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USACE / NAVFAC / AFCESA / NASA **UFGS-33 52 44 (April 2006)**

Preparing Activity: USACE **Replacing without change UFGS-11145 (February 2005)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2007

Latest changes indicated by CHG tags
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04/06

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SECTION 33 52 44

AVIATION FUELING SYSTEMS
04/06

****
NOTE: This guide specification covers the requirements for direct fueling systems for aircraft including helicopters.

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 and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).
****

PART 1 GENERAL

1.1 REFERENCES

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

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the

reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

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

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 7	(1995; R 2001) Shaft and Housing Fits for Metric Radial Ball and Roller Bearings (Except Tapered Roller Bearings) Conforming to Basic Boundary Plan

AMERICAN PETROLEUM INSTITUTE (API)

API RP 1110	(1997) Pressure Testing of Liquid Petroleum Pipelines
API RP 2003	(1998) Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents
API Spec 1581	(2002) Specifications and Qualification Procedures for Aviation Jet Fuel Filter/Separators
API Spec 5L	(2004) Specification for Line Pipe
API Spec 6D	(2002; Errata 2005) Specification for Pipeline Valves
API Spec 6FA	(1999; Errata 2006) Specification for Fire Test for Valves
API Std 1529	(2005) Aviation Fueling Hose and Hose Assemblies
API Std 594	(2004) Check Valves: Wafer, Wafer-Lug and Double-Flanged Type
API Std 607	(2005) Fire Test for Soft-Seated Quarter-Turn Valves
API Std 609	(2004) Butterfly Valves: Double Flanged, Lug-and-Wafer Type

API Std 610	(2004) Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(2001) Recommended Practice

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C203	(2002) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2004; Errata 2004) Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.10/A5.10M	(1999) Bare Aluminum and Aluminum Alloy Welding Electrodes and Rods
AWS A5.4/A5.4M	(2006) Stainless Steel Electrodes for Shielded Metal Arc Welding

ASME INTERNATIONAL (ASME)

ASME B16.11	(2005) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2005) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.3	(1998) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	(2004) Valves - Flanged, Threaded and Welding End
ASME B16.39	(1998) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
ASME B16.9	(2003) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.3	(2004) Process Piping
ASME B40.100	(2006) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2004; 2005 Addenda; 2006 Addenda) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2004; 2005 Addenda; 2006 Addenda) Boiler

and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASTM INTERNATIONAL (ASTM)

ASTM A 167	(2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 181/A 181M	(2006) Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A 182/A 182M	(2006) Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 193/A 193M	(2006a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(2006a Standard Specification for) Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service or Both
ASTM A 216/A 216M	(2004) Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A 234/A 234M	(2006a) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 269	(2004) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 276	(2006) Standard Specification for Stainless Steel Bars and Shapes
ASTM A 307	(2004e1) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 312/A 312M	(2006) Standard Specification for Seamless, Welded, and Heavily Worked Austenitic Stainless Steel Pipes
ASTM A 356/A 356M	(2005) Standard Specification for Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines
ASTM A 358/A 358M	(2005) Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for

	High-Temperature Service and General Applications
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 403/A 403M	(2006) Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 733	(2003) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 743/A 743M	(2006) Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM B 241/B 241M	(2002) Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B 26/B 26M	(2005) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B 345/B 345M	(2002) Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube for Gas and Oil Transmission and Distribution Piping Systems
ASTM B 687	(1999; R 2005e1) Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM D 229	(2001) Rigid Sheet and Plate Materials Used for Electrical Insulation
ASTM D 5677	(2000) Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Pipe Fittings, Adhesive Bonded Joint Type, for Aviation Jet Turbine Fuel Lines
ASTM E 94	(2004) Radiographic Examination
ASTM F 1199	(1988; R 2004) Cast (All Temperatures and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)
ASTM F 1200	(1988; R 2004) Fabricated (Welded) Pipe Line Strainers (Above 150 psig and 150 degrees F)

ASTM F 436	(2004) Hardened Steel Washers
ASTM F 436M	(2004) Hardened Steel Washers (Metric)

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

MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application

NACE INTERNATIONAL (NACE)

NACE RP0169	(2002) Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0185	(1996) Extruded, Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe
NACE RP0274	(2004) High Voltage Electrical Inspection of Pipeline Coatings

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(2006) Standard for Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(2003; Errata 2004; Errata 2006) Flammable and Combustible Liquids Code
NFPA 407	(2006) Standard for Aircraft Fuel Servicing
NFPA 70	(2005; TIA 2005) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS3275	(1999; Rev B) Sheet, Acrylonitrile Butadiene (NBR) Rubber and Non-Asbestos Fiber Fuel and Oil Resistant
SAE AS5877	(2001) Aircraft Pressure Refueling Nozzle
SAE J514	(2001) Hydraulic Tube Fittings

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6	(2000; E 2004) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-52747	(Rev F; Notice 1) Nozzle Assembly, Closed-Circuit Refueling, Standard and Arctic Service
MIL-PRF-52748	(Rev F; Notice 1) Nozzle, Adapter, Closed-Circuit to Gravity Fill, Standard and Arctic Service
MIL-PRF-81380	(Rev E) Filter/Monitor, Contamination, Aviation Fuel Dispensing System

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50696	(Basic) Reels, Static Discharge, Grounding, 50 and 75 Foot Cable Lengths

UNDERWRITERS LABORATORIES (UL)

UL 567	(2003; Rev thru Oct 2004) Emergency Breakaway Fittings, Swivel Connectors and Pipe-Connection Fittings for Petroleum Products and LP-Gas
UL 674	(2003; Rev thru Apr 2006) Standard for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(2006) Industrial Control Equipment for Hazardous (Classified) Locations
UL 886	(1994; Rev thru Nov 2005) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations

1.2 SYSTEM DESCRIPTION

****
NOTE: This specification will be used in conjunction with the Naval Facilities Engineering Command (NAVFAC) Definitive Drawings 1403985 and 1403986, Standard Design 78-24-27 "Standard Fueling Systems; Aboveground Vertical Steel Tanks with Floating Pans and Fixed Roofs", and the MIL-HDBK 1022 "Petroleum Fuel Facilities". Include in this specification any additional equipment/devices necessary to meet state and local regulations.
****

This specification section defines the provisions necessary for a complete and totally functional aviation fueling system for direct fueling of aircraft including helicopters. These systems shall be capable of refueling aircraft while engines are [stopped] [either stopped or idling].

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. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" 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.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Aviation Fueling System[; G][; G, [_____]]

Detail drawings including a complete list of equipment and materials.

Leak Detection for Underground Piping[; G][; G, [_____]]

Detail drawings of the entire leak detection system including a complete list of equipment and materials.

SD-03 Product Data

Standard Products[; G][; G, [_____]]

Manufacturer's standard catalog data giving the brand names and catalog numbers of all materials, fueling equipment, accessories, and piping components in sufficient detail to demonstrate complete specification compliance.

Spare Parts Data

Spare parts data for each different item of equipment specified.

Installation

The manufacturer's installation instructions and procedures for the fueling equipment, accessories, and piping components.

Framed Instructions

Framed instructions for posting, at least 2 weeks prior to construction completion.

Leak Detection for Underground Piping

Leak detection system diagrams for posting, at least 2 weeks prior to construction completion, which include distance markings such that alarm indications can be correlated to leak location in plan view if a cable detection system is used. The diagrams shall include a piping and wiring display map with schematic diagrams from the leak detection system manufacturer. The diagrams shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

Experience

A letter listing prior projects, the date of construction, a point of contact for each prior project, the scope of work of each prior project, and a detailed list of work performed. The letter shall also provide evidence of prior manufacturer's training, state licensing, etc.

Welding

A letter listing the qualifying procedures for each welder. The letter shall include supporting data such as test procedures used, what was tested to, etc. and a list of the names of all qualified welders and their identification symbols.

Radiographic Piping Tests[; G][; G, [_____]]

A letter, prior to performing any radiographic pipe test, identifying the commercial or testing laboratory responsible for performing the test. The letter shall define the laboratory's qualifications and previously related job experience.

Verification of Dimensions

A letter stating the date the site was visited and a listing of all discrepancies found.

Fuel Supply

A letter, at least [120] [_____] days prior to fuel delivery, stating the amount of fuel required for testing, flushing, cleaning, or startup of the system. The letter shall define the required dates of each fuel delivery necessary.

Factory Tests

A schedule, at least [2] [_____] weeks prior to the factory tests, which identifies the date, time, and location for the tests.

Tests

A letter, at least [10] [_____] working days in advance of each test, advising the Contracting Officer of the test. Individual letters shall be submitted for the piping tests, the equipment tests, and the system performance tests.

Demonstrations

A letter, at least 14 working days prior to the proposed training date, scheduling a proposed date for conducting the onsite training.

SD-04 Samples

System Flushing

Fuel samples, prior to any flushing procedures, taken from the transfer piping, pump house piping, fueling loop supply and return piping, supply and return piping to the operating tanks, product recovery piping, and each pantograph. Each sample shall be clearly identified according to the location from which it was taken. The Contracting Officer will have a preliminary contamination test performed on the samples. The Government will be responsible for the expense of the test.

Flushing Acceptance

Fuel samples, following flushing procedures but prior to cleaning, taken from the transfer piping, pump house piping, fueling loop supply and return piping, supply and return piping to the operating tanks, product recovery piping, and each pantograph. Each sample shall be clearly identified according to the location from which it was taken. The Contracting Officer will have a contamination test performed on the samples. The Government will be responsible for the expense of the test.

Cleaning Acceptance

Fuel samples, following cleaning procedures, taken from the transfer piping, pump house piping, fueling loop supply and return piping, supply and return piping to the operating tanks, product recovery piping, and each pantograph. Each sample shall be clearly identified according to the location from which it was taken. The Contracting Officer will have a contamination test performed on the samples. The Government will be responsible for the expense of the test.

SD-06 Test Reports

Factory Tests[; G][; G, [_____]]

[Six] [_____] copies of the report in bound 216 by 279 mm 8-1/2

by 11 inch booklets. Report shall certify compliance with the testing and qualification procedures defined in API Spec 1581. The report shall contain complete records of the tests including data sheets, performance curves, chronological test records, photographs, sample calculations, test procedures, and a description of the test apparatus. The report shall include color photographs of the sample elements before and after tests.

Tests[; G][; G, [_____]]

[Six] [_____] copies of each test containing the information described below in bound 216 by 279 mm 8-1/2 by 11 inch booklets. Individual reports shall be provided for the piping tests, the equipment tests, and the system performance tests. Drawings shall be folded blue lines, with the title block visible.

(1) The date the tests were performed.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken.

(4) The parameters to be verified.

(5) The condition specified for the parameter.

(6) The inspection results, signed, dated, and certified by the installer. The certification shall state that required procedures were accomplished, that the procedures were conducted in compliance with the plans and specifications.

(7) A description of adjustments performed.

SD-07 Certificates

Exterior Coatings for Underground Piping

Certification, prior to performing the exterior coating tests, from the tester manufacturer of the electric holiday detector's latest calibration date and crest voltage testing.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

[Six] [_____] complete copies, at least 2 weeks prior to the demonstrations, of operation manuals in bound 216 by 279 mm 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, a brief description of equipment, and the basic operating features of each piece of equipment. The manuals shall include procedures necessary for annual tightness testing of all secondary containment piping.

[Six] [_____] complete copies, at least 2 weeks prior to the demonstrations, of maintenance manuals in bound 216 by 279 mm 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a troubleshooting guide. The

manuals shall include piping, equipment layouts, and simplified wiring and control diagrams of the system as installed.

1.4 QUALIFICATIONS

1.4.1 Experience

****
NOTE: Include any specific local regulatory requirements which must be met by the Contractor.
****

Each installation Contractor shall have successfully completed at least three 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, leak detection, and tank management systems and meet the licensing requirements in the state.

