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Change 1 - 02/21

Preparing Activity: USACE | Superseding
UFGS-33 52 43.13 (February 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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AVIATION FUEL PIPING
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NOTE: This guide specification covers the requirements for piping and valves for aircraft refueling systems constructed to the requirements of the DoD Type III/IV/V, and Cut and Cover Hydrant Refueling System Standards.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

PART 1 GENERAL

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NOTE: DoD Type III systems must conform to Standard Design AW 078-24-28 PRESSURIZED HYDRANT FUELING SYSTEM TYPE III. DoD Type IV/V systems must conform to Standard Design AW 078-24-29 PRESSURIZED HYDRANT DIRECT FUELING SYSTEM TYPE IV/V. Cut and Cover systems must conform to Standard Design AW 078-24-33 UNDERGROUND VERTICAL STORAGE TANKS CUT AND COVER. Field fabricated ASTs must conform to AW 078-24-27 ABOVEGROUND VERTICAL STEEL TANKS WITH FIXED ROOFS.Standards can be found on the Whole Building Design Guide at the following location

https://www.wbdg.org/ffc/dod/non-cos-standards.

Subject Matter Expert (SME) is defined as Service Headquarters Subject Matter Experts: Air Force - The Air Force Fuels Facilities Subject Matter Expert (HQ AFCEC/COS), Army - Headquarters, U.S. Army Corps of Engineers, POL-MCX Facilities Proponent (CECW-EC) through the Army Petroleum Center (APC), Navy/Marine Corps - NAVFAC POL Facility Subject Matter Expert (NAVFAC EXWC, CI11).

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1.1 REFERENCES

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

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

****

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

AMERICAN PETROLEUM INSTITUTE (API)

API RP 1110	(2013; R 2018) Recommended Practice for the Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide
API STD 600	(2015) Steel Gate Valves-Flanged and Butt-welding Ends, Bolted Bonnets
API STD 608	(2012) Metal Ball Valves - Flanged, Threaded, And Welding End
API Spec 5L	(2018; 46th Ed; ERTA 2018) Line Pipe
API Spec 6D	(June 2018, 4th Ed; Errata 1 July 2018; Errata 2 August 2018) Specification for Pipeline and Piping Valves

API Spec 6FA	(1999; R 2006; Errata 2006; Errata 2008; R 2011) Specification for Fire Test for Valves
API Std 594	(2017) Check Valves: Flanged, Lug, Wafer and Butt-Welding
API Std 607	(2016) Fire Test for Quarter-turn Valves and Valves Equipped with Non-metallic Seats
API Std 609	(2016; ERTA 2017) Butterfly Valves: Double Flanged, Lug-and-Wafer Type

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2022) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2022) Nuts for General Applications: Machine Screw Nuts, and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B31.3	(2022) Process Piping
ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C209	(2019) Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fitting for Steel Water Pipelines
AWWA C215	(2022) Extruded Polyolefin Coatings for Steel Water Pipe

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding

AWS A5.5/A5.5M	(2022) Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding
AWS A5.9/A5.9M	(2022) Welding Consumables-Wire Electrodes, Strip Electrodes, Wires, and Rods for Arc Welding of Stainless and Heat Resisting Steels- Classification

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A105/A105M	(2021) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A182/A182M	(2023) Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A193/A193M	(2023) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2023) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A234/A234M	(2023a) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A269/A269M	(2022) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A312/A312M	(2022a) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A358/A358M	(2019) Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications
ASTM A403/A403M	(2022b) Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A564/A564M	(2019) Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening

	Stainless Steel Bars and Shapes
ASTM A960/A960M	(2018a) Standard Specification for Common Requirements for Wrought Steel Pipe Fittings
ASTM A961/A961M	(2023) Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications
ASTM D229	(2019) Standard Test Methods for Rigid Sheet and Plate Materials Used for Electrical Insulation
ASTM F436	(2011) Hardened Steel Washers

BRITISH STANDARDS INSTITUTE (BSI)

BS EN ISO 10497	(2022) Testing of Valves Fire Type-Testing Requirements

ENERGY INSTITUTE (EI)

EI 1529	(2014; 7th Ed) Aviation Fueling Hose and Hose Assemblies

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

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

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(2024) Flammable and Combustible Liquids Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 1	(2015) Solvent Cleaning

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AS5877	(2016; Rev B) Detailed Specification for Aircraft Pressure Refueling Nozzle
SAE J514	(2012) Hydraulic Tube Fittings

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-25896	(1983; Rev E; Notice 1 1989; Notice 3

	2003) Adapter, Pressure Fuel Servicing, Nominal 2.5 inch diameter
MIL-PRF-4556	(1998; Rev F; Am 1 1999; CANC Notice 1 2011) Coating Kit, Epoxy, for Interior of Steel Fuel Tanks
MIL-PRF-13789	(1999; Rev E; Notice 1 2008; Notice 2 1016; Notice 3 2021) Strainers, Sediment: Pipeline, Basket Type
MIL-STD-161	(2005; Rev G; Notice 1 2010) Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels

1.2 ADMINISTRATIVE REQUIREMENTS

Design conditions must be as specified in Section 33 52 43.11 AVIATION FUEL MECHANICAL EQUIPMENT. Submit Operation and Maintenance Manuals for the equipment items or systems listed below. Refer to Section 01 78 23.33 OPERATION AND MAINTENANCE MANUALS FOR AVIATION FUEL SYSTEMS for the information to be submitted for various type of equipment and systems.

Manual Valves
Flexible Ball Joints
Surge Suppressor Tank and Valve
Strainers
Protective Coatings
Sample Connections
Isolating Gasket Kits
Gaskets
Flexible Hoses
Top Loading Arms

1.3 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for

Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor Qualifications; G[, [_____]]

SD-03 Product Data

Carbon Steel Piping; G[, [_____]]

Stainless Steel Piping; G[, [_____]]

Protective Coatings for Buried Stainless Steel Piping; G[, [_____]]

Fittings; G[, [_____]]

Isolating Gasket Kits; G[, [_____]]

Flange Protectors; G[, [_____]]

Lightning Surge Arrester; G[, [_____]]

Nuts and Bolts; G[, [_____]]

Gaskets; G[, [_____]].

Ball Valves; G[, [_____]].

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

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

Silent Check Valves; G[, [_____]].

Butterfly Valve with Fusible Link Operator; G[, [_____]].

Relief Valves; G[, [_____]].

Flexible Ball Joints; G[, [_____]]

Strainers; G[, [_____]]

Sample Connections; G[, [_____]]

Flanged Swivel Joints; G[, [_____]]

Fuel Hose; G[, [_____]]

Nozzle Adapter (SPR); G[, [_____]]

Pigging Accessories; G[, [_____]]

Flexible Hoses; G[, [_____]]

Top Loading Arms; G[, [_____]]

Automatic Air Vent; G[, [_____]]

Surge Suppressor Tank and Valve; G[, [_____]]

SD-05 Design Data

Pipeline Inventory; G[, [_____]]

SD-06 Test Reports

Pneumatic Test

Hydrostatic Test

Geometry/Ultrasonic Tool Reports; G[, [_____]]

SD-07 Certificates

Carbon Steel Piping

Stainless Steel Piping

Protective Coatings for Buried Stainless Steel Piping

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Nuts and Bolts

Gaskets

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Plug (Double Block and Bleed) Valves

Swing Check Valves

Silent Check Valves

Butterfly Valve with Fusible Link Operator

Relief Valves.

