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USACE / NAVFAC / AFCEC / NASA **UFGS-33 52 43 (May 2011)**

Preparing Activity: USACE **Superseding**
UFGS-33 52 13 (February 2010)
UFGS-33 52 43.00 20 (November 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2014
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SECTION 33 52 43

AVIATION FUEL DISTRIBUTION (NON-HYDRANT)
05/11

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NOTE: This guide specification covers the requirements for piping, piping components, valving and miscellaneous accessories for general aviation fueling systems (non-hydrant type). Do not use this specification for designs related to pressurized hydrant fueling systems. For such systems, refer to Standard Design 078-24-28 PRESSURIZED HYDRANT FUELING SYSTEM (TYPE III).

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 items(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 equipment/devices necessary to meet state and local regulations.

The specification is written around ASME's standard Class 150 rating. For applications requiring higher pressure ratings (e.g., Class 300, etc.), 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 an aviation fuel distribution system. Provide the entire aviation fuel distribution system as a complete and fully operational system. Size, select, construct, and install equipment and 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. Equipment and piping specified herein shall be designed to handle a working pressure of 1900 kPa 275 psig at 38 deg C 100 deg F. Equipment specified herein shall be compatible with the fuel to be handled.

1.1.1 Related Sections

1.1.1.1 Interior and Underground Epoxy Coating, Carbon Steel Pipe

Coat in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEMS.

1.1.1.2 Exterior Coating, Aboveground Piping

Coat in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEMS.

1.1.1.3 Fuel Dispensing Equipment

Fuel dispensing equipment shall be in accordance with Section 33 57 00 FUEL RECEIVING/DISPENSING EQUIPMENT.

1.1.1.4 Welding

****
NOTE: Use Section 33 52 90.00 20 to define all welding requirements for pressure piping. Edit Section 33 52 90.00 20 around the requirements of ASME B31.3.

Within Section 33 52 90.00 20, require 100 percent radiographic testing on all underground product piping as well as all product piping downstream of pumps (see UFC 3-460-01). For all other product piping, require random radiographic testing per ASME B31.3, Category M fluid service (20 percent).
****

Perform welding activities for pipe and piping components in accordance with Section 33 52 90.00 20 WELDING FOR POL SERVICE PIPING.

1.1.1.5 Commissioning

Commission the fueling system in accordance with Section 33 08 55 COMMISSIONING OF FUEL FACILITY SYSTEMS.

1.1.1.6 Earthwork

****
NOTE: Require backfill for aluminum, stainless steel, or carbon steel pipe to be pea gravel, crushed stone, or sand.

Require pea gravel to be between 3 and 20 mm (1/8 and 3/4 inch) in diameter. Require crushed stone to be between 3 and 13 mm (1/8 and 1/2 inch) in diameter. Require sand to be a fine aggregate that is washed and thoroughly dried, contains no more than 500 ppm chlorides, contains no more than 500 ppm sulfates, and has a pH greater than 7.

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 tanks as specified in [Section 31 00 00 EARTHWORK] [Section 31 23 00.00 20 EXCAVATION AND FILL].

1.1.1.7 Cathodic Protection

Provide buried metallic components including pipe, anchors, conduit, etc., 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 shall be coordinated and compatible with the tank corrosion control system.

1.1.1.8 Concrete Manholes

****
NOTE: The design of manholes including size, reinforcing, arrangement, penetrations, equipment 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/equipment. 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 in) 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, will wick through the concrete to the surrounding soil. To add fuel resistance to the walls of a concrete manhole, include the last sentence.

****

Construct manhole of concrete in accordance with [Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE] [Section 03 30 00 CAST-IN-PLACE CONCRETE]. [Coat the interior of each manhole in accordance with Section 09 97 23.13 INTERIOR LINING FOR CONCRETE STORAGE TANKS (FOR PETROLEUM FUELS).]

1.2 REFERENCES

****

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

Use the Reference Wizard's Check Reference feature when you add a 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 2003	(2008; 7th 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 Spec 5L	(2012) Specification for Line Pipe
API Spec 6D	(2008; Errata 1 2008; Errata 2 2008; Errata 3 2009; Addendum 1 2009; Errata 4 2010; Errata 5 2010; Errata 6 2011; Addendum 2 2011; Addendum 3 2012) Specification for Pipeline Valves

API Spec 6FA	(1999; R 2006; Errata 2006; Errata 2008; R 2011) Specification for Fire Test for Valves
API Std 594	(2010) Check Valves: Flanged, Lug, Wafer and Butt-Welding
API Std 607	(2010) Testing of Valves: Fire Test for Soft-Seated Quarter-Turn Valves
API Std 609	(2009) Butterfly Valves: Double Flanged, Lug-and-Wafer Type

ASME INTERNATIONAL (ASME)