1.4.2 Welding

Welding shall be in accordance with qualifying procedures using performance qualified welders and welding operators. Welding tests shall be performed at the work site. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Each welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05 05 23 WELDING, STRUCTURAL.

1.4.3 Radiographic Piping Tests

****
NOTE: The tests are added safety against piping fatigue or failure for systems under a constant ON/OFF operation.
****

Radiographic piping inspectors shall have qualifications in accordance with ASNT RP SNT-TC-1A or ASTM E 94.

1.5 REGULATORY REQUIREMENTS

The design, fabrication, and installation of the entire aviation fueling system shall be in accordance with this specification, as well as meet all federal, state, and local code requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather and contamination. Proper protection and care of material before, during, and after installation shall be the Contractor's responsibility. Any material found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.7.2 Fuel Supply

Fuel required for the flushing, cleaning, and testing of materials, equipment, piping, meters, pumps, instruments, etc., as specified in this section will be provided by the Contracting Officer. The Contracting Officer will also furnish the operators, equipment, and services as necessary for filling the system's fuel storage tanks. The Contractor shall provide the labor, equipment, appliances, and materials as required for the flushing, cleaning, and testing operations. Systems shall not be flushed, cleaned, or tested with any 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.

1.7.3 Spare Parts Data

The Contractor shall submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than [_____] months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

1.7.4 Detail Drawings

1.7.4.1 Aviation Fueling System

The Contractor shall submit detail drawings containing the following:

a. Complete piping and wiring drawings and schematic diagrams of the overall system.

b. Equipment layout and anchorage.

c. Clearances required for maintenance and operation.

d. Any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

1.7.4.2 Leak Detection for Underground Piping

The Contractor shall submit detail drawings containing the following:

a. An overview drawing detailing the leak detection system operation.

b. Wiring schematics for all parts of the system showing each operating device and listing their normal ranges of operating valves (including pressures, temperatures, voltages, currents, speeds, etc.).

c. Single line diagrams of the system.

d. Alarm panel layout along with panel mounting and support details.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Material and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and material under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. 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. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations. The completed installation shall conform to the applicable requirements of NFPA 30.

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.
****

Specified equipment, gauges, thermometers, and valves shall have an attached nameplate to list the manufacturer's name, address, component type or style, model or serial number, catalog number, capacity or size, and the system which is controlled. Plates shall be durable and legible throughout equipment life and made of [anodized aluminum] [stainless steel] [_____]. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.3 ELECTRICAL WORK

****
NOTE: The maximum temperature rating of electrical equipment will be equal to the ignition temperature of the fuel to be handled. Ignition temperatures will be as defined in NFPA 497M.
****

Electrical equipment, motors, and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Each motor shall conform to NEMA MG 1 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage. Electrical characteristics shall be as shown, and unless otherwise indicated, motors of 373 W 1 horsepower and above shall be the continuous duty, high efficiency type. Switches and devices necessary for controlling the electrical equipment shall be

provided. Pumps shall be completely wired and ready for connection to the power circuit. Wiring, motors, equipment, and fittings, unless otherwise indicated, shall be explosion-proof in conformance with the applicable requirements of UL 674, UL 698, and UL 886 for Class I, Division 1, Group C and D hazardous locations. Electrical equipment shall conform to the requirements of NFPA 70. Electrical equipment shall have a maximum temperature rating of [_____] in accordance with NFPA 70, Article 500-3.

2.4 MATERIALS

2.4.1 Fuels

Materials which come in contact with any fuel shall be stainless steel, aluminum, interiorly coated carbon steel, or fiberglass. No zinc coated metals, brass, bronze, or other copper bearing alloys shall be used in contact with the fuel to be handled.

2.4.2 Gaskets

Gaskets shall be factory cut from one piece of material and be resistant to the effects of aviation hydrocarbon fuels.

2.4.2.1 Nitrile Butadiene (Buna-N)

Buna-N material shall be in accordance with SAE AMS3275.

2.4.2.2 Acrylonitrile Butadiene Rubber (NBR)

NBR material shall conform to SAE AMS3275.

2.4.3 Electrically Isolating Gaskets for Flanges

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

Flanges shall be provided with an electrical insulating material of 1000 ohms minimum resistance conforming to ASTM D 229. The material shall be resistant to the effects of aviation hydrocarbon fuels. Gaskets shall be full face and shall be provided between flanges. Flanges shall have full surface 762 micrometers 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. High-strength 3.2 mm 1/8 inch thick phenolic insulating washers shall be provided next to the flanges with flat circular stainless steel washers over the insulating washers. Bolts shall be long enough to compensate for the insulating gaskets and stainless steel washers.

2.4.4 Electrically Isolating Unions

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

Unions shall be provided with an electrical insulating material of 1000 ohms minimum resistance conforming to ASTM D 229. The material shall be resistant to the effects of aviation hydrocarbon fuels.

2.4.5 Concrete Anchor Bolts

Concrete anchors shall be Group II, Type A, Class 2, in accordance with ASTM A 307.

2.4.6 Bolts

Bolts shall be in accordance with ASTM A 193/A 193M, Grade B8.

2.4.7 Nuts

Nuts shall be in accordance with ASTM A 194/A 194M, Grade 8.

2.4.8 Washers

Washers shall be in accordance with ASTM F 436M ASTM F 436, flat circular stainless steel. Washers shall be provided under each bolt head and nut.

2.5 FUELING EQUIPMENT

2.5.1 Pantograph

Assembly, including all components, shall be constructed of Schedule 10S, Grade TP304L, stainless steel in accordance with ASTM A 312/A 312M or Schedule 80 aluminum alloy 6061-T6 in accordance with ASTM B 241/B 241M. Intermediate and end swivel joints shall have spring-loaded casters and tires. Pantograph shall be designed so that tires rest upon the apron regardless of the different pavement conditions. The hose dispensing end shall couple to aircraft at heights of 300 mm 12 inches to [_____] m feet above the apron. The overall electrical resistance throughout the entire length of the pantograph shall not exceed 1000 ohms. Grounding straps across the swivel joints are not permitted. Welded reinforcing shall be added on the underside of the pipe sections to avoid sagging. Steel members used for reinforcement shall be in accordance with ASTM A 36/A 36M. Pantograph shall be delivered completely assembled from the manufacturer. The piping assembly shall be a nominal [50] [80] [100] mm [2] [3] [4] inches in diameter and be capable of expanding to reach [_____] m feet. Pantograph shall be supplied with a draw bar or pull handle for positioning.

2.5.1.1 Pressure Fueling Nozzle

****

NOTE: Delete the last sentence if inapplicable.

Coordinate the type of nozzles required with the type of aircraft to be refueled. Delete any inapplicable nozzles.

SAE AS5877 nozzles have an I.D. of 63.5 mm (2-1/2 inches) and are intended for flow rates up to 38 L/s (600 gpm) at 241 kPa (35 psi), 310 kPa (45 psi) or 380 kPa (55 psi). MIL-PRF-52747 nozzles have an I.D. of 38.1 mm (1-1/2 inches) and are intended for flow rates of 2.2 L/s (35), 4.1 L/s (65), or 6.3 L/s (100 gpm) at 0 to 860 kPa (0 to 125 psi). Indicate the required nominal flow rate and operating pressure required on the drawings.

SAE AS5877 nozzle, Type D-1R, incorporate a 45 degree inlet configuration for preferential horizontal refueling. Type D-2R nozzles incorporate a straight inlet configuration for preferential vertical refueling.

Note that both the MIL-PRF-52747 nozzles and the SAE AS5877 nozzles will be provided with a pressure regulating device. The pressure regulators will work as a safety backup to the pantograph control valve in controlling the fuel pressure. Note that these pressure regulators are nonadjustable. Indicate on the drawings that the setting for each pantograph control valve is 5 psi lower than the setting of the pressure regulator at the corresponding nozzle.

****

Nozzles shall conform to [SAE AS5877, Type [D-1R] [D-2R]] [MIL-PRF-52747, Type I, Class A]. Nozzle shall include a pressure regulating device which limits the downstream pressure as indicated. Nozzles and nozzle components shall be compatible with the pantograph assembly and with the fuel to be handled. Nozzles shall be provided with an internal 60 mesh stainless steel strainer and a fuel sample connection tapping. Nozzle design shall be for single point fueling of aircraft. Nozzles shall be provided with a compatible dry break quick disconnect coupler and actuator. Coupler shall allow for quick disconnect and reconnect of fueling nozzles with corresponding adapters. Coupler and adapter shall provide a positive, leakproof connection under constant or surge flow. Coupler shall be designed to prevent blowout of internal poppet. MIL-PRF-52747 nozzles shall be provided with a nozzle adapter in accordance with MIL-PRF-52748 in order to allow for open port or gravity fill dispensing.

2.5.1.2 Emergency Breakaway Coupler

Coupler shall be the emergency breakaway type connected to the last swivel in the pantograph assembly to allow dry breakaway at 890 N 200 pounds tensile loading. Coupler shall be of the same material as the pantograph assembly, shall be compatible with the fuel to be handled, and shall be line size. Unit shall operate independently of internal pressure and shall be capable of reinstallation without replacement parts. Coupler shall provide complete shutoff of the fueling line in the event of separation.

2.5.1.3 Aviation Fueling Hose

****

NOTE: Delete this paragraph if a hoseless type pantograph assembly is required. Hoseless type pantographs should be used exclusively for hot pad refueling (engines running) systems.

****

A 3 m 10 foot length of [50] [80] inch [2] [3] inch diameter aviation fueling hose shall be provided for each pantograph. Hose shall be in accordance with NFPA 407 and API Std 1529, Grade 3, Type C, semi-hardwall. Hose shall be designed for use with designed for use with the specified fuel for a working pressure of 2.07 MPa 300 psig. Hose shall be constructed of braided synthetic cord surrounded by an interior rubber tube and an exterior rubber cover. Permanent brass couplings and bonding wire

wrapped with a minimum of 10 coils around the exterior of the hose shall be provided and connected to both couplings.

2.5.1.4 Hose Tray and Nozzle Holder

****
NOTE: Delete this paragraph if a hoseless type pantograph assembly is required. Hoseless type pantographs should be used exclusively for hot pad refueling (engines running) systems.
****

Each pantograph shall be provided with a horizontal hose tray and nozzle holder. The tray and holder shall support the entire length of aviation fueling hose as well as the pressure fueling nozzle. The hose tray shall allow complete drainage of rain water. The tray and holder shall be constructed of aluminum or stainless steel compatible with the piping.

2.5.1.5 Spring-Loaded Casters and Tires

Pantograph shall be equipped with spring loaded casters made of steel or cast steel, galvanized or hot-dipped galvanized. Caster swivel head shall be equipped with low lubricated ball bearings with grease nipples. Wheels shall be equipped with two lubricated grooved ball bearings with grease nipples. Pantograph tires shall be 203 mm 8 inch diameter solid oil resistant polymer tires and may be mounted independent of swivel joints or as part of the swivel joint.

2.5.1.6 Flanged Swivel Joints

Anchor end swivel joints, intermediate swivel joints, and hose end swivel joints shall have flanged connections capable of 360 degree rotation. Swivel joints shall be of the non-lubricated type with non-lubricated bearings. Welded swivel joints and welding of swivel joints to the pipe and/or elbow will not be permitted. Welding of swivel joints to flange joints will not be permitted. Swivel joints shall come from the manufacturer with required flanged bodies and flanged elbows. Swivel joints shall be warranted for 2 years against leakage due to both positive and negative pressure conditions.

2.5.1.7 Counterbalancing

****
NOTE: Delete this paragraph if a hose end type pantograph assembly is required.
****

Each pantograph assembly shall be supplied with [hydraulically actuated cylinders] [spring counterweights] to counter balance the weight of the dispensing end to ensure that only minimum force occurs when connecting pantograph to aircraft. One person shall be able to operate the dispensing end.