Flexible Ball Joints

Strainers

Sample Connections

Flanged Swivel Joints

Fuel Hose

Nozzle Adapter (SPR)

Pigging Accessories

Flexible Hoses

Automatic Air Vent

Surge Suppressor Tank and Valve

Survey Final Elevations

Pipeline Pigging Verification; G[, [_____]]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G[, [_____]]

1.4 QUALITY ASSURANCE

1.4.1 Design Data

1.4.1.1 Pipeline Inventory

Fuel system volume must be calculated using as constructed pipe lengths, internal diameters, fittings, and components. Totals must be provided for all items containing fuel with the exception of tanks which is covered by other specifications. A detailed list with sizes, lengths, quantity, and volumes must be provided for pumphouse, hydrant loop, etc.

1.4.2 Contractor Qualifications

Each installation Contractor must have successfully completed at least 3 projects of the similar scope and the same size or larger within the last 6 years. Each installation Contractor must demonstrate specific installation experience in regard to the specific system installation to be performed. Each installation Contractor must have taken, if applicable, manufacturer's training courses on the installation of piping and must meet the licensing requirements in the state. Submit a letter listing prior projects, the date of construction, a point of contact for each prior project, the scope of work of each prior project, and a detailed list of work performed. Provide in the letter evidence of prior manufacturer's training and state licensing.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

****
NOTE: Per SME.
****

Pipe and fittings in contact with fuel must be stainless steel, interior epoxy coated carbon steel, or carbon steel as indicated on the drawings. No zinc coated metals, brass, bronze or other copper bearing alloys must be used in contact with the fuel. All carbon steel and stainless steel underground piping must have an exterior protective coating and must be cathodically protected in accordance with Section 26 42 17 IMPRESSED CURRENT CATHODIC PROTECTION (ICCP) SYSTEM. Identification of piping must be in accordance with MIL-STD-161 unless specified otherwise. Material for manual valves must be as specified hereinafter.

2.1.1 Carbon Steel Piping

Subject each length of pipe to factory hydrostatic testing and ultrasonic testing in accordance with their respective pipe specification.

a. Piping 305 mm 12-Inches and Larger: Seamless, ASTM A53/A53M Grade B having a wall thickness of 9 mm 0.375-inch.

b. Piping 62 through 250 mm 2 1/2 through 10-Inches: Seamless, Schedule 40 API Spec 5L Grade B or ASTM A53/A53M Grade B.

c. Piping 50 mm 2-Inches and Smaller: Seamless, Schedule 80 API Spec 5L Grade B or ASTM A53/A53M Grade B.

d. Welding Electrodes (Factory Fabrication): E70XX low hydrogen electrodes conforming to AWS A5.1/A5.1M or AWS A5.5/A5.5M.

e. Internal Pipe Coating (Epoxy Lining) for piping 90 mm 3.5 inches and larger must be fusion bonded epoxy coated in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEM. The ends of the pipe must be masked or wiped back a minimum of 25 mm one inch but not more than 37 mm 1-1/2 inches.

2.1.2 Stainless Steel Piping

****
NOTE: A cyclic fatigue analysis need not be made by the designer to determine wall thickness of welded pipe as long as the pipe meets the sizes listed in TABLE A. The minimum wall thickness that welded pipe can be is the Schedule 20 listed in TABLE A. Pressures found in the surge analysis will be used.
****

a. Piping 62 mm 2-1/2-Inches and Larger:

(1) ASTM A358/A358M, Grade 304L, Class 1 or Class 3 with supplementary requirements of S1, S2 and S3, or ASTM A312/A312M Type 304L, seamless (only). Any agreements between the purchaser and the manufacturer or supplier as referenced in the applicable ASTM must include the Contracting Officer as a party to the

agreement. All piping welds will receive 100 percent radiographic inspection, 100 percent liquid penetrant inspection, 100 percent visual inspection and all tests as required by the applicable ASTM Standard. Piping must be provided with a nominal wall thickness as shown in Table A for ASTM A358/A358M with the deviation from the nominal wall thickness less than 0.25 mm 0.01-inch. ASTM A312/A312M seamless piping must be provided with a minimum schedule 10S wall thickness.

TABLE A		
Nominal Pipe Size	Nominal (Average) Pipe O.D.	Wall Thickness(tn)
405 mm 16 inches	405 mm 16.000 inches	7.8 mm 0.312 inch
356 mm 14 inches	356 mm 14.000 inches	7.8 mm 0.312 inch
305 mm 12 inches	322 mm 12.750 inches	6.2 mm 0.250 inch
254 mm 10 inches	273 mm 10.750 inches	6.2 mm 0.250 inch
203 mm 8 inches	218 mm 8.625 inches	6.2 mm 0.250 inch
152 mm 6 inches	167 mm 6.625 inches	5.5 mm 0.219 inch
100 mm 4 inches	114 mm 4.500 inches	5.5 mm 0.219 inch
64 mm 2.5 inches	72 mm 2.875 inches	3.9 mm 0.156 inch

(2) Pipe Ends: All Piping must be provided with beveled ends per Chapter V, ASME B31.3, and must be shipped with the ends capped.

(3) Factory Testing and Inspection Records: Per Table K341.3.2 of Chapter IX of ASME B31.3, visual, radiographic and liquid penetrant tests must be performed for each section of piping provided as all sections are subjected to cyclic conditions. All testing and inspections records must be submitted to the Contracting Officer and must indicate the pipe mark and installed location of each piping section on the project site. Observation by the Contracting Officer of the manufacturers and the fields testing and inspection procedures must be allowed under this contract. Pipe certification along with pipe markings must be submitted before the pipe arrives on the job site.

(4) Provide a qualified inspector in accordance with Chapter VI of ASME B31.3. to act as the owner's inspector (for the Government) at the pipe manufacturer's facility in addition to the manufacturer's inspector.

(5) Submit Quality Assurance Plan for the welding, inspecting and testing of the welded seam pipe.

b. Piping 50 mm 2-inches and Smaller: Schedule 80 ASTM A312/A312M seamless Type 304L for threaded piping and schedule 40 (unless otherwise indicated) ASTM A312/A312M seamless Type 304L for welded piping.

c. Stainless Steel Control Tubing: Seamless, fully annealed tubing conforming to ASTM A269/A269M, Grade TP316, Rockwell hardness B80 or less. Wall thickness for 13 mm 1/2-inch tubing to be 1.2 mm 0.049-inch.

d. Welding Electrodes (Factory Fabrication): E308L conforming to AWS A5.9/A5.9M.