ASME B1.1	(2003; R 2008) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.11	(2011) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2011) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.3	(2011) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	(2013) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2009) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2013) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2012) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2010) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B31.3	(2012) Process Piping
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME B40.200	(2013) Thermometers, Direct Reading and Remote Reading
ASME BPVC SEC VIII D1	(2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M	(2013) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A182/A182M	(2013a) Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A193/A193M	(2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2013) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A216/A216M	(2012) Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A234/A234M	(2013) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A269	(2013) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A276	(2013a) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2012) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A312/A312M	(2013b) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A351/A351M	(2013) Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM A358/A358M	(2012) Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A403/A403M	(2013a) Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A564/A564M	(2013) Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A733	(2003; E 2009; R 2009) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A743/A743M	(2013a) Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B241/B241M	(2012; E 2013) Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B247	(2009) Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings
ASTM B26/B26M	(2012) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B345/B345M	(2011) Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube for Gas and Oil Transmission and Distribution Piping Systems
ASTM B687	(1999; R 2011) Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
ASTM B696	(2000; R 2009) Standard Specification for Coatings of Cadmium Mechanically Deposited
ASTM B766	(1986; R 2008) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM D229	(2013) Rigid Sheet and Plate Materials Used for Electrical Insulation
ASTM D3308	(2012) PTFE Resin Skived Tape
ASTM F2329	(2013) Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel

	Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F436	(2011) Hardened Steel Washers

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1100	(2005) Emerald Book IEEE Recommended Practice for Powering and Grounding Electronic Equipment
IEEE 142	(2007) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book

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
MSS SP-69	(2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

NACE INTERNATIONAL (NACE)

NACE SP0188	(1999; R 2006) Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2011; Errata 2012) Motors and Generators
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(2012; Errata 2011; Errata 2011) Flammable and Combustible Liquids Code
NFPA 407	(2012; TIA 11-1) Standard for Aircraft Fuel Servicing
NFPA 70	(2014; AMD 1 2013; Errata 2013; AMD 2 2013) National Electrical Code
NFPA 77	(2014) Recommended Practice on Static Electricity
NFPA 780	(2014) Standard for the Installation of Lightning Protection Systems

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

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 5/NACE No. 1 (2007) White Metal Blast Cleaning

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.

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.][information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Work Plan[; G][; G, [_____]]

SD-02 Shop Drawings

Grounding and Bonding
Pipe Hangers and Supports

SD-03 Product Data

Carbon Steel Pipe
Stainless Steel Pipe
Aluminum Pipe
Pressure Gauge
Flexible Ball Joint
Bellows Expansion Joint
Full-Opening Swing Check Valve
Dual-Plate Wafer Check Valve
Ball Valve
Ball Valve (Double Block and Bleed Type)
Plug Valve (Double Block and Bleed Type)
Plug Valve (PTFE Sleeved Tapered Type)
Globe Valve
Pressure Relief Valve
Butterfly Valve with Fusible Link Operator

SD-06 Test Reports

Exterior Coating Holiday Test
Preliminary Pneumatic Test
Final Pneumatic Test
Hydrostatic Test

SD-07 Certificates

Contractor Qualifications[; G][; G, [_____]]
Systems Supplier[; G][; G, [_____]]
Demonstrations

SD-08 Manufacturer's Instructions

Flexible Ball Joint
Bellows Expansion Joint

SD-10 Operation and Maintenance Data

Flexible Ball Joint
Bellows Expansion Joint
Full-Opening Swing Check Valve
Dual-Plate Wafer Check Valve
Ball Valve
Ball Valve (Double Block and Bleed Type)
Plug Valve (Double Block and Bleed Type)
Plug Valve (PTFE Sleeved Tapered Type)
Globe Valve
Pressure Relief Valve
Butterfly Valve with Fusible Link Operator

1.4 QUALITY ASSURANCE

1.4.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship. Materials and equipment shall have been in satisfactory commercial or industrial use for a minimum

2 years prior to bid opening. The 2 year period shall include applications of the equipment and materials under similar circumstances and of similar size. Materials and equipment shall 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.]

1.4.2 Contractor Qualifications

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

Each installation Contractor shall have successfully completed at least 3 projects of the same scope and the same size or larger within the last 6 years. Each installation Contractor shall demonstrate specific installation experience in regard to the specific system installation to be performed. Each installation Contractor shall have taken, if applicable, manufacturer's training courses on the installation of piping and shall 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. Provide in the letter evidence of prior manufacturer's training and state licensing.

1.4.3 Systems Supplier

Furnish control valves and pump control systems throug a single systems supplier regularly engaged in the supply of such equipment. Pump control systems shall be inclusive of but not limited to fueling system pumps, pump control panels, venturi tubes, transmitters, flow switches, field instrumentation, and all applicable hardware and software needed to make an integrated system. Systems supplier shall be a company whose regular, normal, and primary business is representing manufacturers in the distribution and start-up of aviation fueling facilities. Systems supplier shall have no affiliation with the Contractor other than as a seller to the Contractor. Systems supplier shall provide all applicable equipment and appurtenances regardless of manufacture, be a factory authorized certified representative, be responsible to the Contractor for satisfactory operation of the entire system, and shall oversee the installation of the equipment. Contractor and the systems supplier shall be present at the system commissioning, and shall coordinate and schedule the work during construction, testing, calibration, and acceptance of the system. Systems supplier shall be responsible to the Contractor for scheduling all field personnel associated with system start-up and final commissioning. Systems supplier shall have provided and installed at least three PLC-based, aviation pump control systems in the last six years all of which involved multiple pumps as well as automatic cycling of pumps based upon varying dispensing demands. Submit a letter listing prior projects, the date of construction, a point of contact for each prior project (including telephone number), the scope of work of each prior project, and a detailed list of work performed.