2.5.2 Fuel Sample Connections

Quick disconnects shall be compatible throughout the piping systems, fit in 9.5 mm 0.375 inch ports and extend outward less than 21.3 mm 0.84 inch from the port boss. Each disconnect shall be provided with an aluminum dust plug with bronze chain.

2.5.3 Nozzle Adapter

Adapter shall be the international standard 3-lug, 65 mm 2-1/2 inches (nominal) aircraft type adapter which is compatible with the type of nozzle specified. Adapter shall include an internal self-closing valve or poppet which is drip-tight throughout the entire specified temperature range and which is compatible with the associated working pressures. Adapter shall be constructed of stainless steel or aluminum and be compatible with the associated fuel. Adapter shall be provided with a dust cap. Adapter shall be provided with a 100 mm 4 inch flange connection.

2.5.4 Filter Separator

Unit shall be tested and qualified in accordance with the performance requirements of API Spec 1581, Group II, Class B, except as modified herein.

2.5.4.1 Housing Vessel

****
NOTE: Carbon steel construction will only be used for Air Force projects.
****

Unit shall be fabricated from [carbon steel internally coated with an epoxy coating in accordance with Section 09 97 13.15 INTERIOR COATING OF WELDED STEEL PETROLEUM FUEL TANKS] [aluminum] [stainless steel]. Unit shall be constructed and labeled in accordance with ASME BPVC SEC VIII D1. The housing shall be designed for a working pressure of 1.03 MPa 150 psig. Unit shall be horizontal, end-opening type with coalescers and separators mounted side-by-side (coalescers at the bottom of the vessel and separators at the top). The head opening shall be equipped with a hinged or pivoting device to facilitate swinging the head to one side for servicing. The hinges or pivots shall support the head during servicing without distortion or misalignment. Swing-type bolts shall be used on main closures. Unit shall be provided with 80 mm 3 inch inside diameter lifting eyes spaced to support the entire weight of the unit. The housing shall be provided with a 19 mm 3/4 inch inlet compartment fuel drain plug. A hand hole access plate shall be provided in the inlet compartment. Gaskets and O-ring shall be Buna-N construction. Threaded base mounting adapters shall be provided for the coalescers. The separators shall be mounted on adapters with blunted "Vee" type knife edges.

2.5.4.2 Legs

Unit shall be provided with four each 80 by 80 by 6 mm 3 by 3 by 1/4 inch angle-shaped legs welded to the housing. Each leg shall be fitted with a 100 by 100 by 13 mm 4 by 4 by 1/2 inch base plate.

2.5.4.3 Inlet and Outlet Connections

The inlet and outlet connections shall be [_____] [150] mm [_____] [6] inch nominal pipe size and be located parallel to each other as indicated. Both inlet and outlet shall be provided with flanged end connections.

2.5.4.4 Manual Drain Valve

Unit shall be equipped with a 19 mm 3/4 inch stainless steel manual ball valve on a water and fuel drain line. The valve shall allow the drainage

of water, fuel, and sediment from the unit by gravity.

2.5.4.5 Sight Gauge

Unit shall be provided with a 13 mm 1/2 inch clear liquid level gauge for observing the water accumulation in the sump. The gauge shall be equipped with nickel-copper alloy ball checks in both the upper and lower fittings, an upper and lower shutoff valve, and a bottom blowoff cock. The gauge shall contain a colored density sensitive ball.

2.5.4.6 Automatic Air Eliminator and Pressure Relief Valve

Unit shall be provided with an angle pattern pressure relief valve on top of the unit to assure the design working pressure of the unit is never exceeded. An automatic air eliminator shall be installed on top of the unit to vent trapped air from within the vessel. The air eliminator shall release at pressures up to 1.03 MPa 150 psi with no fuel leakage. The air eliminator shall be provided with a nonreturn check valve feature, opening pressure of 7 kPa 1 psi, to prevent air from being drawn into the unit via the air eliminator.

2.5.4.7 Sampling Connections

Sampling connections shall be provided at the inlet and outlet connections to the housing. Each sampling connection shall consist of a 6 mm 1/4 inch sampling probe where the probe faces upstream, a ball valve, a quick disconnect coupling, and an aluminum dust cap. The sampling connections shall be capable of accepting a sampling kit for drawing the samples required to assure fuel quality.

2.5.4.8 Spider Assembly

Unit shall be provided with a spider assembly to hold the coalescers and separators in position and to support against vibration. The method of stabilization shall assure an electrical bond between the spider and the vessel.

2.5.4.9 Coalescer and Separator Cartridges

Unit shall be provided with coalescers and separators that have been qualified to the performance requirements of API Spec 1581, Group II, Class B. Separators shall be 200 mesh stainless steel coated on both sides with Teflon. Coalescers shall have a minimum capacity of 5.7 mL/s per mm 2.27 gpm per inch of length, and separators shall have a minimum capacity of 20.7 mL/s per mm 8.33 gpm per inch of length.

2.5.4.10 Differential Pressure Gauge

The unit housing shall be equipped with a direct-reading, piston type differential pressure gauge that measures the differential pressure across both coalescers and separators. The gauge shall consist of a spring-supported, corrosion resistant piston moving inside a glass cylinder. The cylinder shall have stainless steel end flanges with Viton O-ring seals. The high pressure inlet of the gauge shall have a 10 micrometer 10 micron pleated paper filter and the low pressure connection shall have a fine mesh stainless steel strainer. The gauge shall have an operating pressure of 2.06 MPa 300 psi with a cylinder burst pressure of not less than 8.3 MPa 1200 psi. Differential pressure range of the gauge through approximately 75 mm 3 inches of piston movement shall be 0-210 MPa

0-30 psi with an accuracy of plus or minus 3.5 kPa 0.5 psi, calibrated linearly with 7 kPa 1 psi scale graduations. High and low pressure connections shall be 6 mm 1/4 inch NPT female with a stainless steel bar stock valve at each connection. Construction of the gauge shall be such that a 3-valve manifold is not necessary. If only one bar stock valve is closed, the gauge shall not be damaged by up to 2.06 MPa 300 psi differential pressure in either direction. The differential pressure gauge shall be attached to the filter separator by a gauge panel.

2.5.5 Venturi Tubes

Venturi tubes shall be constructed of Type 304L stainless steel with flanged end connections on each end suitable for a working pressure of 1.9 MPa 275 psig at 38 degrees C 100 degrees F. Venturi tubes shall be low loss differential pressure producers consisting of a short housing piece and fully machined, contoured throat section providing a restriction at the center, with both inlet approach and exit having geometrically symmetrical curves. Venturi tubes shall be velocity head, impact, differential producing devices designed to measure differential pressure of the fuel being handled. Tubes shall be of sufficient thickness to withstand the same stresses as the upstream and downstream piping.

2.5.5.1 Discharge Coefficient

Venturi tubes discharge coefficient "C" shall be greater than or equal to 0.97 over pipe Reynolds number range between 200,000 and 1,000,000 and shall be independent of Beta over a Beta range of 0.4 to 0.75. Pressure loss shall be less than 24 percent of differential pressure generated by the venturi tube. Repeatability of the discharge coefficient "C" shall be 2 percent for Reynolds number range of 10,000 to 1,000,000.

2.5.5.2 Manometer

One manometer, complete with hoses, shall be provided with fittings and suitable tables for each venturi tube. The tables shall convert Pascal inches differential pressure to L/second gpm. Maximum range of the manometer shall be 1-1/2 times the maximum flow tube differential. Manometers shall be furnished with a permanent carrying case capable of storing the manometer, hoses, fittings and tables.

2.5.5.3 Issue and Return Venturi Tubes

****
NOTE: Indicate the minimum inlet-to-throat differential pressure for each venturi at rated flow.
****

Each venturi shall have a minimum of four each 13 mm 1/2 inch connections to allow for the connection of differential pressure transmitters.

2.5.5.4 Pantograph Venturi Tubes

Pantograph venturi shall provide for compensated pressure regulation on each pantograph control valve. Venturi shall be sized to compensate for the pressure drop through the entire pantograph assembly at the minimum through maximum flow rate. The amount of recoverable pressure drop shall be adjustable and the maximum unrecoverable pressure drop at [_____] [37.9] L/s [_____] [600] gpm shall be less than [_____] [69] kPa [_____] [10] psi. Venturi control lines shall be provided with a needle valve to be used

during final adjustment of pantograph. Venturi control lines shall be provided with a Type 316 stainless steel pressure gauge (with an indicating range between 0 and 690 kPa 0 and 100 psig) and a stop cock. Venturi shall be provided with stainless steel fuel sensing line for connection to refueling control valve pilot control system.

2.5.6 Fuel Meter

****

NOTE: Fuel meters will be provided at each aircraft direct fueling station and each truck fill stand in accordance with MIL-HDBK 1022 "Petroleum Fuel Facilities". For each meter, indicate the maximum flow rate to be metered as well as the allowable pressure drop at the maximum flow rate.

****

Meter shall be of the continuous duty, positive displacement, straight-through flow type, designed for outdoor installation. Meter shall be capable of handling diesel fuel, automotive gasoline, aviation gasoline and aviation jet fuels at a flow of 38 L/s 600 gpm. Meter shall be constructed of either Type 304 or 316 stainless steel or 3003, 6061-T6, or 356-T6 aluminum alloy and be in accordance with ASME BPVC SEC VIII D1. Meter shall be suitable for hydrostatic testing at 1900 kPa 275 psig. Meter shall be reversible and be capable of momentary overspeeding to 115 percent of maximum rated capacity without damage or impairment of accuracy. Pressure drop across a meter shall not exceed 35kPa 5 psig when operated at rated capacity. Meter shall be provided with 150 mm 6-inch Class 300 flanges in accordance with ASME B16.5. Meter shall be a manufacturer's standard commercial product. Meter shall be so designed and constructed as to prevent parts from working loose in service and permit easy accessibility for maintenance and service in the field. Meter shall be treated and painted in accordance with the manufacturer's standard practice. A leakproof drain shall be provided at the lowest point of the meter housing. [Meter shall be provided with electronic thermal compensation capability.] [Meter shall be equipped with a heating device for protection from low or freezing temperatures.] [Meter shall be provided with a card printer.] Meter shall be equipped with an accuracy adjustment mechanism that will operate without change during the life of the meter, except by manual adjustment. Meter shall be factory calibrated. Manual adjustment of a meter shall be possible while under pressure without leakage or loss of product and without requiring disassembly other than removal of a cover plate. Meter shall be equipped with a digital readout register mounted on the meter housing. Meter register shall contain a seven-figure nonsetback totalizer and a five-figure setback flow indicator without the mL tenth-of-gallon indicator. Digits on a meter register shall be a minimum 19 mm 3/4 inch in height. Meter error shall not exceed 0.1 percent for any one predetermined flow rate and accuracy setting. The maximum meter error shall not exceed 0.3 percent for any one given accuracy adjustment at any flow rate ranging from 1.9 to 37.9 L/second 30 to 600 gpm.

2.5.7 Fuel Quality Monitor

Monitor shall be in accordance with MIL-PRF-81380, except as modified herein. Monitor shall have Type 304 or 316 stainless steel or Types 3003 or 6061-T6 aluminum alloys fabricated housing with flanged inlet and outlet, two gauge taps, an air release tap complete with automatic air eliminator, and a 19 mm 3/4 inch drain valve. Fuel quality monitor elements shall also conform to MIL-PRF-81380 for test procedures and

performance requirements, except elements shall be of the slow-closing, water-absorbing type. Piston type direct-reading pressure differential gauge shall be provided wherein the piston moves downward in a glass cylinder along a 0 to 210 kPa 0 to 30 psi graduated scale; permanent set of the spring shall be clearly visible by the position of the piston when there is no differential pressure. One complete set of elements for each unit shall be provided along with a calibrated tag showing differential pressure versus fuel flow for clean and dirty elements. One complete spare set of elements for each unit shall be provided.