2.1.3 Protective Coatings for Aboveground Piping

Provide coating of aboveground piping, piping in pits, pipe supports, filter separators, and miscellaneous metal and equipment in accordance with Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES. Color of finish coat must be [white][beige]. Do not paint stainless steel or aluminum surfaces.

2.1.4 External Protective Coatings for Buried Steel Piping

2.1.4.1 Protective Coatings for Buried Carbon Steel Piping

a. New pipe and fittings must be factory coated fusion bonded epoxy (FBE) in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEM.

b. Field joints and repairs must be fusion bonded epoxy (FBE) in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEM.

c. Field joints and repairs in tight spots (valve pits, etc. when heaters are too big) must be liquid epoxy in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEM.

d. Existing systems must match existing coating system and must be in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEM.

[e. Abrasion-resistant topcoat. Following the initial FBE coating application, provide a 20 mil thick abrasion-resistant FBE topcoat. Abrasion-resistant topcoat must be specifically suited for directional boring piping installation.

]2.1.4.2 Protective Coatings for Buried Stainless Steel Piping

Provide pipe with AWWA C215 Type B coating system of factory-applied adhesive undercoat and continuously extruded plastic resin coating; minimum thickness of plastic resin must be 0.9 mm 36 mils for pipe sizes 150 mm 6 inches and larger. Surface preparation must follow SSPC SP 1. Adhesion to steel substrate test must be a minimum of 5 lb/in0.875 N/mm. Cathodic disbondment test is not required. Fittings, couplings, irregular surfaces, damaged areas of pipe coating, and existing piping affected by the Contractor's operations must be clean, dry, grease free, and primed before application of tape. Tape must overlap the pipe coating not less than 75 mm 3 inches . Waterproof shrink sleeves may be provided in lieu of tape and must overlap the pipe coating not less than 150 mm 6 inches . Pipe coating and adhesive undercoat surfaces to be wrapped with tape must be primed with a compatible primer prior to application of tape. Primer must be as recommended by tape manufacturer and approved by pipe coating manufacturer.

a. Damaged Areas of Pipe Coating: Provide AWWA C209, 0.5 mm 20 mils nominal thickness of tape over damaged areas. Residual material from damaged areas of pipe coating must be pressed into the break or

trimmed off. Apply tape spirally with one-third overlap as tape is applied. A double wrap of one full width of tape must be applied at right angles to the axis to seal each end of the spiral wrapping.

b. Fittings, Couplings, and Regular Surfaces: Provide AWWA C209, 0.25 mm 10 mils nominal thickness tape overlapped not less than 25 mm 1.0 inch over damaged areas. Initially stretch and apply first layer of tape to conform to component's surface. Then apply and press a second layer of tape over first layer of tape.

c. Testing of Protective Coatings: Perform tests with an approved silicone rubber electric wire brush or an approved electric spring coil flaw tester. Tester must be equipped with an operating bell, buzzer, or other audible signal which will sound when a holiday is detected at minimum testing voltage equal to 1,000 6,275 times the square root of the average coating thickness in mm. mils. Tester must be a type so fixed that field adjustment cannot be made. Calibration by tester manufacturer must be required at six-month intervals or at such time as crest voltage is questionable. Certify in writing the calibration date and crest voltage setting. Maintain the battery at ample charge to produce the crest voltage during tests. Areas where arcing occurs must be repaired by using material identical to original coating or coating used for field joints. After installation, retest the exterior surfaces, including field joints, for holidays. Promptly repair holidays.

2.1.5 Fittings

2.1.5.1 General

Welding ells, caps, tees, reducers, etc., must be of materials compatible for welding to the pipe line in which they are installed, and wall thickness, pressure and temperature ratings of the fittings must be not less than the adjoining pipe line. Unless otherwise required by the conditions of installation, all elbows must be the long radius type. Miter joints are not acceptable. Make odd angle offsets with pipe bends or elbows cut to the proper angle. Butt weld fittings must be factory-made wrought fittings manufactured by forging or shaping. Fabricated fittings will not be permitted. Welding branch fittings must be insert type suitable for radiographic inspections specified herein, unless indicated otherwise on the drawings.

2.1.5.2 Carbon Steel Fittings

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NOTE: Tees with branch lines 50 percent of the main line size or more should have guide bars in piggable systems.

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a. Fittings 62 mm 2.5 Inches and Larger: Butt weld, conforming to ASTM A234/A234M, grade WPB and ASME B16.9 of the same wall thickness as the adjoining pipe. All welds must be radiographically examined throughout the entire length of each weld. Each fitting must be subjected to the Supplementary Requirements S52 and S53, Liquid Penetration examination and Magnetic-Particle Examination per ASTM A960/A960M. Detectable flaws will not be accepted in the supplementary examinations. Fittings must be identified to relate

them to their respective radiograph. Elbows located between the pig launcher and the receiver, must have a radius 1.5 times the pipe diameter. Tees with branches 150 mm 6-inches and larger, must have guide bars as detailed on the drawings.

b. Fittings 50 mm 2 Inches and Smaller. Forged (socket welded or if indicated on drawings, threaded), 900 kg 2,000-pound W.O.G., conforming to ASTM A105/A105M, Grade 2 and ASME B16.11. Threaded fittings must only be used for above grade applications. Underground and in pits low point drain pipe and high point vent pipe must be butt welded.

c. Flanges: 68 kg 150 pound weld neck, forged flanges conforming to ASTM A105/A105M, and ASME B16.5. For flanges 2" and smaller located in contained pumphouses, contained truck offloads, contained truck fill stands, and other visibly contained areas the fitting may be forged (socket welded), 900 kg 2,000-pound W.O.G., conforming to ASTM A105/A105M, Grade 2 and ASME B16.11. In pits, vaults, on PRV piping for pipeline routes, and other uncontained locations the connection must be butt welded. Flanges to be 2 mm 1/16-inch raised face with phonographic finish, except where required otherwise to match equipment furnished. Match flange face to valves or equipment furnished. Flange face must be machined to match valves or equipment furnished. Use of spacing rings or gaskets discs are not allowed. Flanges must be subjected to the Supplementary Requirements S56, Liquid Penetrant Examination as outlined in ASTM A961/A961M. Detectable flaws will not be accepted.

d. Interior Epoxy Coating System must be applied to the fittings as specified in paragraph "Carbon Steel Piping."