1.4.4 Work Plan

Submit a comprehensive work plan that provides sufficient detail to demonstrate a thorough understanding of the project. Document that all components to be provided will function together and produce the results expected by the Government. Include any proposed dates for piping system shutdowns as well as the Contractor's ability to complete the work within the allotted shutdown periods. Show proposed dates and nature of piping system operations required of the Government. Include a list of manpower, spare piping and equipment that will be on hand for each phase of the work. Describe, in detail, the means of:

a. Coordinating work with Government and third parties.

b. Preparing for safe piping repair work.

c. Pressure testing new piping sections.

[d. Interrupting or isolating an existing fuel service or system.

] e. Purging piping.

f. Vapor monitoring.

g. Preparations for containing and disposing of residual fuel.

h. Cutting, sealing, and welding into existing piping systems.

i. Welding tie-ins in place.

j. Examining repair section tie-in welds.

k. Collecting, storing and disposing of waste fuel generated during work.

1.4.5 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 equipment, 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 shall

be 25 by 65 mm 1 by 2.5 inches. Lettering shall 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 shall identify its function.]

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment 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 FUEL SUPPLY

Fuel required for the hydrostatic test as specified in this section will be provided and delivered by the Contracting Officer. Do not test any system with fuel or liquid not intended for final system operation. Fuel used in the system shall remain the property of the Government. Fuel shortages not attributable to normal handling losses shall be reimbursed to the Government.

PART 2 PRODUCTS

2.1 MATERIALS

Internal parts and components of equipment, piping, piping components, and valves that could be exposed to fuel during system operation shall 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.

2.1.1 Nitrile Butadiene (Buna-N)

Provide Buna-N material that conforms to SAE AMS3275.

2.1.2 Acrylonitrile Butadiene Rubber (NBR)

Provide NBR material that conforms to SAE AMS3275.

2.2 ELECTRICAL WORK

****

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

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

calculating the economy of using an adjustable speed drive is described in UFC 3-520-01 DESIGN: INTERIOR ELECTRICAL SYSTEMS.

Coordinate the ignition temperature of the fuel(s) to be handled with the electrical design. Ignition temperatures will be as defined in NFPA 497M. Fuel ignition temperatures will dictate the maximum allowable temperature rating of the electrical equipment. Coordinate the area classification and the electrical design with UFC 03-460-01.

****

2.2.1 General

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

2.2.2 Motors

Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage. Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Provide polyphase, squirrel-cage medium induction motors, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

2.2.3 Motor Controllers

[Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Use solid-state variable-speed controllers for motors rated 7.45 kW 10 hp or less and adjustable frequency drives for larger motors.] [Provide variable frequency drives for motors as specified in Section 26 29 23 VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS.]

2.2.4 Underground Wiring

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

2.2.5 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.

2.3 FLANGED END CONNECTIONS

2.3.1 Flanges

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

2.3.1.1 Carbon Steel

Carbon steel flanges shall conform to ASTM A105/A105M.

2.3.1.2 Stainless Steel

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

2.3.1.3 Aluminum

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

2.3.2 Flange Gaskets, Non-Isolating

Provide flange gaskets that are 3.2 mm (1/8 in) 1/8 inch thick and that conform to ASME B16.21, that use a Buna-N binder, and that have a raised-face type unless otherwise indicated. Provide gaskets that are factory cut from one piece of material.

2.3.3 Flange Gaskets, Electrically Isolating

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

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

2.3.4 Flange Protectors

****
NOTE: Use flange protectors to minimize the

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

****

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

2.3.5 Flange Bolts, Nuts, and Washers

Bolts and nuts for pipe flanges, flanged fittings, valves and accessories shall conform to ASME B18.2.1 and ASME B18.2.2, except as otherwise specified. Bolts shall be of sufficient length to obtain full bearing on the nuts and shall project no more than two full threads beyond the nuts with the bolts tightened to the required torque. Bolts shall 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 when only carbon steel flanges are involved. Bolts shall be threaded in accordance with ASME B1.1, Class 2A fit, Coarse Thread Series, for sizes 25 mm 1 inch and smaller and Eight-Pitch Thread Series for sizes larger than 25 mm 1 inch. Nuts shall 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 for carbon steel bolts. Nuts shall be threaded in accordance with ASME B1.1, Class 2B fit, Coarse Thread Series for sizes 25 mm 1 inch and smaller and Eight-Pitch Thread Series for sizes larger than 25 mm 1 inch. Provide washers under bolt heads and nuts. Washers to be ASTM F436, flat circular stainless steel for stainless steel bolts, and carbon steel for carbon steel bolts. Torque wrenches shall be used to tighten all flange bolts to the torque recommended by the gasket manufacturer. Tightening pattern shall be as recommended by the gasket manufacturer. Anti-seize compound shall be used on stainless steel bolts.

2.4 PIPE

****

NOTE: Indicate on the drawings all piping configurations, slopes, sizes, and piping materials (i.e., carbon steel, internally coated carbon steel, stainless steel, or aluminum) 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. Direct buried threaded end connections should be avoided if possible. Specifically indicate the location of each threaded end connection on the drawings. Note that radiographic testing of socket-welded or threaded

end connections is not typically possible.

For Army and Air Force project, specify only seamless type carbon steel pipe.