2.5.8 Fuel Pumps

****
NOTE: Indicate the capacity, discharge head pressure, net positive suction head available, overall efficiency, voltage, phase, frequency, etc., required for each pump.
****

Pump assembly shall be statically and dynamically balanced for flow rates which range from 0 up to 120 percent of design flow. Pump case shall be designed for a 1.9 MPa 275 psi maximum operating pressure. Pump shall be driven by an explosion-proof motor for Class I, Division 1, Group D, hazardous locations as defined in NFPA 70. Motor shall be provided with lifting lugs on the motor casing. Pump motor shall not exceed 3,600 rpm nominal. Pump shall be accessible for servicing without disturbing connecting piping. Pumps shall be in accordance with API Std 610, except as modified herein.

2.5.8.1 Centrifugal

Pump shall be the single-stage, non-overloading, [horizontal, end-suction with vertical discharge] [vertical in-line] centrifugal type. Pump shall have a vertical or radial split case with enclosed impellor and flanged end connections. Pump gaskets shall be inert in the product to be pumped. Shaft seals shall be the stuffing-box type. The gasket fit for seal gland to stuffing-box shall be of the controlled compression type with metal-to-metal joint contact. Pump shall have oil lubricated, anti-friction, radial and thrust bearings. The bearings shall be selected to give a minimum L-10 rating life of 25,000 hours in continuous operation. Bearings shall be retained on the shaft and fitted into housings in accordance with ABMA 7. The bearing housing shall be finned for maximum air cooling and heat dissipation. Pump shall be of the back pull-out design to permit access to internal parts without disturbing the suction or discharge piping or the driver. Pump shall be constructed of the following materials:

a. Case and Cover: Stainless steel ASTM A 743/A 743M CR CF8M or GR CA6NM or aluminum ASTM A 356/A 356M GR T6.

b. Impeller: Stainless steel ASTM A 743/A 743M CR CF8M or GR CA6NM.

c. Wear Rings: Stainless steel ASTM A 182/A 182M GR F6 or ASTM A 276 TP410 or 416.

d. Shaft: Stainless steel ASTM A 276 Type 410 or 416 with renewable shaft sleeve of ASTM A 276 Type 316L with hard facing under mechanical seal gasket.

e. Baseplate: Cast iron construction.

2.5.8.2 Vertical Turbine

Pump shall be a [single] [multi] stage vertical turbine pump with flanged end connections as indicated. Shaft shall be stainless steel ASTM A 276 Type 410 or 416 with renewable shaft sleeve of ASTM A 276 Type 316L with hard facing under mechanical seal gasket. Pump materials shall be non-corrosive compatible with the fuel to be handled. Baseplate shall be suitable for pedestal mounting as indicated. Bearings shall be grease-lubricated with a grease fitting mounted above the base. Each stage of the pump shall be flanged and bolted together. Pump shall be provided with a suction bell to allow smooth entry of liquid into the impellor eye, while minimizing vortex formation.

2.5.9 Flow Switch

Switch shall be actuating vane type flow switch with single adjustable set-point. Switch shall mount on a flanged end connection. Switch shall be provided with a snap action switch mechanism which is UL listed for Class 1, Division 1, Group D hazardous locations. Switch to be double pole double throw. Switch power shall be 120 volts, single phase, 60 hertz, and 10 amps minimum.

2.5.10 Differential Pressure Transmitter

Transmitter shall consist of a bellows type pressure-sensing element and an indicating gauge and shall be capable of providing an analog two-wire electrical 4-20 milliamp signal directly proportional to the differential pressure across the corresponding venturi tube. Indicator accuracy shall be 0.5 percent of full scale and transmitter accuracy shall be 0.25 percent of pointer indication. Transmitter shall be provided with built-in pulsation damper and suitable over-range protection. Transmitter shall not require recalibration due to power outages. Transmitter shall be UL listed for Class 1, Division 1, Group D hazardous locations. Each transmitter shall be supplied with a factory assembled five-valve stainless steel manifold. Vent valves shall be furnished on upper ports of each transmitter. Differential pressure ranges shall be selected as necessary to operate in conjunction with corresponding venturi tubes. Transmitter shall be mounted and installed according to manufacturer's recommendations.

2.5.10.1 Bellows Type Pressure Sensing Element

Bellows pressure sensing element shall operate on a differential in pressure of fuel and shall be dual opposed, liquid filled, rupture-proof type with bellows movement converted to rotation and transmitted by a torque tube. Displacement of bellows shall be 25 mL 1-1/2 cubic inches for full scale travel. Bellows housing shall be stainless steel and shall have a rated working pressure of not less than 3.5 MPa 500 psi. Differential pressure ranges shall be selected as necessary to operate in conjunction with the associated venturi tube. During operating conditions the pointer shall be approximately in the mid-range of the gauge. Liquid used to fill the bellows shall be suitable for the expected minimum ambient temperature.

2.5.10.2 Indicating Gauge

The indicating gauge shall be an indicating dial at least 150 mm 6 inches in diameter with a weatherproof glass cover. The gauge shall be driven by the bellows unit. The case shall be finished with a weather resistant

epoxy resin enamel. The indicating pointer shall traverse a 270 degree arc. The scales shall be graduated over the selected pressure ranges so that the flow rate can be accurately read in L/second gpm.

2.5.11 Relaxation Tank

****
NOTE: Relaxation tanks may be deleted if piping configuration allows sufficient capacity to retain the maximum flow of the fueling stations for 30 seconds and if fuel is not JP-5.
****

Tank shall be in accordance with API RP 2003. Tank shall be fabricated from aluminum. Unit shall be constructed and labeled in accordance with ASME BPVC SEC VIII D1. Housing shall be designed for a working pressure of 1.03 MPa 150 psig. Tank shall have air eliminator, pressure relief valve, drain valve, and internal baffling to prevent flow short circuiting. Relaxation time at maximum flow rate of the system shall be a minimum 30 seconds from the last filter or monitor to the exit point in a tank that may contain air. Each tank shall be provided with an ASME pressure vessel seal.

2.5.12 Hydraulic Deadman Control, Fuel Sensing Hose, and Hose Reel

Deadman controls shall be hydraulically connected to the pilot system of the pantograph control valve. The deadman shall contain a manually activated ON/OFF deadman switch. The pantograph control valve shall open when the deadman switch is pressed and close when the deadman switch is released. The pantograph control valve shall fail closed in the event of a malfunction with the deadman control. Each deadman control shall be provided with a self winding reel and [8] [23] m [25] [75] feet of fuel sensing hose. Hose shall be dual type with Buna-N tube, vertically braided textile body with fuel resistant neoprene cover with stainless steel fittings. Controls shall be compatible with the fuel to be handled.

2.5.13 Grounding Cable Reel

Each pantograph shall be provided with a self winding reel with 23 m 75 feet of grounding cable. The cable reel, the grounding cable, and the connection clamp shall be in accordance with CID A-A-50696, except as modified herein.

2.5.14 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.
****

Pit shall be prefabricated units that are the standard products of a firm regularly engaged in their manufacture. Pit shall consist of minimum 6.4 mm 1/4 inch thick fiberglass 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.

2.5.14.1 Pit Cover

Pit cover shall be cast aluminum and shall be a hinged door in lip ring design. The assembly shall be removable, including the ring. The pit cover shall be designed to 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. Cover shall be in accordance with ASTM B 26/B 26M, and be either a Number 356 alloy with a final temperature designation of T-6; or be Number 713 alloy with a final temperature designation of T-5. 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. Pit cover shall not be painted. 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 inch total indicator runout. Unit shall be provided with minimum 13 mm 1/2 inch diameter hinge pin in a free floating hinge assembly. Cover shall be provided with latching device for holding cover in the closed position.

2.5.14.2 Pipe Riser Seal

The riser pipe penetration through the pit floor shall be sealed by means of a Buna-N boot. The boot shall be secured 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.

2.6 ACCESSORIES

2.6.1 Leak Detection for Underground Piping

The leak detection equipment selected shall be sensitive to the presence of the fuel being handled as well as water. The leak detection equipment shall be compatible with each type of aviation fuel to be handled. The leak detection system shall provide continuous integrity check on the status of each sensor's connections and wiring. Normally open or normally closed nomenclature on the sensors will not be acceptable. Underground piping shall be provided with both an automatic line leak detector and a method for periodic line tightness testing. The system shall also monitor each vent, drain and valving pit for the presence of the fuel being handled as well as water. Line leak detectors shall be capable of detecting a leak against a minimum 1.8 m 6 feet of head pressure.

2.6.1.1 Automatic Line Leak Detector

Underground product piping shall be monitored by an automatic line leak detector which can detect a minimum leak rate of 3 mL/s 3 gallons per hour at 69 kPa 10 psig line pressure within 1 hour. The detector shall have a probability of detection of 95 percent and a probability of false alarm of 5 percent.

2.6.1.2 Line Tightness Testing

****
NOTE: If secondary containment piping is not used, delete subparagraph b. If secondary containment piping is used, both options should be given.
****

The monitoring system shall be capable of detecting a leak from any portion

of the below grade product piping. Means shall be provided to allow for periodic line tightness testing by providing one of the following:

a. An automatic line leak detector, as specified above, which is also capable of detecting a minimum leak rate of 0.1 mL/s 0.1 gallons per hour at 1.5 times the operating pressure on a monthly basis or;

b. An automatic line leak detector, as specified above, which is also capable of detecting a minimum leak rate of 0.08 mL/s 0.08 gallons per hour at normal operating pressure on a monthly basis or;

c. A continuous and automatic system capable of monitoring the interstitial space between the primary product piping and the exterior containment piping for product leaks.

2.6.2 Leak Detection Alarm Panel

The alarm panel shall be connected to each piping leak detection system and shall be capable of providing an audible and visual alarm in the event of a detected leak. The panel shall provide audible and visual alarms for any failed integrity check. The panel shall provide a means of delineating between individual alarm conditions.

2.6.2.1 Panel Housing

****
NOTE: Panels located outdoors will require NEMA 4 enclosures. Panels located indoors will only require a standard industrial enclosure. Explosion-proof enclosures are currently unavailable.
****

Panels shall be housed in a [NEMA 4 rated enclosure in accordance with NEMA 250] [standard industrial enclosure]. Each alarm panel shall have a hinged door to swing left or right (doors shall not swing up or down). Panels using computer memory shall be capable of maintaining current programmable information in the event of a power failure.

2.6.2.2 Audible Alarm

Alarm shall be a buzzer sounding at 70 decibels or greater.

2.6.2.3 Visual Alarm

Each visual alarm shall indicate the type and location of the alarm condition. Visual alarms shall be capable of delineating between individual alarm conditions.

2.6.2.4 Acknowledge Switch

Each leak detection panel shall be provided with a manual acknowledge switch which shall be capable of deactivating the audible alarm. The acknowledge switch shall not be capable of deactivating subsequent audible alarms unless depressed manually again for each occurrence. This acknowledgement switch shall not extinguish the visual alarms until the alarm condition has been corrected. Switches shall be an integral component located on the front panel and shall be either a key switch or push button.

2.6.3 Emergency Shutdown Station

Activation of the emergency shutdown pushbutton shall shut down power to the entire fueling system and send an alarm signal to the fire department as indicated.

2.6.3.1 Station Housing

Housing shall be 1.311 mm 18 gauge galvanized steel with a watertight enclosure, a replaceable break glass front with hammer, and an open bottom. The galvanized enclosure shall be painted red. Mounting hardware shall be corrosion resistant.

2.6.3.2 Pushbutton

The emergency pushbutton shall be mounted inside the station housing and shall be accessible through the break glass front. Pushbutton shall be a single unit with a jumbo mushroom operator, 1-NC and 1-NO contact, and a NEMA 4 enclosure. During activation, the pushbutton shall maintain contact until deactivated by a key release.