2.1.5.3 Stainless Steel Fittings

a. Fittings 62 mm 2.5 Inches and Larger: Butt weld stainless steel conforming to ASTM A403/A403M, Class WP, Type 304L, seamless or welded, and ASME B16.9 of the same minimum wall thickness as the adjoining pipe. Welded fittings must be tested and inspected the same as the welded seam pipe and meet the same requirements as for the pipe. Elbows located between the pig launcher and the receiver, must have a radius 1.5 times the pipe diameter. Tees with branches 150 mm 6-inches and larger, must have guide bars as detailed on the drawings.

b. Fittings 50 mm 2-Inches and Smaller: Forged Type 304 or 304L (socket welded or if indicated on drawings, threaded), 900 kg 2,000-pound W.O.G. conforming to ASTM A182/A182M and ASME B16.11. Threaded fittings must only be used for above grade applications. Underground and in pits low point drain pipe and high point vent pipe must be butt welded.

c. Unions. Conforming to ASTM A312/A312M, Grade 304 or 316.

d. Flanges. 68 kg 150 pound weld neck, forged Type 304 stainless steel flanges conforming to ASTM A182/A182M and ASME B16.5, except flanges that are to be connected to the fueling/defueling pumps must be 135 kg 300-pound. For flanges 2" and smaller located in contained pumphouses, contained truck offloads, contained truck fill stands, and other visibly contained areas the fitting may be forged (socket welded), 900 kg 2,000-pound W.O.G., conforming to ASTM A182/A182M and ASME B16.11. In pits, vaults, on PRV piping for pipeline routes, and

other uncontained locations the connection must be butt welded. Flanges to be 2mm 1/16-inch raised-face with phonographic finish, except where required otherwise to match equipment furnished. Match flange face to valves or equipment furnished. Flanges must be subjected to the Supplementary Requirements S56, Liquid Penetrant Examination as outlined in ASTM A961/A961M. Detectable flaws will not be acceptable.

e. Stainless Steel Tube Fittings. Flareless, 316 stainless steel fittings conforming to SAE J514.

2.1.5.4 Isolating Gasket Kits (Insulating) for Flanges

Provide ASTM D229 electrical insulating material of 1,000 ohms minimum resistance or 500 Volts per Mil (VPM) minimum dielectric strength; material must be resistant to the effects of aviation hydrocarbon fuels. Provide full face insulating gaskets between flanges with fluoroelastomer (FKM), commonly referred to as Viton, O-ring sealing surfaces. Provide full surface 0.75 mm 0.03-inch thick wall thickness, spiral-wound mylar insulating sleeves between the bolts and the holes in flanges; bolts may have reduced shanks of a diameter not less than the diameter at the root of threads. Provide 3 mm 0.125-inch thick high-strength phenolic insulating washers next to flanges and provide flat circular stainless steel washers over insulating washers and under bolt heads and nuts. Provide bolts 12 mm 0.5-inch longer than standard length to compensate for the thicker insulating gaskets and the washers under bolt heads and nuts. Above grade flanges separated by electrically isolating gasket kits must be provided with weatherproof lightning surge arrester devices. The surge arrester must bolt across flanges separated by insulating gasket kits per detail on contract drawings. The arrestor must have the following features:

a. Weatherproof NEMA 6P enclosure.
b. Bidirectional and bipolar protection.
c. Constructed of solid state components, no lights, fuses or relays and used without required maintenance or replacement.
d. Withstand unlimited number of surges at 50,000 Amperes.
e. Maximum clamping voltage of 700 Volts based on a IEEE C62.41 8x20 microsecond wave form at 50,000 Amperes peak measured at the device terminals (zero lead length).
f. A UL listed arrester for installation in Class 1, Division 1 or Class 1, Division 2, Group D, hazardous areas.

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

Line Size	Bolt Size
50 mm2 inch	16 mm5/8 inch
62 mm2.5 inch	16 mm5/8 inch
75 mm3 inch	16 mm5/8 inch
100 mm4 inch	16 mm5/8 inch
150 mm6 inch	19 mm 3/4 inch
203 mm8 inch	19 mm3/4 inch
254 mm10 inch	22 mm7/8 inch

Line Size	Bolt Size
305 mm12 inch	22 mm 7/8 inch
355 mm14 inch	25 mm 1 inch
406 mm 16 inch	25 mm 1 inch
Note: Make allowance for the1 mm 1/32-inch thickness of the insulating sleeve around the bolts when sizing the mounting lugs.	

2.1.5.5 Flange Protectors

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NOTE: Use near coastal areas and in wet locations (valve pits).
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Protect the bolts, studs, nuts, and gaskets of a flanged end connection from corrosion or damage due to exposure to the environment. Protectors must be weather and ultraviolet (UP) resistant. Protectors must allow for quick and easy removal and re-installation by maintenance personnel. Provide grease filled bolt caps. Provide non-expansive corrosion prevention grease and design for the service. Provide protectors that allow for visual inspection of the flange gasket without requiring removal. Provide protectors with grease fittings which allow the injection of grease into the flange cavity.

2.1.6 Nuts and Bolts

Bolts and nuts for pipe flanges, flanged fittings, valves and accessories must conform to ASME B18.2.1 and ASME B18.2.2, except as otherwise specified. Bolts must be of sufficient length to obtain full bearing on the nuts and must project no more than three full threads beyond the nuts with the bolts tightened to the required torque. Bolts must be regular hexagonal bolts conforming to ASME B18.2.1 with material conforming to ASTM A193/A193M, Class 2, Grade B8, stainless steel, when connections are made where a stainless steel flange is involved, and Grade B7, chromium molybdenum alloy, when only carbon steel flanges are involved. Bolts must be threaded in accordance with ASME B1.1, Class 2A fit, Coarse Thread Series, for sizes 25 mm one inch and smaller and Eight-Pitch Thread Series for sizes larger than 25 mm one inch. Nuts must conform to ASME B18.2.2, hexagonal, heavy series with material conforming to ASTM A194/A194M, Grade 8, stainless steel for stainless steel bolts, and Grade 7, chromium molybdenum allow for chromium molybdenum alloy bolts. Nuts must be threaded in accordance with ASME B1.1, Class 2B fit, Coarse Thread Series for sizes 25 mm one inch and smaller and Eight-Pitch Thread Series for sizes larger than 25 mm one inch. Provide washers under bolt heads and nuts. Use chromium molybdenum alloy washers dimensioned to ASTM F436 flat circular for chromium molybdenum bolts. Stainless steel washer dimensioned in accordance with ASTM F436 flat circular, use material the same as the bolt. Use torque wrenches to tighten all flange bolts to the torque recommended by the gasket manufacturer. Tight in the pattern recommended by the gasket manufacturer. Use anti-seize compound on

stainless steel bolts.

2.1.7 Gaskets

ASME B16.21, composition ring, using a Buna-N, polytetrafluoroethylene (PTFE), or a protein and glycerin binder, 3 mm0.1250-inch thick. Gaskets must be resistant to the effects of aviation hydrocarbon fuels and manufactured of fire-resistant materials. Full-face gaskets must be used for flat-face flanged joints. Ring gaskets must be used for raised-face flanged joints. Gaskets must be of one piece factory cut.

2.1.8 Relief and Drain System Piping

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NOTE: Per SME.
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Pressure relief valve discharge lines and drain lines to the product recovery tank must be Schedule 40 [API Spec 5L Grade B or ASTM A53/A53M Grade B Carbon Steel] [ASTM A312/A312M seamless Type 304L Stainless Steel]. See Gaskets specified herein before.

2.1.9 Relief and Drain System Protective Coating

Pipe must be factory coated as specified herein before for steel piping.