****

Provide pipe that meets 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. Pipe 65 mm 2-1/2 inches and larger shall be Schedule 40. Pipe smaller than 65 mm 2-1/2 inches shall be Schedule [80][160].

a. Conform to ASTM A53/A53M, Type S Grade B.

b. Conform to API Spec 5L, Product Specification Level (PSL) 1, Grade B, [seamless] [seamless or electric welded] [submerged-arc welded or gas metal-arc welded].

2.4.1.1 Fittings and End Connections

End connections for pipe or fittings smaller than 65 mm 2-1/2 inches shall be forged, socket weld type conforming to ASTM A182/A182M and ASME B16.11, unless indicated otherwise. End connections for pipe or fittings 65 mm 2-1/2 inches and larger shall 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. Conform to ASTM A312/A312M, Type TP304L, seamless only. Pipe smaller than 200 mm 8 inches shall be Schedule 40S. Pipe 200 mm 8 inches or larger shall be Schedule 10S.

b. Conform to ASTM A358/A358M, Grade 304L, Class 1 or 3, longitudinally welded. Radiographically inspect 100 percent of factory longitudinal welds in accordance with ASME BPVC SEC VIII D1. Minimum pipe wall thickness shall be 6 mm 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 in) 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 in) and Smaller

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

2.4.2.3 Control Piping

eamless, fully annealed stainless steel tubing conforming to ASTM A269, Grade TP316, with a Rockwell hardness of B80 or less. For 15 mm (1/2 in) 1/2 inch tubing, provide a minimum 1.3 mm (0.049 in) 0.049 inches tubing wall thickness.

2.4.2.4 Control Piping Fittings

Flareless, Type 316 stainless steel type conforming to SAE J514.

2.4.3 Aluminum Pipe

****
NOTE: Aluminum piping has poor structural integrity, corrodes readily, and is difficult to weld. Use of aluminum piping must be approved by the using agency.
****

Conform to ASTM B241/B241M or ASTM B345/B345M, Alloy 6061-T6, Schedule 40 for pipe sizes 50 mm 2 inches through 300 mm 12 inches; Schedule 80 for pipe sizes 50 mm 2 inches and smaller.

2.4.3.1 Fittings and End Connections

Buttwelded connections shall conform to ASME B16.9. Socket welded connections shall conform to ASME B16.11. Fitting materials shall conform to ASTM B247, Alloy 6061-T6.

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 shall be Class 150 as defined in ASME B16.5.

2.5.1 Welded Nipples

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

2.5.2 Steel Couplings

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 above ground applications if specifically indicated on the

drawings. As stated previously, never require a threaded end connection to be direct buried. Typically, threaded end connections are only to be used on piping 50 mm (2 in) or less in size.

****

Unions shall conform to ASME B16.39, Class 150. Unions materials shall conform to ASTM A312/A312M, Grade 304 or 316.

2.5.3.1 Dielectric Type

****

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

****

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

2.5.4 Joint Compound

Resistant to water and suitable for use with fuel containing 40 percent aromatics.

2.5.5 Flexible Pipe Connector

****

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

****

Connector shall be the flexible, close pitch, metal hose type that is constructed with exterior annular corrugations and provided with a single layer of braided wire sheath covering. Connectors shall be constructed entirely of stainless steel and be rated for the system working pressure and temperature. [Connectors shall have flanged end connections.] [Provide threaded end connections for connectors smaller than 65 mm 2-1/2 inches. Provide flanged end connections for connectors 65 mm 2-1/2 inches and larger.]

2.5.6 Strainer

****

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

****

The in-line, cleanable, [simplex] [duplex] basket type configured in either

an "S" or "T" pattern. Strainer body shall be fabricated of [cast steel] [Type 304 or 316 stainless steel] [Type 3003 or 6061 aluminum alloys]. Strainer body shall include a body cavity drain connection. Install a strainer drain line that is inclusive of pipe nipples, a ball valve for shutoff, and a cap. Strainer shall be equipped with a removable cover, flanged end connections, an air eliminator, differential pressure ports, and arrows clearly cast on the strainer sides that indicate the direction of flow. Strainers shall have a removable, 60 mesh, Type 316 stainless steel wire sediment screen. The ratio of net effective strainer area to the area of the connecting pipe shall be not less than 3 to 1.

2.5.7 Thermometer

****
NOTE: Indicate the scale range for each thermometer on the drawings.
****

Analog, dial-type bimetallic actuated type that conforms to ASME B40.200. Thermometer shall have a 125 mm 5 inches diameter dial, a hermetically sealed stainless steel case, a stainless steel stem, a safety glass face, a fixed threaded connection, and a scale range as indicated. Thermometer accuracy shall be within one percent of the scale range.

2.5.8 Pressure Gauge

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

Gauge shall be the single style type that conform to ASME B40.100. Gauge shall have a 115 mm 4-1/2 inches dial, a stainless steel case and tube, a stainless steel ball valve, pressure snubbers, and a scale range as indicated. Gauge shall be liquid-filled with [glycerin] [or] [silicone]. [Provide gauge with an adjustable marker arrow that allows a user to mark a specific pressure for future reference.]