2.6.3.3 Caution Sign

Sign, mounted on each side of the emergency shutdown station, with red 50 mm 2 inch letters stating "HYDRANT FUELS EMERGENCY SHUTDOWN". Sign shall have a white background and shall be of noncorrosive construction.

2.6.4 Pump Control Start/Stop Station

Station shall be an 1.311 mm 18 gauge galvanized steel NEMA 4 enclosure with a start pushbutton, a stop pushbutton, and a green indicating light. The sequence of operation for the station shall be as indicated on the drawings. A pump control start/stop station shall be provided where indicated for each pantograph assembly. Mounting hardware shall be corrosion resistant. During activation, the start pushbutton shall maintain contact until deactivated by the stop pushbutton. The stop pushbutton shall maintain contact until deactivated by the start pushbutton.

2.6.5 Pump Control Panel

****
NOTE: Indicate the control sequences for all equipment and components on the drawings.
****

The control panel shall include on and off indication lights for each pump. The panel shall contain an adjustable control logic for pump operation in accordance with the indicated operation. The panel shall also have a manual override switch for each pump to allow for the activation or deactivation of each pump. Panel, except as modified herein, shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.6.6 Underground Wiring

Underground electrical wiring shall be enclosed in PVC coated conduit. Conduit shall be dielectrically isolated at any steel storage tank connection.

2.6.7 Bonding

Electrical bonding of materials shall be performed in accordance with NFPA 70. The fuel piping system shall be bonded in metallic contact to provide electrical continuity to fixed and moving components for grounding the entire system. Jumpers shall be provided to overcome the insulating effects of gaskets, paints, or nonmetallic components. Minimum size ground conductor shall be Number 6, with single covered, flexible, stranded, copper conductor, Type RR-USE. Dielectric connections shall be provided in each riser pipe for underground piping protected by impressed current.

2.6.8 Buried Utility Tape

Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape shall be provided for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Tape shall be provided in minimum 75 mm 3 inch width rolls, color coded for the utility involved, with warning identification imprinted in bold black letters continuously and repeatedly over entire tape length. Permanent code and letter coloring shall be used which is unaffected by moisture and other substances contained in trench backfill material.

2.7 PIPING COMPONENTS

****
NOTE: Indicate on the drawings piping configuration, slope, sizes, and piping materials (i.e., steel, stainless steel, aluminum, or FRP) permitted for each piping system.
****

2.7.1 Secondary Containment Piping

****
NOTE: Delete item e. below if containment piping will not be used under any type of surface load (road, etc.).

Release detection of petroleum underground storage tank (UST) systems is required in accordance with 40 CFR 280 Subpart D (1989). The most preferred way of meeting these requirements is to provide factory designed double-wall secondary containment piping in conjunction with an automatic line leak detector and interstitial monitoring capabilities. The maximum readily available size of secondary containment piping is 150 mm (6 inches). Secondary containment piping on systems with underground piping greater than 150 mm (6 inches) will have to be specially constructed and may be cost prohibitive.

An alternative to the factory designed secondary containment piping may be using single-wall piping inside a sealed, watertight, 360 degree secondary containment barrier (liner). The construction of the liner must meet the requirements of 40 CFR 280.43 (g). This type system would also require an automatic line leak detector and interstitial monitoring capabilities.

A single wall piping system will only be used when the secondary containment alternatives listed above are economically unfeasible, and the using agency at the facility provides written approval. Keep in mind that secondarily contained piping will more than pay for itself in the event that a leak occurs, by avoiding possible environmental cleanup costs.

****

Piping system shall be of double-wall construction with the internal pipe being the product pipe and the exterior pipe being an FRP containment pipe. The exterior containment piping shall allow for complete inspection of the primary piping before the exterior piping is sealed. Secondary containment piping, both primary and exterior, shall be provided with test fittings to allow for verification of a detected leak. The test fittings shall be accessible without dismantling any piping. The exterior piping for the secondary containment system for underground piping shall be:

a. Chemically compatible with the type of fuel to be handled.

b. Non-corrosive, dielectric, non-biodegradable, and resistant to attack from microbial growth.

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

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

e. Capable of withstanding H-20 highway loading as defined by AASHTO HB-17.

2.7.2 Stainless Steel Pipe

2.7.2.1 Piping 200 mm (8 Inch) and Larger

Stainless steel pipe 200 mm 8 inches or larger shall be in accordance with ASTM A 312/A 312M, Schedule 10S, Type TP304L, seamless only or ASTM A 358/A 358M, Grade 304L, Class 1 or 3, with wall thickness of 6.4 mm 0.25 inches for 200 mm 8 inch, 255 mm 10 inch, and305 mm 12 inch piping and 7.9 mm 0.312 inches for 356 mm 14 inch, 406 mm 16 inch, and 457 mm 18 inch piping. Factory longitudinal weld shall be 100 percent radiographically inspected in accordance with ASME BPVC SEC VIII D1.

2.7.2.2 Piping 150 mm (6 Inch) and Smaller

Stainless steel pipe 150 mm 6 inches or smaller shall be in accordance with ASTM A 312/A 312M, Type TP304L, seamless only. Piping with threaded joints shall be Schedule 80 (minimum). Piping with welded joints shall be Schedule 40 (minimum). Threaded pipe joints shall be used in aboveground applications only. Longitudinally welded 150 mm 6 inch pipe also can be provided if made in accordance with ASTM A 358/A 358M, Grade 304L, Class 1 or 2, with a minimum wall thickness of 6.4 mm 0.25 inches.

2.7.2.3 Control Piping

Stainless steel control piping shall be seamless, fully annealed tubing conforming to ASTM A 269, Grade TP316, with a Rockwell hardness of B80 or less. Tubing wall thickness for 13 mm 1/2 inch tubing shall be a minimum 1.3 mm 0.049 inch.

2.7.2.4 Fittings 65 mm (2-1/2 Inches) and Larger

****

NOTE: A cyclic fatigue analysis must be performed by the designer to determine wall thickness of welded fittings and the wall thickness shall be shown on the drawings. Pressures found in CERL Memorandum for Record, Subject: Analysis of Hydrant Fueling System Failures can be used.

****

Fittings shall be the butt weld type and shall be:

a. Stainless steel conforming to ASTM A 403/A 403M, 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 A 403/A 403M, Class WP-XX, Grade WP 304L, of wall thickness as indicated. Starting material shall not be fabricated by fusion welding process without addition of filler metal. No forming will be allowed using fusion welding process without addition of filler metal. Factory longitudinal weld shall be 100 percent radiographically inspected in accordance with ASME BPVC SEC VIII D1.

2.7.2.5 Fittings 50 mm (2 inches) and Smaller

Fittings shall be stainless steel Type F 304L (socket welded or if indicated on drawings, threaded), 900 kg 2000 pound W.O.G. conforming to ASTM A 182/A 182M and ASME B16.11. Threaded fittings shall be used for aboveground applications only.

2.7.2.6 Unions

Stainless steel unions shall conform to ASTM A 312/A 312M, Grade 304 or 316.

2.7.2.7 Flanges

Stainless steel flanges shall be forged Type 304 or 304L conforming to ASTM A 182/A 182M and ASME B16.5 with 68 kg 150 pound weld necks. Flanges shall be 1.6 mm 1/16 inch raised-face with phonographic finish, except where required otherwise to match equipment furnished. The Contractor shall match flange faces to valves or equipment furnished.

2.7.2.8 Control Piping Fittings

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

2.7.2.9 Welding Process

The welding process for stainless steel piping shall be a gas tungsten arc or gas metal arc process in accordance with ASME B31.3.

2.7.2.10 Welding Electrodes

Welding electrodes shall be E308L conforming to AWS A5.4/A5.4M.

2.7.3 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.
****

Aluminum piping shall be in accordance with ASTM B 241/B 241M or ASTM B 345/B 345M, 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.

2.7.3.1 Connections

Socket welded connections shall be in accordance with ASME B16.11, except aluminum shall be alloy 5083-H112, alloy 6061-T6, or alloy 356-T6. Buttwelded connections shall be in accordance with ASME B16.9, except aluminum shall be in accordance with ASTM B 241/B 241M, alloy 6061-T6, of the same weight as the pipe.

2.7.3.2 Welding Process

The welding process for aluminum piping shall be a gas tungsten arc or gas metal arc process in accordance with ASME B31.3.

2.7.3.3 Welding Electrodes

Welding electrodes shall be ER5356 conforming to AWS A5.10/A5.10M.

2.7.4 Fiberglass Reinforced Plastic (FRP) Pipe

2.7.4.1 Pipe

Pipe shall be compatible with the fuel to be handled and shall be in accordance with ASTM D 5677. Use of fiberglass piping shall be limited to buried service only and at pressures not exceeding that marked on the pipe.

2.7.4.2 Fittings

FRP fittings and adhesives shall be in accordance with ASTM D 5677. Fittings and adhesives shall be compatible with the fuel to be handled. Fittings for the exterior piping of secondary containment piping shall accommodate the primary inner pipe and any additional equipment required, such as leak detection cables.

2.7.5 Steel Pipe

****
NOTE: Steel piping should not be used to transport any type of aviation fuel. Specifically indicate each use of steel pipe.
****

2.7.5.1 Pipe

Carbon steel pipe shall be in accordance with ASTM A 53/A 53M, Type E or S, Grade A or B, or API Spec 5L, seamless or electric-weld, Grade A or B. Pipe smaller than 65 mm 2-1/2 inches shall be in Schedule 80. ASTM A 53/A 53M pipe 65 mm 2-1/2 inches and larger shall be Schedule 40. API Spec 5L pipe 65 mm 2-1/2 inches and larger shall be Schedule 40S.

2.7.5.2 Connections

Connections for pipe smaller than 65 mm 2-1/2 inches shall be forged, socket weld type, 2000 W.O.G. conforming to ASTM A 182/A 182Mand ASME B16.11. Connections for pipe 65 mm 2-1/2 inches and larger shall be buttweld type conforming to ASTM A 234/A 234M, Grade WPB and ASME B16.9 of the same wall thickness as the adjoining pipe.

2.7.5.3 Welding Electrodes

Welding electrodes shall be E70XX low hydrogen type conforming to AWS A5.1/A5.1M or AWS A5.4/A5.4M.

2.7.5.4 Threaded Connections

****
NOTE: Specifically indicate each threaded connection.
****

Threaded connections shall only be used on piping 50 mm 2 inches in nominal size or smaller and only where indicated. Connections shall be in accordance with ASME B16.3, Class 150. Threaded connections shall be sealed tightly with a thread sealant or lubricant which is compatible with the fuel to be handled.

2.7.6 Manual Valves

Portions of a valve coming in contact with fuel shall be compatible with the fuel to be handled. Valves shall have bodies, bonnets, and covers constructed of stainless steel conforming to ASTM A 743/A 743M, Type 304 or 316; or aluminum alloy conforming to ASTM B 26/B 26M, Types 3003, 6061-T6, or 356-T6; or cast steel conforming to ASTM A 216/A 216M, Grade WCB internally plated with chromium, nickel, or internally electrodeless nickel plated. Stem and trim shall be stainless steel for each valve. Valves shall be suitable for a working pressure of 1.9 MPa 275 psig at 38 degrees C 100 degrees F with a weatherproof housing. Valves shall be provided with flanged end connections unless indicated otherwise. Seats, body seals, and stem seals shall be Viton or Buna-N.

2.7.6.1 Gate

Valve shall be in accordance with API Spec 6D and shall conform to the fire test requirements of API Spec 6FA. Valve shall be of the flexible wedge disc type, conduit disc type, or double disc type. Valve shall be of the rising stem type with closed yoke, or the non-rising stem type equipped with a device to give positive visual indication of the valve's position.

2.7.6.2 Swing Type Check

Valve shall be swing type conforming to API Spec 6D regular type. Check valves shall be the tilting disc, non-slam type. 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.

2.7.6.3 Wafer Type Check

Valves shall conform to API Spec 6D and API Std 594. Wafer type check valves may be provided in lieu of swing check valves in piping sizes larger than 100 mm 4 inches.