2.1.10 Stainless Steel Field Applied Protective Coatings

The field joints and fittings of all underground piping must be coated as herein specified.

2.1.10.1 Welded Joints

Heat shrinkable radiation-cross-linked polyolefin wraparound type sleeves must be applied to all welded joints. Joints must not be coated until pressure testing is complete. Apply sleeves consisting of 1 mm 40 mil polyolefin backing and 1 mm 40 mil thermoplastic mastic adhesive in accordance with the manufacturer's instructions.

2.1.10.2 Tape for Fittings

Fittings and other irregular surfaces must be tape wrapped. The tape must be a plastic mastic laminated tape having 0.15 mm 6 mil plastic backing of either polyethylene or polyvinylchloride and 0.72 to 2.4 mm 29 to 44 mil of synthetic elastomer.

2.1.11 Threaded Joints

Threaded joints, if indicated on the drawings, must be made tight with manufacturer recommended PTFE tape or a mixture of graphite and oil, inert filler and oil, or with a graphite compound, applied with a brush to the male threads. Not more than three threads must show on made up joints. Threaded joints, mechanical couplings and flanges will not be permitted in buried piping. Threaded joints must not get welded.

2.1.12 Welded Joints

Welded joints in steel pipe must be as specified in Part 3.

2.2 MANUAL VALVES

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NOTE: Per SME for marine environment, provide stainless steel valves on exterior (aboveground and in pits) piping.

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All portions of a valve coming in contact with fuel in stainless steel pipe lines or epoxy lined carbon steel pipe lines must be of noncorrosive material. Valves in stainless steel pipe lines or epoxy lined carbon steel pipe lines must be Type 304 or Type 316 stainless steel or carbon steel internally plated with chromium or nickel or internally electroless nickel plated. Valves in unlined carbon steel pipelines must have carbon steel body. Stem and trim must be stainless steel for all valves. Manually operated valves 150 mm 6 inches and larger must be worm-gear operated and valves smaller than 150 mm 6 inches must be lever operated or handwheel operated. Valves smaller than 50 mm 2 inches must have lever-type handles. Handles installed more than 1.8 m 6 feet above finished floor must have chain operators. Valve indicators installed higher than 1.5 m 5 feet must have a position indicator visible from ground level. Sprocket wheel for chain operator must be aluminum. Valves in the isolation pits in fuel piping between the pig launchers and the pig receivers must be full bore, piggable, double block and bleed type. The full bore piggable valves at the launcher and the receiver must be ball type.

2.2.1 Ball Valves

Ball valves must be fire tested and qualified in accordance with the requirements of API Std 607 and API STD 608. Seal material for the fire test must be graphite, seal material for the project must be as as indicated below. Ball valves must be nonlubricated valves that operate from fully open to fully closed with 90 degree rotation of the ball. Valves 50 mm 2 inches and larger must conform to applicable construction and dimension requirements of API Spec 6D, ANSI Class 150 and must have flanged ends. Valves smaller than 50 mm 2 inches must be ANSI class 150 valves with flanged ends, unless noted otherwise. The balls in valves 254 mm 10 inches full port and 305 mm 12 inch regular port and larger must have trunnion type support bearings. Except as otherwise specified, reduced port or full port valves may be provided at the Contractor's option. Balls must be solid, not hollow cavity.

2.2.1.1 Materials

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

2.2.1.2 Full Port Ball (DBBV) Valves for Piggable Lines

Ball valves must be designed, manufactured, and tested to API Spec 6D, fire-safe and tested to API Spec 6FA, and BS EN ISO 10497 (BS 6755, Part 2). Seal material for the fire test must be graphite, seal material for the project must be as as indicated below. Valves must be trunnion-mounted with independent spring and hydraulically actuated, floating, single piston effect, self-relieving seat rings, with bi-directional sealing. Ball must be solid type with full through-conduit opening, suitable for

passage of pipeline pigs. Stem must be anti-static, blow-out-proof design with o-ring seals and provided with an emergency sealant injection fitting. Valves must be 3-piece, bolted body design with raised-faced ANSI Class 150 flanged connections, equipped with body drain/bleed valve and vent fitting, and suitable for double block and bleed service in the closed and open positions. Valves must be all stainless steel construction, or carbon steel with stainless steel stem, and all wetted parts electroless nickel-plated. Valves must have nylon or polytetrafluoroethylene (TFM) seat inserts, FKM B body, stem, and seat o-rings, with stainless steel and graphite body gaskets and graphite secondary stem seals. Valves located in vaults or pits must be equipped with actuator extensions.

2.2.1.3 Electric Valve Actuator

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

2.2.2 Plug (Double Block and Bleed) Valves

API Spec 6D, ANSI Class 150, non-lubricated, resilient, double seated, trunnion mounted, tapered lift plug capable of two-way shutoff. Valve must have tapered plug of steel or ductile iron with chrome or nickel plating and plug supported on upper and lower trunnions. Sealing slips must be steel or ductile iron, with Viton seals which are held in place by dovetail connections. Valve design must permit sealing slips to be replaced from the bottom with the valve mounted in the piping. Valves must operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valves must have weatherproof operators with mechanical position indicators. Indicator shaft must be stainless steel. Minimum bore size must be not less than 65 percent of the internal cross sectional area of a pipe of the same nominal diameter unless bore height of plug equals the nominal pipe diameter and manufacturer can show equal or better flow characteristics of the reduced bore size design. Full port plug valves in distribution piping must be provided with a 13 mm 1/2-inch threaded body drain.

2.2.2.1 General

Valves in the operating tank suction and fill lines and the valves at the four valve manifold in the pump room in the tank fill lines must be provided with a factory-installed limit switch that is actuated by the valve closure. Tank fill line valve and four valve manifold limit switches must be provided with one double pole double throw contacts or four single pole, double throw contracts, two for open, two for closed. Tank suction line valve limit switches must be provided with one double pole double throw contacts or four single pole, double throw contacts, for closed, and one single pole double throw contact or two single pole, double throw contacts for open. All components must be watertight and U.L. listed for Class I, Division 1, Group D hazardous areas.

2.2.2.2 Valve Operation

Rotation of the handwheel toward open must lift the plug without wiping the seals and retract the sealing slips so that during rotation of the plug clearance is maintained between the sealing slips and the valve body. Rotation of the handwheel toward closed must lower the plug after the sealing slips are aligned with the valve body and force the sealing slips against the valve body for positive closure. When valve is closed,

the slips must form a secondary fire-safe metal-to-metal seat on both sides of the resilient seal. Plug valves located in Isolation Valve Pits or vaults must be provided with handwheel extensions.

2.2.2.3 Relief Valves

ANSI Class 150. Provide plug valves with automatic thermal relief valves to relieve the pressure build up in the internal body cavity when the plug valve is closed. Relief valves must open at 175 kPa 25 psi differential pressure and must discharge to the throat of, and to the upstream side, of the plug valve.