2.5.9 Pipe Hangers and Supports

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

Hangers and supports shall be the adjustable type conforming to MSS SP-58 and MSS SP-69, 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 shall conform to MSS SP-58 and MSS SP-69, Type 40, except material shall be Type 316 stainless steel. Provide shields at each slide type pipe hanger and support.

2.5.9.2 Low Friction Supports

Supports shall have self-lubricating anti-friction bearing elements composed of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates, prebonded to appropriate backing steel members. The coefficient of static friction between bearing elements shall be 0.06 from initial installation for both vertical and horizontal loads and deformation shall not exceed 51 micrometers 0.002 inch under allowable static loads. Bonds between material and steel shall be heat cured, high temperature epoxy. Design pipe hangers and support elements for the loads applied. Provide anti-friction material with a minimum of 2.3 mm 0.09 inch thick. Provide hot-dipped galvanized steel supports. Provide supports that are factory designed and manufactured.

2.5.10 Escutcheon

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

2.5.11 Flexible Ball Joint

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

The carbon steel type with chromium plated steel balls capable of 360 degree rotation plus 15 degree angular flex movement. Provide joints with flanged end connections and pressure molded composition gaskets designed for continuous operation at operating conditions.

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 [guided,] bellows expansion type with internal sleeves, external protective covers, and flanged end connections. Bellows shall be corrugated, [Type 304 stainless steel] [inconel] with reinforced rings. Joints shall be provided with limit stops to limit total movement in both directions. Joints shall be capable of withstanding 10,000 cycles over a period of 20 years.

2.5.13 Sight Flow Indicator

Construct indicator of [stainless steel] [carbon steel] and provide with flanged end connections. Indicator shall include an internal rotating

propeller to provide visual flow indication. Indicator housing shall include a tempered glass observation port for viewing the rotating propeller. Indicator shall have Buna-N seals.

2.6 GENERAL VALVES

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

a. Valves Connected to Stainless Steel, Aluminum, or Internally Coated Carbon Steel Piping. Provide valves with bodies, bonnets, and covers constructed of stainless steel conforming to ASTM A743/A743M, Type 304 or 316; or cast steel conforming to ASTM A216/A216M, Grade WCB internally plated with nickel or internally electroless nickel plated; or ductile iron conforming ASTM A536, electroless nickel plated.

b. Valves Connected to Carbon Steel Piping (No Internal Coating). Provide valves with bodies, bonnets, and covers constructed of cast steel conforming to ASTM A216/A216M.

2.6.1 Full-Opening Swing Check Valve

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

2.6.2 Dual-Plate Wafer Check Valve

The dual-plate, wafer type that conforms to API Std 594, Type A. Wafer type check valves may be provided in lieu of swing check valves in piping sizes larger than 100 mm 4 inches. Valve disc shall be constructed of ASTM A351/A351M, Grade CF8M stainless steel. Valve spring, hinge pin, stop pin, and radial-thrust bearing materials shall be constructed of Type 316 stainless steel.

2.6.3 Ball Valve

The non-lubricated, double seated, ball type that conforms to API Spec 6D. [Valve shall meet the fire test requirements of API Spec 6FA.] Valve shall operate from fully open to fully closed with 90 degree rotation of the ball. Valve shall be capable of 2-way shutoff. Valve ball shall be constructed of stainless steel. Valves smaller than 50 mm 2 inches shall have one piece bodies and shall have a minimum bore not less than 55 percent of the internal cross sectional area of a pipe of the same nominal diameter. Balls shall be provided with trunnion type support bearings for valves 350 mm 14 inches and larger. Provide valves with worm gear operators, except valves 150 mm 6 inches and smaller may be lever operated with a minimum 10 adjustable positions between fully opened and fully closed.

2.6.4 Ball Valve (Double Block and Bleed Type)

****

NOTE: Suggest using double block and bleed ball

valves on product piping where isolation is required but only when the valve is anticipated to operate very infrequently (less than weekly). Indicate on the drawings the location of each of valve.

****

Valves shall be designed, manufactured, and tested to API Spec 6D. [Valve shall meet the fire test requirements of API Spec 6FA.] Valves shall be trunnion-mounted with independent spring and hydraulically actuated, floating, single piston effect, self-relieving seat rings with bi-directional sealing. Ball shall be solid type with full through-conduit opening, suitable for passage of pipeline pigs. Stem shall be anti-static, blow-out-proof design with o-ring seals and provided with an emergency sealant injection fitting. Valves shall be 3-piece, bolted body design equipped with body drain/bleed valve and vent fitting, and suitable for double block and bleed service in the closed and open positions. Valves shall have nylon or teflon seat inserts, viton B body, stem, and seat o-rings, with stainless steel and graphite body gaskets and graphite secondary stem seals. Valves located in vaults or pits shall be equipped with actuator extensions.