2.7.6.4 Ball

Valves 50 mm 2 inches and larger shall conform to API Spec 6D. 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. The ball shall be stainless steel. Valve shall be fire tested and qualified in accordance with API Spec 6FA. Valve shall be non-lubricated and operate from fully open to fully closed with 90 degree rotation of the ball.

2.7.6.5 Plug

Valve shall be in accordance with API Spec 6D. Valve shall be non-lubricated, resilient, double seated, trunnion mounted type with a tapered lift plug capable of 2-way shutoff. Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valve shall have weatherproof operators with mechanical position indicators.

2.7.6.6 Globe

Valve shall conform to ASME B16.34.

2.7.6.7 Pantograph Relief Valve

Relief valves located on the pantograph assembly shall be the fully enclosed, spring loaded, angle pattern, ball seated type with lift lever. Valve stem shall be fully guided between the fully opened and fully closed positions. Valve shall be factory set to open at the set pressure indicated on the drawings.

2.7.6.8 Butterfly 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 during a fire.

****

Valves shall be in accordance with API Std 609 and shall conform to the fire test requirements of API Std 607. Valves shall be designed for bubbletight bidirectional shutoff service at maximum pressure ratings. Stem seals shall be capable of withstanding the rated pressure and temperature of the valve seat. Valves shall be provided with 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.

2.7.7 Control Valves

Valves shall be single-seated, diaphragm actuated, pilot-controlled globe valves. Each shutoff valve shall be provided with a position indicator, a pilot circuit strainer, and pressure gauge quick-disconnect fittings located in the valve inlet, outlet, and cover. Service and adjustments to a valve shall be possible without removing the valve from the line. Portions of a valve coming in contact with fuel shall be compatible with the fuel and shall be of noncorrosive material. Valves shall have bodies, bonnets, and covers constructed of stainless steel conforming to ASTM A 743/A 743M, Type 304 or 316; or aluminum alloy conforming to ASTM B 26/B 26M, Types 3003, 6061-T6, or 356-T6; or cast steel conforming to ASTM A 216/A 216M, Grade WCB internally plated with chromium, nickel, or internally electrodeless nickel plated. Stem and trim shall be stainless steel for each valve. Valves shall be suitable for a working pressure of 1.9 MPa 275 psig at 38 degrees C 100 degrees F with a weatherproof housing. Valves shall be provided with flanged end connections unless otherwise indicated. Seats, body seals, and stem seals shall be Viton or Buna-N.

2.7.7.1 Solenoid Controlled Shutoff Valve

Valve shall be hydraulically operated and fail normally closed. When energized, the solenoid controls shall cause the main valve to open. When de-energized, the solenoid controls shall cause the main valve to close, providing a driptight shutoff. The solenoid shall be rated for Class I, Division 1, Group C and D hazardous locations. The solenoid shall accommodate the specific control conditions of the system in which the valve is to be installed. Functions shall be externally adjustable. If shutoff valve's diaphragm fails, the main valve shall close.

2.7.7.2 Pantograph Control Valve

Valve shall be hydraulically operated and fail normally closed. Valve shall regulate the downstream pressure to the pressure indicated using a remote pressure signal from the pantograph venturi. Valve shall have opening speed controllers. The solenoid shall be NEMA 7 rated for Class I, Division 1, Group C and D hazardous locations. Depressing of the corresponding deadman switch shall open the control valve and initiate the fueling process. Releasing the deadman switch shall close the control valve and stop the fueling process.

2.7.7.3 Pressure Control Valve

****
NOTE: Indicate the desired upstream and downstream pressure to be maintained.
****

Valve shall be capable of maintaining the downstream flow rate at the indicated pressure. Valve setpoint shall be adjustable within a minimum range of plus or minus 20 percent of the indicated setpoint. Functions shall be externally adjustable. Valve shall be provided with a stainless steel orifice plate integrally mounted at the inlet port of the valve. Stainless steel control piping shall be provided to allow sensing

differential pressure across the orifice plate. Valve shall be provided with opening speed controllers which are adjustable from 2 to 30 seconds without affecting the closing of the valve. Speed controllers shall be field adjustable and factory set for 15 seconds.

2.7.7.4 Float-Operated Control Valve

Valve shall be float-operated and normally closed. The valve shall be the on/off type that is fully open at the low set point and fully closed at the high set point. The float and float assembly shall be stainless steel compatible with the fuel to be handled. The high/low movement span of the float shall be field adjustable.

2.7.7.5 Relief Valve

****

NOTE: Relief valves will typically be placed down stream of control valves to relieve the pressure buildup created when the control valve is closed. Indicate the operating pressure required for each valve. Also, use relief valves to relieve possible thermal expansion in a pipe line if no other provisions exist. Indicate on the drawings a site flow indicator downstream of each relief valve.

****

Valve shall be hydraulically operated and normally closed. Valve shall be capable of maintaining a constant upstream pressure regardless of the downstream demand. Valve shall have an angle or straight pattern as indicated. Valves shall be factory-set to open at the indicated pressure and shall be field adjustable. Valve setpoint shall be adjustable within a minimum range of plus or minus 20 percent of the indicated setpoint.

2.7.7.6 Nonsurge Check

Valve shall be a hydraulically operated, pilot-controlled, diaphragm type nonsurge check valve with a closing time of 1 to 5 seconds, located on the discharge side of each fueling pump. Valve shall automatically prevent reverse flow and open at a controlled rate to keep pump starting surges from shocking downstream equipment. Opening rate shall be adjustable from 5 to 60 seconds.

2.7.7.7 Filter Separator Control Valve and Float Assembly

Valve shall be float-operated and normally opened. Valve shall be capable of maintaining the downstream flow rate at the indicated pressure. Functions shall be externally adjustable. Valve shall be provided with a stainless steel orifice plate integrally mounted at the inlet port of the valve. Stainless steel control piping shall be provided to allow sensing differential pressure across the orifice plate. Valve shall be provided with a float-operated pilot control assembly. The float and float assembly shall be stainless steel. The movement span of the float shall be field adjustable. The assembly shall be fitted into the filter separator housing sum. The float assembly shall control both the filter separator control valve and the automatic water drain valve. Float shall ride on the fuel-water interface inside the filter separator sump and have three stages of operation. The stages of operation include:

a. Stage I: With the float down, the filter separator control valve

shall be open and the automatic water drain valve closed.

b. Stage II: With the float at the intermediate level, the filter separator control valve shall remain open while the automatic water drain valve opens.

c. Stage III: With the float at a high level, the filter separator control valve shall close while the automatic water drain valve remains open.

2.7.7.8 Filter Separator Automatic Water Drain Valve

****
NOTE: Before including automatic water drain valves into a design, note that the valves can be costly to operate, are continuous maintenance problems, and can result in high environmental disposal costs in certain states.
****

Valve shall be float-operated and normally closed. The valve shall be the on/off type and shall work in conjunction with the float-operated pilot control assembly. Valve shall be field adjustable.

2.7.8 Piping Accessories

2.7.8.1 Flanges

Flanges installed on equipment, fittings, or pipe shall be Class 150 pound flanges which are rated in accordance with ASME B16.5. Flanges shall be the 1.6 mm 1/16 inch raised face type, except for connections to FRP pipe. Connections to FRP pipe shall be made with flat face flanges. Stainless steel flanges shall conform to ASTM A 182/A 182M. Aluminum flanges shall conform to ASTM A 182/A 182M, alloy 6061-T6 or alloy 356-T6. Carbon steel flanges shall conform to ASTM A 181/A 181M, Grade 2.

2.7.8.2 Flange Gaskets

Flange gaskets shall be 1.6 mm 1/16 inch thick, NBR, and shall be in accordance with ASME B16.21. Full-face gaskets shall be provided for flat-face flanged pipe joints. Ring gaskets shall be provided for raised-face flanged pipe joints.

2.7.8.3 Welded Nipples

Nipples shall be in accordance with ASTM A 733 or ASTM B 687 and shall be of the same material as the pipe supplied.

2.7.8.4 Threaded Union

Threaded unions shall only be used on cast steel piping 50 mm 2 inches in nominal size or smaller and only where indicated. Union shall be in accordance with ASME B16.39, Class 150.

2.7.8.5 Joint Compound

Joint compounds for any type of piping system shall be resistant to water and shall be suitable for use with fuel containing 40 percent aromatics.

2.7.8.6 Flexible Connector

Connectors shall conform to requirements of UL 567 and shall be the flexible metal hose, corrugated type with braided wire sheath covering. Connectors shall have close-pitch annular corrugations and be rated for a working pressure of at least 1.9 MPa 275 psig at 38 degrees C 100 degrees F. Connectors shall have a minimum 300 mm 12 inch live length with flanged end connections. Metal for hose and braided wire sheath shall be stainless steel in accordance with ASTM A 167.

2.7.8.7 Strainer

****
NOTE: Reference ASTM F 1199 when the operating conditions are at 1.0 MPa (150 psig) and 65 degrees C (150 degrees F) or less; otherwise reference ASTM F 1200.
****

Strainer shall be in accordance with ASTM F 1199 or ASTM F 1200, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. Strainer body shall be fabricated of [cast steel or brass] [Type 304 or 316 stainless steel] with the bottom drilled and tapped. The body shall have arrows clearly cast on the sides indicating the direction of flow. Strainer shall be equipped with a removable cover and sediment screen. Screen shall be 60 mesh wire screen with larger wire mesh reinforcement. Screen shall be [0.759 mm 22 gauge brass or corrosion-resistant steel] [Type 316 stainless steel]. Pressure drop for clean strainer shall not exceed 21 kPa 3 psig at design flow rates. Each strainer shall be provided with an air eliminator. The ratio of net effective strainer area to the area of the connecting pipe shall be not less than 3 to 1.

2.7.8.8 Pipe Hangers and Supports

Hangers and supports shall be of the adjustable type conforming to MSS SP-58 and MSS SP-69, except as modified herein. The finish of rods, nuts, bolts, washers, hangers, and supports shall be hot-dipped galvanized. Nuts, bolts, washers, and screws shall be Type 316 stainless steel when located under any pier. Miscellaneous metal shall be in accordance with ASTM A 36/A 36M, standard mill finished structural steel shapes, hot-dipped galvanized.

a. Pipe Protection Shields. Shields shall conform to MSS SP-58 and MSS SP-69, Type 40, except material shall be Type 316 stainless steel. Shields shall be provided at each slide type pipe hanger and support.

b. 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. Pipe hangers and support elements shall be designed for the loads applied. Anti-friction material shall be a minimum of 2.3 mm 0.09 inch thick. Steel supports shall be hot-dipped galvanized. Units shall be factory designed and manufactured.

2.7.8.9 Exterior Coatings for Underground Piping

****
NOTE: Delete this paragraph if only secondary containment piping is used underground. Heat shrink sleeves can be used in lieu of the protective tape; however, the sleeves are not recommended for systems with numerous bends. Delete the last sentence of subparagraph b., if heat shrink sleeves are not desired.
****

Piping, excluding FRP piping, placed in direct contact with backfill or soil shall be provided with an exterior protective coating.

a. Pipe: Pipe shall receive protective coating system of factory-applied adhesive undercoat and continually extruded polyethylene coating conforming to NACE RP0185, Type A. The protective coating shall have a minimum thickness of 762 micrometers 30 mils.

b. Fittings and Other Surfaces: Fittings, couplings, regular surfaces, damaged areas of extruded polyethylene coating and existing piping affected by the Contractor's operations shall be protected by the application of polyethylene tape which conforms to NACE RP0169, 762 micrometers 30 mils nominal thickness. Surfaces to be tape wrapped shall be clean, dry, grease free, and primed with a compatible primer prior to application of tape. Primer shall be as recommended by the tape manufacturer and approved by the pipe coating manufacturer. Heat shrink sleeves may be provided in lieu of tape and shall overlap the pipe coating not less than 150 mm 6 inches.

c. Flanges, Valves, and Irregular Surfaces: Irregular surfaces shall be protected with a cold-applied liquid primer and heated coal-tar base tape in accordance with AWWA C203.