2.2.2.4 Bleed Valves

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

2.2.2.5 Electric Valve Actuator

The actuator, controls and accessories must be the responsibility of the valve-actuator supplier for sizing, assembly, certification, field-testing and any adjustments necessary to operate the valve as specified. The electric valve actuator must include as an integral unit the electric motor, actuator unit gearing, limit switch gearing, position limit switches, torque switches, drive bushing or stem nut, declutch lever, wiring terminals for power, remote control,indication connections and handwheel. The electrically actuated plug valve must be set to open and close completely in 30 to 60 seconds against a differential pressure of 2 MPa 275 PSIG. The actuator settings of torque and limit contacts must be adjustable. The valve actuator must be suitable for mounting in a vertical or horizontal position and be rated for 30 starts per hour. The valve actuator must be capable of functioning in an ambient environment temperature ranging from -38 to 70 degrees C -32 to 158 degrees F.

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

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

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

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

lubricate the gearcase.

e. The actuator must integrally contain local controls for Open, Close and Stop and a local/remote three position selector switch: Local Control Only, Off, and Remote Control plus Local Stop Only. A metallic handwheel must be provided for emergency operation. The handwheel drive must be mechanically independent of the motor drive. The remote control capability must be to open and close. Rim pull to operate valve manually must not exceed 28 kg 80 pounds.

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

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

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

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

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

2.2.3 Swing Check Valves

Swing check valves must conform to dimensional requirements of API Spec 6D, regular type, ANSI Class 150 with flanged end connections. Check valves must conform to API STD 600 and be swing type with material as previously indicated herein. Discs and seating rings must be renewable without removing the valve from the line. The disc must be guided and controlled to contact the entire seating surface.

2.2.4 Silent Check Valves

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

2.2.5 Butterfly Valve with Fusible Link Operator

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NOTE: Consult with SME before using this valve. Not permitted on Air Force projects. There are specific locations this valve is to be used on Navy projects in accordance with UFC 3-460-01.

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Valve must conform to API Std 609. Valve must meet the fire test requirements of API Std 607. Valve must be designed for bubble tight bidirectional shutoff service at operating conditions. Disc must be Type 304L or Type 316, stainless steel. Stem must be ASTM A276/A276M Type 416

or ASTM A564/A564M Type 630 stainless steel. Seal ring must be Teflon with metal backup. Stem seals must be capable of withstanding the rated pressure and temperature of the valve seat. Provide valves 150 mm 6 inches and larger and valves at pump discharge with weatherproof gear operators with handwheel; other valves must have minimum 10 position throttling handles. Valve must have a fusible link type valve operator. The fusible link and spring assembly must 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 must be fully enclosed to ensure safety. Provide valve with flanged end connections independent of other flanged end connections provided on items such as equipment, piping, piping components, or valves.

2.3 RELIEF VALVES

Relief valves must be the fully enclosed, spring loaded, angle pattern, single port, hydraulically operated type with plain caps, and must be labeled in accordance with ASME BPVC SEC VIII D1 (L/sGPM). Valve stems must be fully guided between the closed and fully opened positions. The valves must be factory-set to open at 1.8 MPa 265 psi unless otherwise indicated on the drawings. Operating pressure must be adjustable by means of an enclosed adjusting screw. The valves must have a minimum capacity of 1.3 L/s 20 GPM at 10 percent overpressure. Valves must have a replaceable seat. Relief valves that do not relieve to a zone of atmospheric pressure or tank must be a balanced (non-ASME) type relief or regulator valve.

2.3.1 Valve Materials

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

2.3.2 Quick Disconnect

If indicated on drawings provide quick disconnect on relief valve system. Quick disconnects must be double shut-off, dry-break design, 316 stainless steel construction, with Fluorocarbon (Viton) seals, minimum working pressure of 1000 psig at 100°F., with ½" female NPT threaded connections for both coupler and adapter, manufactured in accordance with ISO 7241, Series B. The couplers and nipple/adapters are to be provided with aluminum dust caps to protect the fitting when not in use. Five nipple/adapters are to be provided to the installation for connecting to government test equipment.

2.4 PIPING ACCESSORIES

2.4.1 Flexible Ball Joints

Flexible ball joints must be [stainless steel] [carbon steel with electroless nickel-plating to a minimum of 0.075 mm 3 mils thickness], capable of 360-degree rotation plus 15-degree angular flex movement, ASME B16.5, Class 150 flanged end connections. Provide either pressure molded composition, PEEK, or polytetrafluoroethylene (TFM) gaskets designed for continuous operation temperature of 135 degrees C 275 degrees F. Joints must be designed for minimum working pressure of ANSI Class 150. Injectable packing will not be allowed.

2.4.2 Pipe Sleeves

Pipe sleeves must be installed where indicated and at all points where the piping passes through concrete construction. Such sleeves must be of sufficient inside diameter to provide a minimum clear distance between the pipe and the sleeve of 13 mm 1/2-inch. Sleeves through concrete pits or slabs must be standard weight carbon steel pipe with a protective coating. Each sleeve must extend through the respective pit wall or slab and must be provided with a Buna-N casing seal (Viton when exposed to sunlight). Sleeves where piping passes under roads or piping indicated to be double walled must be standard weight carbon steel pipe with a protective coating as previously specified. Alignment of the sleeve and piping must be such that the pipe is accurately centered within the sleeve by a nonconductive centering element. The sleeve must be securely anchored to prevent dislocation. Closure of space between the pipe and the pipe sleeve must be by means of a mechanically adjustable segmented elastomeric seal. The seal must be installed so as to be flush.

2.4.3 Strainers

2.4.3.1 Basket Type

Strainer must be single or multi (four) basket type as indicated in compliance with MIL-PRF-13789, except as specified otherwise. Strainer end connections must be designed in accordance with ASME B16.5, Class 150. Strainer body material must be the same as the material specified for manual valves. Strainers must have removable baskets of 60 mesh wire screen with larger wire mesh reinforcement; wire must be stainless steel, Type 316. Pressure drop for clean strainer must not exceed 20 kPa 3 psig at maximum design flow rate. The ratio of net effective strainer area to the area of the connecting pipe must be not less than three to one. Each strainer must be provided with a suitable drain at the bottom, equipped with a ball valve. The strainer must be equipped with a direct-reading, piston type differential pressure gauge that measures the differential pressure across the basket. The gauge must consist of a spring-supported, corrosion resistant piston moving inside a glass cylinder, with high pressure applied on top of the piston and low pressure applied below it. Under a differential pressure of 21 kPa 30 PSI, leakage past the piston must not exceed 120 drops per minute. The cylinder and flanges must be stainless steel with Viton O-ring seals. The high pressure inlet of the gauge must have a 10-micron pleated paper filter and the low pressure connection must have a fine mesh stainless steel strainer. The gauge must have an operating pressure of 210 kPa 300 PSI. Differential pressure range of the gauge through approximately 75 mm 3 inches of piston movement must be 0-21 kPa 0-30 PSI with an accuracy of ± 0.034 0.5 PSI, calibrated linearly with one kPa PSI scale graduations. High and low pressure connections must be 6 mm 1/4 inch NPT female with a stainless steel bar stock valve at each connection. Construction of the gauge must be such that a 3-valve manifold is not necessary. If only one bar stock valve is closed, the gauge must not be damaged by up to 210 kPa 300 PSI differential pressure in either direction. A pressure gauge must be attached to the differential pressure gauge to indicate the high pressure and have a range of 210 kPa 300 psi.