2.6.5 Plug Valve (Double Block and Bleed Type)

The non-lubricated, resilient, double seated, trunnion mounted type with a tapered lift plug capable of 2-way shutoff that conforms to API Spec 6D. Valve shall have electroplated nickel interiors. Valve plug shall be constructed of steel or ductile iron with electroplated nickel that is supported on upper and lower trunnions. Valve sealing slips shall be constructed of steel or ductile iron with Viton seals. Valve design shall permit sealing slips to be replaced from the bottom with the valve mounted in the piping. Minimum bore size shall be 65 percent of the internal cross sectional area of a pipe of the same nominal diameter, unless the manufacturer can show an equivalent or greater flow rate with a lower percent internal cross sectional area. Valves 150 mm 6 inches and larger shall have removable lower and bonnet (upper) bushing. Valve shall have weatherproof, worm gear operators with mechanical position indicators. Indicator flag and shaft shall be made of steel. For valves installed in loop or distribution piping, provide valve body with a body cavity drain connection. Install a valve drain line that is inclusive of pipe nipples, a ball valve for shutoff, and a cap.

2.6.5.1 Valve Operation

Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Rotation of the plug toward open shall lift the plug without wiping the seals and retract the sealing slips so that clearance is maintained between sealing slips and valve body. Rotation of the handwheel toward closed shall lower the plug after sealing slips are aligned with the valve body and force the sealing slips against the valve body for positive closure. When valve is closed, slips shall form a secondary fire-safe metal to metal seat on both sides of the resilient seal.

2.6.5.2 Pressure/Thermal Relief

Provide plug valve with an automatic pressure/thermal relief valve(s) to relieve pressure buildup in the internal body cavity when the plug valve is closed. Relief valve shall open at a 172 kPa 25 psi differential pressure, and discharge to the throat of and to the upstream side of the plug valve.

2.6.5.3 Bleed Valve

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

2.6.6 Plug Valve (PTFE Sleeved Tapered Type)

Valve shall be the non-lubricated, PTFE sleeved tapered plug type that conforms to API Spec 6D. Valve shall have 360 degree port defining lips to retain the sleeve against deforming into the flow passages. Valve shall provide abrasion protection and shall prevent fuel entry behind the sleeve. Plug shall operate with a 90 degree turn for closure. For valves installed in loop or distribution piping, provide valve body with a body cavity drain connection. Install a valve drain line that is inclusive of pipe nipples, a ball valve for shutoff, and a cap.

2.6.7 Globe Valve

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

2.6.8 Pressure Relief Valve

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

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

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

2.6.9 Butterfly Valve with Fusible Link Operator

****
NOTE: Consult with the using agency at the facility for the use of this valve. The sole function of the valve is to provide a separate shutoff of the supply and return piping at each pantograph assembly in the event of a fire.
****

Valve shall conform to API Std 609. Valve shall meet the fire test requirements of API Std 607. Valve shall be designed for bubbletight

bidirectional shutoff service at operating conditions. Disc shall be Type 304L or Type 316, stainless steel. Stem shall be ASTM A276 Type 416 or ASTM A564/A564M Type 630 stainless steel. Seal ring shall be Teflon with metal backup. Stem seals shall be capable of withstanding the rated pressure and temperature of the valve seat. Provide valves 150 mm 6 inches and larger and valves at pump discharge with weatherproof gear operators with handwheel; other valves shall have minimum 10 position throttling handles. Valve shall have a fusible link type valve operator. The fusible link and spring assembly shall close the valve automatically when the link material melts at 75 degrees C 165 degrees F and lock the valve in the closed position. Spring assembly shall be fully enclosed to ensure safety. Provide valve with flanged end connections independent of other flanged end connections provided on items such as equipment, piping, piping components, or valves.

2.7 CONTROL VALVES, HYDRAULICALLY OPERATED

Provide valves in accordance with Section 33 52 43.14 AVIATION FUEL CONTROL VALVES.

2.8 VENT AND DRAIN PIT

****
NOTE: Pits shall be used at each high point vent as well as each low point drain. Indicate pit details along with internal piping details.
****

Prefabricated units that are the standard products of a firm regularly engaged in their manufacture. Pit shall consist of minimum 6.5 mm 1/4 inch thick [fiberglass] [polyethylene] walls and floors and shall have a cast aluminum hinged top. Pit shall be suitable for on-shoulder/on-apron installation as well as off-shoulder/off-apron locations.

2.8.1 Pit Cover

Cast aluminum that conforms to ASTM B26/B26M, Alloys 356-T6 or 713-T5. Cover shall have a hinged door in a lip ring design. Cover assembly shall be removable, including the ring. Pit cover shall support an aircraft wheel load of 22,680 kg 50,000 pounds on a contact area of 0.13 square meters 200 square inches with a safety factor of 4:1. The original casting shall be free of visual shrink porosity cavity areas. Weldments and fillers are not allowed. Pit service shall be integrally cast in 1.6 mm 1/16 inch deep letters. Do not paint pit cover. Cover shall open 180 degrees with a 11 kg 25 pound maximum lift and shall close flush. Weight bearing mating flange surfaces of the pit and cover shall be machined flat within 254 micrometers (0.01 in) 0.01 inch total indicator runout. Provide unit with a minimum 15 mm (1/2 in) 1/2 inch diameter hinge pin in a free floating hinge assembly. Provide cover with a latching device for holding cover in the closed position.

2.8.2 Pipe Riser Seal

Seal the riser pipe penetration through the pit floor by means of a Buna-N boot. Secure the boot to a metal collar welded to the pipe riser and to a flange at the floor opening by stainless steel clamps. Collar shall be fabricated from the same material as the pipe.

2.9 FRP CONTAINMENT SUMP

****

NOTE: FRP sumps may be used as an alternative to the vent and drain pits defined above, except that these sumps are non-load bearing and will not be used under an aviation apron.