2.7.8.10 Exterior Coatings for Aboveground Steel Piping

Aboveground steel piping shall be painted as specified in Section 09 90 00 PAINTS AND COATINGS. Paint shall be rated for use on hot metal surfaces up to 230 degrees C 450 degrees F and for surfaces exposed to the weather. Color of the finish coat shall be aluminum or light gray.

2.7.8.11 Gauges

****
NOTE: Indicate the scale range for each pressure gauge.
****

Gauges shall conform to ASME B40.100. Gauges shall be single style pressure gauge for fuel with 114.3 mm 4-1/2 inch dial, and shall have brass or aluminum case, bronze tube, stainless steel ball valve, pressure snubbers, and scale range for the intended service.

2.7.8.12 Flexible Ball Joints

****
NOTE: Indicate the location and details of each

pipe expansion joint, amount of pipe movement, and pipe anchors.

****

Joints shall be carbon steel with polished steel balls capable of 360 degree rotation plus 15 degree angular flex movement, with flanged end connections. Joints shall be provided with pressure molded composition gaskets designed for continuous operation temperature of 135 degrees C 275 degrees F. Joints shall be designed for a minimum working pressure of 1.9 MPa 275 psig at 38 degrees C 100 degrees F.

2.7.8.13 Bellows Expansion Joints

****

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

****

Joints shall be Type 304 stainless steel corrugated bellows, reinforced with rings, internal sleeves, external protective covers, and flanged end connections. Limit stops shall be provided to limit total movement in both directions. Joints shall be cold set to compensate for the temperature at the time of installation. Joints shall be designed to withstand 10,000 cycles over a period of 20 years, and for a minimum working pressure of 1.9 MPa 275 psig at 38 degrees C 100 degrees F. The first pipe alignment guide shall be provided no more than 4 pipe diameters from the expansion joint. The second pipe alignment guide shall be provided no more than 14 pipe diameters from the first guide.

2.7.8.14 Site Flow Indicator

Indicator shall be of stainless steel construction, be compatible with the fuel to be handled, and have flanged end connections. The sight flow indicator shall consist of a housing containing a rotating propeller that is visible through a tempered glass observation port.

2.8 FACTORY TESTS

Factory tests shall be performed on a filter separator to demonstrate compliance with the testing and qualification procedures defined in API Spec 1581 for Group II, Class B filter separators. The tests shall be performed in the presence of a Government Representative, if deemed necessary by the Contracting Officer. The tests shall be on a full-scale test system in accordance with API Spec 1581, except as modified herein. The test sample shall consist of a complete filter separator with coalescer and separator elements installed. Elements shall be representative of a production lot. The filter separator, coalescers, and separator screens shall be identified with the manufacturer's part number. Prior to performing Test Series 1, 2, and 3, the filter separator shall be subjected to a hydrostatic pressure of 1.9 MPa 275 psig per the requirements of ASME BPVC SEC VIII D1. The average free water content in a test set shall not exceed 10 parts per million and any single sample shall not exceed 15 parts per million.

2.9 SUPPLEMENTAL COMPONENTS/SERVICES

2.9.1 Earthwork

Excavation and backfilling for piping shall be as specified in Section 31 00 00EARTHWORK except as modified herein. Backfill for FRP pipe shall be pea gravel or crushed stone. Backfill for aluminum, stainless steel, or carbon steel pipe shall be pea gravel, crushed stone, or sand.

2.9.1.1 Pea Gravel

Pea gravel shall be between 3 mm 1/8 inch and 19 mm 3/4 inch diameter.

2.9.1.2 Crushed Stone

Crushed stone shall be between 3 mm 1/8 inch and 13 mm 1/2 inch diameter in accordance with ASTM C 33.

2.9.1.3 Sand

Sand shall be fine sand aggregate in accordance with ASTM C 33, washed and thoroughly dried, shall contain no more than 500 ppm chlorides nor more than 500 ppm sulfates, and shall have a pH greater than 7.

2.9.2 Cathodic Protection

Buried metallic components including pipe, anchors, conduit, etc., shall be provided with a cathodic protection system in accordance with [Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [and] [Section 26 42 17.00 10 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)]. Cathodic protection for metal components that attach to a tank shall be coordinated and compatible with the tank corrosion control system.

2.9.3 Exterior Coatings of Miscellaneous Items

Steel surfaces to be externally coated or painted shall be cleaned to a commercial grade blast cleaning finish in accordance with SSPC SP 6 prior to the application of the coating. Exterior surfaces, other than stainless steel pipe and flexible connectors, which are not otherwise painted and do not require the application of an exterior coating, and items supplied without factory-applied finish paint, not including primer only items, shall be painted as specified in Section 09 90 00 PAINTS AND COATINGS.

2.9.4 Identification Markings

Aboveground pipe, equipment, etc., supplied under this section shall have identification markings applied in accordance with Section 09 90 00 PAINTS AND COATINGS.

2.9.5 Product Recovery Tank and Accessories

Product recovery tanks and accessories shall be supplied and installed in accordance with Section 23 10 00 FUEL STORAGE SYSTEMS.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment, material, 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.

3.1.1 Equipment

Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions. Supports shall be provided for equipment, appurtenances, and pipe as required. Floor-mounted pumps shall be provided with mechanical vibration isolators or a vibration isolation foundation. Anchors, bolts, nuts, washers, and screws shall be installed where required for securing the work in place. Sizes, types, and spacings of anchors and bolts not indicated or specified shall be as required for proper installation.

3.1.2 Piping

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NOTE: FRP piping should never be used under concrete slabs (excluding concrete walkways). Indicate on the drawings the piping materials to be allowed for each piping run.

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Underground fuel piping shall be [single wall stainless steel, aluminum, or FRP] [a secondary containment piping system], as indicated. Piping shall be inspected, tested, and approved before burying, covering, or concealing. Piping shall be installed straight and true to bear evenly on supports. Piping shall be free of traps and shall not be embedded in concrete pavement. Any pipe, fittings, or appurtenances found defective after installation shall be replaced. Piping connections to equipment shall be as indicated or as required by the equipment manufacturer. Pipe and accessories shall be handled carefully to assure a sound, undamaged condition. The interior of the pipe shall be thoroughly cleaned of foreign matter and kept clean during installation. The pipe shall not be laid in water or stored outside unprotected when weather conditions are unsuitable. When work is not in progress, open ends of pipe and fittings shall be securely closed so that water, earth, or other substances cannot enter the pipe or fittings. Cutting pipe, when necessary, shall be done without damage to the pipe. Pipe shall be reamed to true internal diameter after cutting to remove burrs. Changes in pipe sizes shall be made through tapered reducing pipe fittings. Stainless steel pipe shall in no case be welded directly to carbon steel pipe. FRP piping shall not be used aboveground or under concrete slabs (except concrete walkways). Cutting of FRP pipe shall be performed with a hacksaw or circular saw. A site flow indicator shall be placed downstream of each relief valve.

3.1.2.1 Aboveground Piping

Pipe sections shall be completely installed as indicated prior to performing any piping tests.

3.1.2.2 Belowground Piping

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NOTE: Delete the last two sentences if secondary containment piping is not used.

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Underground pipelines shall be laid with a minimum pitch of 25 mm per 15 m 1 inch per 50 feet. Fifty mm Two-inch pipe size valved drain connections shall be provided at each low point and 40 mm 1-1/2 inch pipe size valved vent connections shall be provided at each high point. Horizontal sections of pipe shall be installed with a minimum of 450 mm 18 inches of backfill between the top of the pipe and the ground surface. The full length of each section of underground pipe shall rest solidly on the pipe bed. Joints in secondary piping shall not be made until the product pipe has passed the necessary pneumatic tests. Nonmetallic pipe shall be installed in accordance with pipe manufacturer's instructions.

3.1.2.3 Pipe Hangers and Supports

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NOTE: Indicate details and spacing of pipe supports, if a Government designer (either Corps office or A/E) is the Engineer of Record, and show on the drawings. Delete the bracketed phrase if seismic details are not provided. Section 13 48 00 SEISMIC PROTECTION FOR MICSCELLANEOUS EQUIPMENT and 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, properly edited, must be included in the contract documents.
****

Seismic details shall be in accordance with Sections 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT [as shown on the drawings]. Additional hangers and supports shall be installed for concentrated loads in piping between hangers and supports, such as for valves. Miscellaneous steel shapes as required shall be installed in accordance with ASTM A 36/A 36M. Piping shall be supported as follows:

Nominal Pipe Size (mm)	25 and Under	40	50	80	100	150	200	250	300
Maximum Hanger Spacing (m)	2.1	2.7	3	3.7	4.3	5.2	5.8	6.7	7.0
Nominal Pipe Size (Inches)	One and Under	1.5	2	3	4	6	8	10	12
Maximum Hanger Spacing (Feet)	7	9	10	12	14	17	19	22	23

3.1.2.4 Pipe Sleeves

Piping passing through concrete or masonry construction shall be fitted with sleeves. Each sleeve shall be of sufficient length to pass through the entire thickness of the associated structural member and shall be large enough to provide a minimum clear distance of 13 mm 1/2 inch between the pipe and sleeve. Sleeves through concrete shall be 0.912 mm 20 gauge steel, fiberglass, or other material approved by the Contracting Officer. Sleeves shall be accurately located on center with the piping and securely fastened in place. The space between a sleeve and a pipe shall be caulked and sealed as specified in Section 07 92 00 JOINT SEALANTS. In fire walls and fire floors, caulk both ends of a pipe sleeve with UL listed fill, void, or cavity material.

3.1.2.5 Pipe Anchors

Where steel piping is to be anchored, the pipe shall be welded to the structural steel member of the anchor and the abraded area shall be patched with protective coating or covering as specified.

3.1.2.6 Exterior Coatings for Underground Pipe

Except as otherwise specified, protective coating shall be applied mechanically in a factory or field plant especially equipped for the purpose. Valves and fittings that cannot be coated and wrapped mechanically shall have the protective coating applied by hand, preferably at the plant that applies the covering to the pipe. Joints shall be coated and wrapped by hand. Hand coating and wrapping shall be done in a manner and with materials that will produce a covering equal in thickness to that of the covering applied mechanically. Piping installed in valve boxes or manholes shall also receive the specified protective coating.

a. Regular Surfaces, Fittings, and Couplings: Tape shall be initially stretched sufficiently to conform to the surface to which it is applied, using one layer lapped at least 25 mm 1 inch. Tape shall overlap the extruded polyethylene coated piping 75 mm 3 inches at all joints. A second layer, lapped at least 25 mm 1 inch, with a tension as it comes off the roll shall be applied and pressed to conform to the shape of the component.

b. Damaged Areas of Extruded Polyethylene Coating: Residual material from coating shall be pressed into the break or trimmed off. Tape shall be applied spirally and one-half lapped as it is applied. Tape shall extend 75 mm 3 inches beyond the damaged area. A double wrap of one full width of tape shall be applied at right angles to the pipe axis to seal each end of the spiral wrapping.

c. Existing Piping Affected by the Contractor's Operation: Pipe shall be wrapped to 75 mm 3 inches beyond the point of connection.

3.1.3 Buried Utility Tape

Utility tape shall be buried 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.

3.1.4 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory, shall be painted and shall have identification markings applied as specified in Section 09 90 00 PAINTS AND COATINGS. Stainless steel and aluminum surfaces shall not be painted. Prior to any painting, surfaces shall be cleaned to remove dust, dirt, rust, oil, and grease.

3.1.5 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. The framed instructions shall be framed under glass or

laminated plastic and be posted where directed by the Contracting Officer. The framed instructions shall be posted before acceptance testing of the system.

