwise indicated on the drawings, pipe joints must be welded.

Construct branch connections with welding tees or forged welding branch outlets. Do not weld stainless steel pipe to carbon steel pipe.

3.1.2.6 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 2 inches 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 must show after the joint is tighten.

3.1.2.7 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.

3.1.2.8 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 must 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.

3.1.3 Bolted Connections

For each bolted connection of stainless steel components (e.g., pipes, piping components, valves, and system components) 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. Bolts to project no more than three full threads and no less than two full threads beyond the nuts with the bolts tightened to the required torque. Prior to installing nuts, apply a compatible anti-seize compound to the male threads.

3.1.4 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 system component 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. For flanges, provide washers under each bolt head and nut. Torque wrenches must be used to tighten all flange bolts to the torque recommended by the gasket manufacturer. Tightening pattern must be as recommended by the gasket manufacturer. Use anti-seize compound on threads for stainless steel bolts.

3.1.5 Flange Protectors

****
NOTE: See Note on FLANGE PROTECTORS paragraph in this section.
****

Provide flange protectors [on each electrically isolating flange connection][on each flanged end connection, including valves and system components][where indicated on the drawings].[Fill the flange cavity of electrically isolating flange connections with corrosion inhibitor type grease.] Provide grease filled bolt caps. Caution should be used when installing stainless steel bands to avoid "grounding out" the insulating flanges.

3.1.6 Valves

Install isolation plug or ball valves on each side of each system component, 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.

3.1.7 Air Vents

Provide [_____] [40 mm] [1-1/2 inches] air vents at all high points and where indicated to ensure adequate venting of the piping system.

3.1.8 Drains

Provide [_____] [50 mm] [2 inches] drains at all low points and where indicated to ensure complete drainage of the piping. Drains must by schedule 120.Drains must be accessible, and must consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.9 Bellows Expansion Joints

Cold set joints to compensate for the temperature at the time of installation. Provide initial alignment guides on the connecting piping no more than 4 pipe diameters from the expansion joint. Provide additional alignment guides on the connecting piping no more than 14 pipe diameters from the first guide.

3.1.10 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.

3.1.11 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 must be of such size as to provide a minimum of 12 mm 1/2 inch 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 must be by means of a mechanically adjustable segmented elastomeric seal. The seal must 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 must be continuous for the entire crossing as well as extend a minimum of 150 mm 6 inches 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.

3.1.12 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.

3.1.13 Access Panels

Provide access panels for all concealed valves, vents, controls, and items requiring inspection or maintenance. Access panels must 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.

3.1.14 Buried Utility Tape

Bury tape with the printed side up at a depth of 300 mm 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.15 Framed Instructions

Framed instructions must include system components layout, wiring and control diagrams, piping, valves, control sequences, and typed condensed operation instructions. The condensed operation instructions must 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.

3.2 PIPE SUPPORTS

Install supports 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 supports where concentrated piping loads exist (e.g., valves).

Table 1. Maximum Support Spacing

Nominal Pipe Size (mm) (Inches)	25 One and Under	40 1.5	50 2	80 3	100 4	150 6	200 8	250 10	300 12
Maximum Support Spacing (m) (ft)	2 7	2.75 9	3 10	3.5 12	4.25 14	5 17	5.75 19	6.50 22	7 23

3.2.1 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 Section 13 48 00 [SEISMIC] BRACING FOR MISCELLANEOUS EQUIPMENT [and Section 22 05 48.00 20 MECHANICAL SOUND, VIBRATION, AND SEISMIC CONTROL] and as shown on the drawings. Structural steel required for reinforcement to properly support piping, headers, and system components but not shown must be provided under this section. Material used for support must be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.2.2 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 system components, but not shown, must be provided under this section. Material used for support must be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.3 FIELD QUALITY CONTROLS

3.3.1 System Commissioning

System commissioning must conform to Section 33 08 55 COMMISSIONING OF FUEL FACILITY SYSTEMS.

3.3.2 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 must be permitted in the area during pneumatic and hydrostatic testing. Isolate system components 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 must 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.

3.3.2.1 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 must include all existing underground piping exposed for this project.

3.3.2.2 Preliminary Pneumatic Test

Apply a 170 kPa 25 psig 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.

3.3.2.3 Final Pneumatic Test

Following the preliminary pneumatic test, apply a 345 kPa 50 psig pneumatic test to all product piping and hold for a period not less than 2-hours. During the test period, there must 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.

3.3.2.4 Hydrostatic Test

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NOTE: Pressure testing of new Mogas, Avgas, and JP-4 pipelines must be with water.

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Testing must comply with the requirements in ASME B31.3, except as modified herein. Hydrostatically test product piping with the fuel to be handled to the lesser of 1-1/2 times operating pressure or 1896 kPa 275 psig 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.

3.3.2.5 Exterior Containment Piping Tests

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NOTE: Delete this paragraph if exterior containment piping is not specified.
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Apply a minimum pneumatic pressure of 35 kPa 5 psig 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 SYSTEM PERFORMANCE TESTS

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NOTE: If applicable, edit Section 33 08 55 COMMISSIONING OF FUEL FACILITY SYSTEMS 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 COMMISSIONING OF FUEL FACILITY SYSTEMS.

3.5 DEMONSTRATIONS

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

-- End of Section --