2.4.3.2 Cone Type

Strainer must be stainless steel type 304 or 316, 100 mesh screen with the ratio of net open area of strainer to the area of the connecting pipe must be not less than three to one at the pump suction, and 4 mm 5/32-inch

perforations and suitable for bi-directional flow at the inlet to the hydrant pit control valves.Pump suction strainer must have a 100 mesh screen with not less than 300% open area (ratio of the strainer open area to the cross section of pipe). Hydrant pit control valve strainer must be the basket type, have 5/32 inch perforations, suitable for bidirectional flow, and have a minimum 200% open area.

2.4.4 Pipe Supports

2.4.4.1 General

Pipe supports must conform to MSS SP-58. Supports must be provided at the indicated locations. Support channels for drain lines must be epoxy coated on all surfaces or hot-dip galvanized after the channels are cut to length. Coated supports must be coated with fusion bonded epoxy resin applied by the fluidized bed method. Thickness of the coating must be not less than 0.25 mm 10 mils. Surface preparation and coating application must be in accordance with the epoxy manufacturer's instructions. The coating must be pinhole free when tested with a low voltage holiday detector set at no more than 100 times the mm mil thickness of the coating. All pinholes must be marked, repaired and retested to ensure a pinhole free film. The coating material must be a 100 percent solids, thermosetting, fusion-bonded, dry powder epoxy resin. The manufacturer must certify that the material is suitable for fluidized bed application and that it is approved by the Environmental Protection Agency. A PTFE pad must be installed between the pipe and the u-bolt.

2.4.4.2 Adjustable Pipe Supports

Adjustable pipe supports must consist of a cast iron saddle and a threaded nipple connected to a carbon steel pipe by means of a special reducer conforming to MSS SP-58. The supports must be provided with PTFE insulation strips.

2.4.4.3 Low Friction Supports

Low friction supports must be self-lubricating antifriction element composed of reinforced PTFE. Units must be factory designed and manufactured.

2.4.4.4 Concrete and Grout

Concrete and grout for anchors and supports must comply with SECTION 03 30 00 CAST-IN-PLACE CONCRETE.

2.4.5 Sample Connections

a. Sample connections must be factory assembled units specifically designed for obtaining representative samples from fuel pipelines. Each connection must include a 6 mm 1/4-inch sampling probe where the probe faces upstream, ball valve and 6 mm 1/4-inch quick disconnect coupling with dust plug, all assembled into a unit that is suitable for installation in a pipe nipple. The sampling probe must extend not less than one inch into the fuel pipe. All materials in the sample connections must be stainless steel or aluminum.

b. Furnish two sampling hose assemblies to the Contracting Officer at the project site. Each assembly must consist of a 1.8 m 6-foot length of 6 mm 1/4-inch clear plastic tubing with internal bonding/grounding

wire. One end of the tubing will contain a male connector that actuates flow when inserted into the quick disconnect coupler. Each end of the bonding/grounding wire must be equipped with clips for attaching to the pipe and metal sample container.

2.4.6 Flanged Swivel Joints

Flanged swivel joints must be stainless steel, single plane, capable of rotating 360 degrees. Welded swivel joints and welding of swivel joints to the pipe and/or elbow is not permitted. Swivel joints must be of the non-lubricated, maintenance free type with sealed bearings and no lubricating fitting. Swivel joint must be flanged at the end connecting to the piping system and threaded (female NPT) at the end connecting to the fuel hose. No leakage must be permitted under positive or negative pressure conditions. No leakage must be permitted under high or low temperature conditions. Welding of swivel joint to six-bolt flange connector is permitted. The swivel joints must be warranted for three years against leakage. There must be electrical continuity from one flange to the other without the use of ground straps. The electrical continuity from one flange to another (without the use of ground straps) must be less than 1000 ohms. Each swivel joint must have two ball bearing raceways, primary and secondary seals with leak detection port, and dust seal.

2.4.7 Monitoring Points

At the following locations, provide 13 mm half-inch pipe, flanged ball valve, and blind flange for future test equipment connections:

a. On the filter separator discharge header in the pumphouse.

b. At the Hydrant Hose Truck Checkout, inlet to Hydrant Valve.

c. At the inlet to the Back Pressure Control Valve in the Pumphouse.

d. At both sides of the isolation valve in all the isolation valve pits.

2.4.8 Fuel Hose

Fuel hose must conform to EI 1529, Grade 2, Type C, threaded, male NPT, both ends.

2.4.9 Top Loading Arms

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NOTE: Top loading is discouraged (safety) and should be used only when equipment is incapable of bottom loading and only when approved by the SME.

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Top loading arm ([2"-100][3"-200][4"-300]gpm) must have sufficient horizontal reach and pivot points to assure the vehicle does not have to be re-spotted. Drop pipe length must be able to reach fill tank bottom and be at a safe elevation for refueler operation. Loading arm must have four planes of movement: up-down (to allow drop pipe to enter tank), side to side (to allow arm to rotate out to tank and back out of position), drop-tube (to assure drop-tube remains vertical), scissor arm pivot (which allows 360 degree rotation of secondary arm allowing the drop-tube to reach further out thus allows a larger spotting distance). Materials of

construction must be stainless steel. Arm must be counterweight or spring assisted for effortless operation of loading arm. Swivel joints must be of the non-lubricated, maintenance free type with sealed bearings and no lubricating fittings. Assembly must be a regular product for the purpose of top loading fuel from a manufacturer who has successfully provided the product for at least the past five years.

2.4.10 Pressure Fueling Nozzle

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NOTE: Specify type of nozzle as directed by the SME.
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Nozzles must conform to SAE AS5877, Type [D-1] [D-2] [D-3]. Nozzles and nozzle components must be compatible with the fuel to be handled. Nozzles must be provided with an internal 60 mesh stainless steel strainer and a fuel sample connection tapping. Nozzle design must be for single point fueling of aircraft. Nozzles must be provided with a compatible dry break quick disconnect swivel. Coupler must allow for quick disconnect and reconnect of fueling nozzles with corresponding adapters. Coupler and adapter must provide a positive, leak proof connection under constant or surge flow. Coupler must be designed to prevent blowout of internal poppet.

2.4.11 Nozzle Adapter (SPR)

Adapter must be a nominal 62 mm 2-1/2 inches with self-closing valve in accordance with MIL-A-25896. Adapter must have a 100 mm 4 inch flange mounting and vacuum tight, locking dust cap using the SPR lugs.

2.4.12 Pigging Accessories

2.4.12.1 Closure Door

The closure must be hinged, swing bolted closure of the same material as the pipe and for a Class 150 system. Gasket must be nitrile. Eye bolts must be pinned to lugs on the hub.