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

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

****

Sump shall be constructed of fiberglass reinforced plastic (FRP) that is chemically compatible with the fuels to be handled. Do not connect sump in any way to the manway cover or concrete above. Cap the top of each containment sump with a [friction fit] [watertight] access cover. Construct cover of the same material as the sump. Cover shall have a minimum diameter of 550 mm 22 inches. Cover shall be easily removable through the manway above. Rainfall drainage shall not drain into a sump. Sump shall be capable of withstanding underground burial loads to be encountered. Container shall have a minimum 19 L 5 gal fuel storage capacity. Container shall not contain any type of drain. The sides of a containment sump shall allow the penetration of carrier pipes, exterior containment pipes, conduits, and vapor pipes as required. Boot or seal penetrations in the containment sump sides to ensure that liquid will not escape from the sump in the event that the liquid level within the sump rises above the pipe penetration. Provide boots and seals that are chemically compatible with the fuel to be handled and that are water resistant to the influx of ground water. Boots and seals shall be designed and installed to accommodate the anticipated amount of thermal expansion and contraction in the piping system.

2.10 ACCESSORIES

2.10.1 Concrete Anchor Bolts

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

2.10.2 Coatings for Bolts, Studs, Nuts, and Washers

Carbon steel bolts, studs, nuts, and washers shall be provided with a factory applied [cadmium coating that conforms to ASTM B696 or ASTM B766] [hot-dipped zinc coating that conforms to ASTM F2329].

2.10.3 Polytetrafluoroethylene (PTFE) Tape

Tape shall conform to ASTM D3308.

2.10.4 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].

2.10.5 Pipe Casings

Provided casings 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]. Casing exterior shall be protected with a coating that conforms to Section 09 97 13.27 EXTERIOR COATING OF STEEL STRUCTURES.

2.10.6 Buried Utility Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in minimum 75 mm 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 shall be at least 25 mm 1 inch high and shall state as a minimum "BURIED JET FUEL PIPING BELOW". Provide permanent code and letter coloring that is unaffected by moisture and other substances contained in trench backfill material.

2.11 FINISHES

2.11.1 Factory Coating

2.11.1.1 Valves

Valve surfaces shall be blasted clean according to SSPC SP 5/NACE No. 1. Valve surfaces shall be primed and coated in accordance with Section 09 97 13.27 EXTERIOR COATING OF STEEL STRUCTURES

2.11.1.2 Exterior Coating, Direct Buried Piping

****
NOTE: Specify rock shield where select fill is not available and possibility of damage from rock fill exists
****

Coating shall be in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEMS. Provide a minimum 3/8 inch thick perforated rock shield around buried piping. Rock shield shall consist of a polyethylene outer surface bonded to a closed cell foam substrate with uniform perforations intended for use with cathodic protection systems. Rock shield shall overlap on itself no less than 6 inches. Secure rock shield tightly to the pipe using either strapping tape or plastic ties. Air filled cell type rock shield is prohibited.

2.11.1.3 Equipment and Components

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

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

****

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

2.11.2 Field Painting

****

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

****

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

PART 3 EXECUTION

3.1 INSTALLATION

****

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

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

****

Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.3 and NFPA 30, except as modified herein. Safety rules as specified in NFPA 30 and NFPA 407 shall be strictly observed. Never direct bury threaded connections, socket welded connections, unions, flanges, valves, air vents, or drains. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.

3.1.1 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 ft).
****

3.1.1.1 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. Use reducing fittings for changes in pipe sizes. Install equipment and piping into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance. Provide electric isolation fittings between dissimilar metals. Install piping straight and true to bear evenly on supports. Piping shall be free of traps, shall not be embedded in concrete pavement, and shall drain as indicated. Make changes in direction with fittings, except that bending of pipe 100 mm 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. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. When work is not in progress, securely close open ends of pipe and fittings with expansion plugs so that water, earth, or other substances cannot enter the pipe or fittings. For belowground piping, the full length of each pipe shall rest solidly on the underlying pipe bed.

3.1.1.2 Welded Connections

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

3.1.1.3 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 require 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 shall show after the joint is tighten.

3.1.1.4 Existing Piping Systems

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

No interruptions or isolation of an existing fuel handling service or system shall be performed unless the actions are appropriately documented in the approved work plan. 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.

3.1.2 Bolted Connections

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

3.1.3 Flanges and Unions

Except where threaded end connections and/or unions are indicated, provide flanged joints in each line immediately preceding the connection to a piece of equipment or material requiring maintenance such as pumps, general valves, control valves, strainers, and other similar items and as indicated. Assemble flanged joints square and tight with matched flanges, gaskets, and bolts.

3.1.4 Flange Protectors

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

3.1.5 General Valves

****
NOTE: Show on the drawings double block and bleed plug valves installed upstream of each pump strainer as well as downstream of each filter separator control valve.
****

Install isolation plug or ball valves on each side of each piece of equipment, at the midpoint of looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Install valves with stems vertically up unless otherwise indicated. Provide individual supports and anchors for each valve.

3.1.6 Air Vents

Provide [_____] [50 mm] [2 inches] air vents at all high points and where indicated to ensure adequate venting of the piping system.