3.1.6 Start-Up Representative

Manufacturer's field service representatives shall be provided 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. Any additional time required due to delays or corrections by the Contractor shall be provided 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.

3.2 TESTS

3.2.1 Piping

3.2.1.1 Exterior Coatings of Underground Piping

The coating system shall be visually inspected for holes, voids, cracks, and other damage during installation. Damage to the protective coating incurred during transit and handling shall be repaired before installation. Before lowering into the trench, each pipe section shall be tested by an electric holiday detector with impressed current in accordance with NACE RP0274, using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Holidays in the protective coating shall be repaired immediately upon detection and retested. The holiday detector shall be a type that field adjustments cannot be made. Calibration of the tester shall be performed by an independent testing manufacturer at 6-month intervals or at such time as the crest voltage is questionable. Following installation, but prior to filling the system with fuel, all exterior protective coatings, including field joints, shall be retested with an electric holiday detector as described above. Holidays in the protective coating shall be repaired immediately upon detection and retested. Extreme care shall be taken in lifting the piping to perform the testing procedure. Chains or metal ropes shall not be used in lifting the pipe for testing. Labor, materials, and equipment necessary for conducting the holiday tests shall be furnished by the Contractor.

3.2.1.2 Radiographic Piping Tests

Prior to the pneumatic and hydrostatic tests, each stainless steel and aluminum piping weld performed at the jobsite shall be examined by radiographic tests as defined herein. Procedures for radiographic testing shall be in accordance with ASNT RP SNT-TC-1A or ASTM E 94. Interpretation of test results and limitations on imperfections in welds shall comply with the requirements of "100 percent Radiography" as defined in ASME B31.3. Testing shall be performed by a qualified commercial or testing laboratory. Costs of testing, including retesting or repaired welds, shall be borne by the Contractor. Weld ripples or surface irregularities that might mask or be confused with the radiographic image of any objectionable defect shall be removed by grinding or other suitable mechanical means. The weld surface shall be merged smoothly with the base metal surface.

3.2.1.3 Pneumatic and Hydrostatic Tests

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NOTE: Delete subparagraph b., if secondary containment piping is not used.
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Testing shall comply with the applicable requirements of ASME B31.3, NFPA 30, and the requirements specified herein. Pressure rating of various fittings shall not be exceeded. Hydrostatic testing shall be performed using the fuel to be handled. Water shall not be introduced into the system for testing. To facilitate the pneumatic and hydrostatic tests, various sections of the piping system may be isolated and tested separately. Where such sections terminate at flanged valve points, the line shall be closed by means of blind flanges in lieu of relying on the valve. Tapped flanges shall be provided to allow a direct connection between the piping and the air compressor and/or pressurizing pump. Tapped flanges shall also be used for gauge connections. No taps in the permanent line will be permitted. Gauges will be subject to testing and approval. Following satisfactory completion of each pneumatic and hydrostatic test, the pressure shall be relieved and the pipe immediately sealed. Provision shall be made to prevent displacement of the piping during testing. Personnel shall be kept clear of the piping during pneumatic testing. Equipment such as pumps, tanks, and meters shall be isolated from the piping system during the testing.

a. Pneumatic Test Procedures for Product Piping: 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 pneumatic test described herein. The pneumatic test pressure shall be applied in increments. A preliminary 170 kPa 25 psig test shall be applied. The pressure shall be maintained while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, the entire run of piping, including the bottom surfaces, shall be visually inspected for leaks (bubble formations). Leaks discovered shall be repaired in accordance with manufacturer's instructions and retested. Following the preliminary test, the piping shall be tested at a pressure of 345 kPa 50 psig for not less than 2 hours, during which time there shall be no drop in pressure in the pipe greater than that allowed for thermal expansion and contraction. The pressure source shall be disconnected during the final test period. Any leaks revealed by the test shall be repaired and the test repeated.

b. Pneumatic Test Procedures for Exterior Containment Piping: Exterior containment piping shall undergo a minimum pneumatic pressure of 35 kPa 5 psig. Pressure in secondary piping shall be maintained for at least 1 hour while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, the entire run of piping, including the bottom surfaces, shall be visually inspected for leaks (bubble formations). Leaks discovered shall be repaired in accordance with manufacturer's instructions and retested. This testing shall be in compliance with the manufacturer's published installation instructions.

c. Hydrostatic Test Procedures for Product Piping: Upon completion of pneumatic testing and prior to backfilling, each piping system shall be hydrostatically tested with fuel at not more than 1.9 MPa 275 psig in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gauge pressure for 4 hours. The Contractor shall furnish

electricity, instruments, connecting devices, and personnel for the test. Fuel will be furnished by the Government. Defects in work performed shall be corrected at the Contractor's expense, and the test repeated until the work is proven to be in compliance with the testing procedures. Any release of fuel (no matter the size) during testing shall be immediately contained, the pressure on the piping relieved, and the piping drained of fuel. The Contracting Officer shall be notified immediately of a fuel release, the exact location, an estimated quantity of release, and a discussion of the containment measures taken.

3.2.2 Equipment Tests

Following the completion of the Initial System Adjustments, but prior to the system performance tests, the following equipment tests shall be performed.

3.2.2.1 Operating Tank Low Level Alarm

Valves shall be positioned to transfer fuel between operating tanks. One fueling pump shall be started and sufficient fuel shall be pumped out of the first operating tank to allow the low level alarm (LLA) to stop the fueling pump. This procedure shall be repeated for each fueling pump and each tank until the LLA stops the fueling pump due to the low liquid level in the operating tank.

3.2.2.2 Fuel Delivery

Flow rates at each direct fueling station shall be measured against various pressure fueling nozzle backpressures. Each timed flow rate period shall be at least 1 minute. False backpressure shall be created by throttling a valve downstream of the nozzle. The valve may be located on a tank truck or in an aircraft direct fueling station return line. The corresponding flow rates L/s GPM shall be recorded at pressure fueling nozzle pressures of 138 kPa 20 psig, 172 kPa 25 psig and 241 kPa 35 psig. During the flow rate measurements, it shall be ensured that each temporary strainer has been removed, valves are fully open, pressure relief valves are not leaking, and the differential pressure drop across each filter separator is within an acceptable range.

3.2.2.3 Fueling Pump Operation

Operation of pressure and flow devices to start and stop the fueling pumps at the indicated pressure and flow rates shall be demonstrated in the presence of the Contracting Officer. The operating sequence shall be repeated with each of the pumps being selected as the lead pump. For this test, the flow rates shall be measured and recorded.

3.2.2.4 Emergency Shutdown

With one fueling pump circulating fuel through the system, each emergency stop pushbutton station shall be tested to verify that the pump stops and the emergency shutoff valve closes at the pushbutton station. The above procedure shall be repeated for each fueling pump. Tests for both the automatic and manual modes shall be conducted. A total emergency stop with three pumps running shall be simulated.

3.2.2.5 Pantograph Control Valve

Each pantograph control valve shall be operated to demonstrate proper surge shutdown capability, pressure control at the corresponding setpoint (plus or minus 35 kPa 5 psi), and deadman closure.

3.2.3 System Performance Tests

Testing as performed under paragraph Equipment Tests shall be performed again and shall be considered the initial system performance test. The initial test shall be performed following necessary system adjustments and calibrations to the various equipment and controls. The initial performance test shall also demonstrate the proper operation of each flushing mode. Following the initial performance test, a final performance test shall be performed which involves the demonstration of the fueling system during actual fueling and defueling of an aircraft. The maximum rated capacity of the system shall be tested by using several aircraft simultaneously. If it is not possible to use the number of aircraft required to receive the full flow, the test shall be supplemented through the use of refueling trucks or bladders. The use of aircraft or refueling trucks shall be coordinated with the Contracting Officer prior to testing. In the event a portion of the system or any piece of equipment fails to meet the test, the Contractor shall make the necessary repairs or adjustments and repeat the performance tests until satisfactory performance is obtained.

3.3 FLUSHING, CLEANING, AND ADJUSTING

3.3.1 Preparations for Flushing

Following installation but prior to equipment tests, the following preparations for flushing the system shall be performed.

3.3.1.1 Initial System Cleaning

Preservatives and foreign matter within the piping, valves, line strainers, pumps, oil/water separators,and other equipment coming in contact with fuel, shall be removed. Fuel will not be delivered to the system until the initial system cleaning is satisfactorily completed and approved by the Contracting Officer.

3.3.1.2 Protection of Equipment

Control valves, fuel sensors, venturi tubes, pressure indicating transmitters, and meters shall be removed from the system prior to the start of flushing operations and, where applicable, replaced with spools of pipe whose diameter is equal to the item removed. Coalescer and separator elements in each filter separator shall also be removed prior to the flushing operations.

3.3.1.3 Temporary Strainers

Temporary 40 mesh cone type strainers shall be installed in the suction line ahead of each fueling pump. The temporary strainers shall remain in place for a minimum of [2] [_____] days after system startup, after which time the Contractor shall remove the strainers and prepare the piping as intended for final system operation.

3.3.2 System Flushing

Flushing procedures shall precede fuel cleaning procedures.

3.3.2.1 Procedures

The entire fuel piping system,including transfer piping from bulk storage tanks, pump house piping, fueling loop supply and return piping, supply and return piping to the operating tanks, and product recovery piping, shall be flushed with fuel. The flow rate of the system during flushing procedures shall gradually be increased up to and held at the maximum rated system capacity for a minimum of 6 hours. During the flushing procedure the product recovery tank shall be filled and emptied a minimum 3 times. Fuel shall be flushed through each pump, filter separator, and each pantograph assembly. Strainers shall be kept clean in order to ensure maximum flow rate.

3.3.2.2 Flushing Acceptance

Acceptance of the flushing procedure shall be based on the fuel having a maximum of 2.1 mg/L 8.0 mg/gallon solids with free water not to exceed 2.1 mL/L 2 mL/quart. If the sample tested exceeds the maximum contamination allowances, the system flushing procedure shall be repeated at the Contractor's expense.

3.3.3 Fuel Cleaning

Following the acceptance of the flushing procedures, temporary strainers shall be removed and piping spools replaced with the appropriate equipment. Fuel sensors, meters, pressure indicating transmitters, and coalescer and separator elements in filter separators shall be reinstalled. Permanent strainers shall be removed, cleaned, and reinstalled. If the pressure differential across the filter/separator elements exceed that recommended by the manufacturer, the elements shall be replaced.

3.3.3.1 Procedures

The cleaning procedure shall be performed by continually circulating fuel through the entire fueling system. The flow rate of the fuel cleaning procedure shall gradually be increased up to the maximum rated system capacity. During the cleaning, only one pump at a time shall operate. The fuel shall be manually alternated between different pumps and filter separators on a periodic basis in order to clean each pump suction and discharge line. The cleaning procedure shall continue until the following acceptance certification is met.

3.3.3.2 Cleaning Acceptance

Acceptance of the fuel cleaning procedure will be based on the certification from the Contracting Officer that each fuel sample has a maximum contamination level of 0.5 mg/L 2.0 mg/gallon solids with free water not to exceed 10 parts per million.

3.3.4 Initial System Adjustments

Following the flushing and cleaning operations but prior to equipment tests, each system component shall be initially adjusted, if necessary, to meet the system's final operational requirements. The Government will supply enough fuel to the system to enable the Contractor to make final

adjustments to equipment and controls. Flow rates and pressures shall be adjusted to meet the indicated requirements. Pumps, control valves, filter separators, etc., shall operate as intended. During initial system adjustments to a pantograph's venturi tube or control valve, the pressure regulating device at each pressure fueling nozzle shall be either disabled or removed. The sequence of control for each component shall be adjusted to meet the indicated system requirements. Following the initial system adjustments, the equipment tests shall be performed in order to determine any necessary final system adjustments.

3.4 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period 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. The field instructions shall cover all of the items contained in the Operation and Maintenance Manuals, as well as demonstrations of routine maintenance operations.

-- End of Section --