3.1.7 Sight Flow Indicator

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

3.1.8 Drains

Provide [_____] [40 mm] [1-1/2 inches] drains at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.9 Flexible Pipe Connectors

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

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

3.1.10 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.

3.1.11 Thermometers

Provide thermometers and thermal sensing elements of control valves 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.

3.1.12 Pipe Hangers and Supports

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

loads exist (e.g., valves).

Table 1. Maximum Hanger Spacing

Nominal Pipe Size (mm)	25 and Under	40	50	80	100	150	200	250	300
Maximum Hanger Spacing (meters)	2	2.75	3	3.5	4.25	5	5.75	6.50	7.0

Nominal Pipe Size (Inches)	One and Under	1.5	2	3	4	6	8	10	12
Maximum Hanger Spacing (ft)	7	9	10	12	14	17	19	22	23

3.1.12.1 Seismic Requirements

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

Support and brace piping and attach valves to resist seismic loads as specified under Sections 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and [13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT][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 equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.1.12.2 Structural Attachments

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

3.1.13 Pipe Sleeves

Provide pipe sleeves at any point where a pipe penetrates a wall, floor, or pit. Do not install sleeves in structural members except where indicated or approved. Extend each sleeve through its respective wall or floor and cut flush with each surface. Install pipe sleeves in masonary structures at the time of the masonary construction. Sleeves shall be of such size as to provide a minimum of 6 mm 1/4 inch all-around clearance between bare pipe and sleeves. Sleeves shall be standard weight carbon steel pipe. Seal penetration of non-fire-rated walls and floors in accordance with Section 07 92 00 JOINT SEALANTS. Seal penetration of fire-rated walls and floors as specified in Section 07 84 00 FIRESTOPPING.

3.1.14 Pipe Casing

****
NOTE: Design casing vents to prevent the influx of rain or groundwater into the casing.
****

Protect piping that crosses under roadways with a pipe casing. Casing shall be continuous for the entire crossing as well as extend a minimum of 150 mm 6 inches beyond both sides of the crossing. Casings shall be of such size as to provide a minimum of 12 mm 1/2 inch all-around clearance between bare pipe and the casing. Alignment of the casing and piping shall be such that the pipe is accurately centered within the casing by a nonconductive centering element. Provide vents and seals at each end of the casing.

3.1.15 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.

3.1.16 Access Panels

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

3.1.17 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.

3.1.18 Framed Instructions

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

3.2 FIELD QUALITY CONTROL

3.2.1 System Commissioning

Conform to Section 33 08 55 COMMISSIONING OF FUEL FACILITY SYSTEMS.

3.2.2 Tests

Labor, materials, equipment, electricity, repairs, and retesting necessary for any of the tests required herein shall be furnished by the Contractor. Perform piping test in accordance with the applicable requirements of ASME B31.3 except as modified herein. To facilitate the tests, various sections of the piping system may be isolated and tested separately. Where

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

3.2.2.1 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. Test shall include all existing underground piping exposed for this project.

3.2.2.2 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.

3.2.2.3 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 shall be no drop in pressure in the pipe greater than that allowed for thermal expansion and contraction. Disconnect the pressure source during the final test period. If leaks are discovered, repair the leaks accordingly and retest.

3.2.2.4 Hydrostatic Test

****

NOTE: Test all product piping with the fuel to be handled, except in environmentally sensitive areas such as fuel piers. Testing with water requires Service Headquarters approval.

If water is to be used for the hydrostatic test, modify this paragraph accordingly. Define who is to provide the water; the Government or the Contractor. If the Contractor is to provide the water, require the water to have a maximum of 250 parts per million of chloride and be sanitized with chlorine or ozone. After testing, document who's responsibility it will be to dispose of the water.

****

Hydrostatically test product piping with the system operating fuel. Test at the corresponding pressures identified in Table 2 for the corresponding product piping material type. 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.

Table 2. Hydrostatic Test Pressures

Product Piping Material Type	Min Test Pressure	Max Test Pressure
Carbon Steel	2930 kPa 425 psig	3103 kPa 450 psig
Stainless Steel (1)	2758 kPa 400 psig	2930 kPa 425 psig
Stainless Steel (2)	2241 kPa 325 psig	2413 kPa 350 psig
Aluminum	1724 kPa 250 psig	1896 kPa 275 psig

Notes:
1. Grade F304 Flanges Used
2. Grade F304L Flanges Used

3.2.3 Manufacturer Field Service

Provide manufacturer's field service representatives at no additional cost to the Government to check each pump and control valve for proper installation prior to system flushing. Following the flushing and adjusting procedures, the service representatives shall also witness as a minimum the first two days of operation. Provide any additional time required due to delays or corrections by the Contractor at no additional cost to the Government. The manufacturer's field service representative shall also instruct the required personnel in the proper operation and maintenance of the pumps and control valves.

3.3 DEMONSTRATIONS

Conduct a training session for designated Government personnel in the operation and maintenance procedures related to the equipment/systems specified herein. Include pertinent safety operational procedures in the session as well as physical demonstrations of the routine maintenance operations. Furnish instructors who are familiar with the installation/equipment/systems, both operational and practical theories, and associated routine maintenance procedures. The training session shall consist of a total of [_____] hours of normal working time and shall 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 --