2.4.12.2 Signaler

The pig signaler must be mechanical flag type with manual reset, and be located on the pig launcher and the pig receiver. Material in contact with the fuel must be stainless steel. Units must be suitable for removal and installation under line pressure of 275 psig. Signaler must be capable of withstanding line pressure of a Class 150 system.

2.5 FLEXIBLE HOSES

Flexible hoses for fueling pumps must have ANSI Class 300 flanges to mate to the pump and Class 150 to connect to the system flanges of stainless steel construction conforming to ASME B16.5. Flexible hoses must be of stainless steel flexible metal hose consisting of an inner corrugated stainless steel tube with stainless steel braid cover and stainless steel flanges. All components to be suitable for not less than 2 MPa 275 psig. Length and application of flexible hoses must be per manufacturer's written recommendations.

2.6 AUTOMATIC AIR VENT

Unit must have 25 mm one-inch connections and automatically vent air under pressure, and prevent a vacuum when pressure drops below a positive pressure. As fuel fills the vent, a float must rise and form a drip-tight closure. The unit pressure rating must be a minimum of 2 MPa 275 psi. The float must be stainless steel. Body and cover be carbon steel or ductile iron and be internally epoxy coated.

2.7 SURGE SUPPRESSOR TANK AND VALVE

The unit must be fabricated from carbon steel, internally coated pressure vessel with a rubber bladder or a stainless steel diaphragm separating the fuel from the gas charge. The epoxy coating must be in accordance with MIL-PRF-4556. The rubber bladder must be molded synthetic nitrile rubber (Buna-N). The unit must be constructed and labeled in accordance with ASME BPVC SEC VIII D1. The housing must be designed for a working pressure of 2 MPa 275 PSIG. The gas precharge must be dry nitrogen and must have a pressure gauge, gas valve, and an adapter for field charging. Bladder precharge pressure must be 1 MPa 80 PSIG. The connection to the piping system must be Class 150 ANSI flange, size as indicated on the drawings. The connection must have a check valve to provide unrestricted flow into the vessel and restricted flow from the vessel. The flange must have a 13 mm 1/2-inch NPT connection with a valve and adapter to relieve fluid pressure during gas recharging and to drain the vessel during removal. A charging assembly must be provided. The surge control supplier must furnish a service person trained to provide installation check-out assistance and to supervise operation and testing necessary to place the surge control system into service and to provide training on charging, recharging, and checking the surge suppressor.

PART 3 EXECUTION

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NOTE: Specify as directed by the SME.
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3.1 VERIFICATION OF DIMENSIONS

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 CLEANING OF PIPING

Keep the interior and ends of all new piping, affected by construction operations, thoroughly cleaned of foreign matter and water before and after being installed. Piping systems must be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of piping and fittings must be closed so that no water or other foreign substance will enter the pipes or fittings. Piping must be inspected before placing into position. The interior of each length of pipe must be cleaned after welding insuring that the interior of the piping is free of foreign matter when it is connected into the system.

3.3 TRENCHING AND BACKFILLING

Trenching and backfilling must conform to Section 31 00 00 EARTHWORK, and

the following bedding and backfill requirements. The pipe must be laid in a bed of sand 150 mm 6 inches deep, compacted in accordance with Section 31 00 00 EARTHWORK, paragraph "Backfilling and Compaction". Sand must meet the requirements of Section 31 00 00 EARTHWORK, paragraph "Select Granular Material". The full length of each section of pipe without any protective covering must be excavated to permit installation of the protective covering. Pipe that has the grade or joint disturbed after laying, must be taken up and relaid. Pipe must not be laid in water or when the trench or weather conditions are unsuitable for such work. After testing and application of protective covering to joints, sand backfill must be placed and compacted around the pipe or protective coating to a depth of 305 mm 1 foot above top of pipe. The remainder of the backfill must be the same as for other types of pipe.

3.4 PIPING LAYOUT REQUIREMENTS

3.4.1 Pipe Fabrication

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

3.4.2 Interferences and Measurements

Provide offsets, fittings, and accessories required to eliminate interferences and to match actual equipment connection locations and arrangements. Verify measurements before commencing work. Submit discrepancies for clarification before proceeding with the installations to the Contracting Officer.

3.4.3 Space and Access

Keep piping, control tubing, which is not detailed close to structures and columns so as to take up a minimum amount of space. Ensure that access is provided for maintenance of equipment, valves and gauges.

3.4.4 Location

Do not place unions in locations that will be inaccessible after the completion of the work. Place unions on each side of equipment.

3.4.5 Piping and Equipment

Provide anchors where required to absorb or transmit thrust or eliminate vibration or pulsation. Provide hangers and supports near each change of direction. Select support components which do not restrict the movement of the pipe due to thermal expansion. Space hangers uniformly and arrange symmetrically.

3.4.6 Structural Support

Provide supplementary or intermediate steel or other structural members as required for transmission of loads to members forming part of the supporting structure. Piping must not be supported from other piping.

3.4.7 Grade

Where profiles of piping lines are shown on the drawings, grade the line uniformly between changes in slope or direction. Maintain gradient to within ± 6 mm 1/4-inch over the entire length of pipe. When backfilling has been completed to the top of the pipe, the pipe must be surveyed at each joint, and logged by station number. Submit to the Contracting Officer for approval the survey final elevations before backfilling can continue.

3.4.8 Size Changes

Make changes in pipe size with reducing fittings. Do not use bushings. In lieu of welding reducing outlet tees for piping 50 mm 2 inches and larger, welding branches suitable for 100 percent radiographic inspection may be used. Do not use weldolets unless specifically called out (labeled) on the drawings.

3.4.9 Direction Changes

Make changes in direction of pipes with long radius fittings. Provide special fittings when required. Do not make miter welds. Make odd-angle offsets with pipe bends or elbows cut to the proper angle.

3.5 WELDING

3.5.1 General

All joints, unless indicated otherwise, in carbon steel and stainless steel piping systems must be welded. Welding of fuel pipe joints must comply with Section 33 52 23.15 SERVICE PIPING WELDING.

3.6 INSTALLATION

3.6.1 Precautions

Take special care to ensure that the protective coating on buried pipe is not damaged during installation and that the completed system is free of rocks, sand, dirt, water, weld slag, and foreign objects including construction debris. Take the following steps to ensure these conditions.

a. Coated pipe must be handled only with canvas or nylon slings or padded clamps. Any coating damaged by improper handling or storage must be repaired as specified.

b. Pipe brought to the site must be stored on blocks or horses at least 458 mm 18 inches above the ground and adequately supported to prevent sagging. Padded blocks or horses must be used for coated pipe. The method and height of storing coated pipe must be in accordance with the coating manufacturer's instructions. Pipe ends must be protected and capped against weather at all times, except to accommodate immediate installation.

c. Visual inspection must be made of the inside of each length of pipe to ensure that it is clear and clean prior to installation.

d. The open ends of the pipe system must be closed at the end of each day's work or when work is not in progress by use of expansion plugs and must not be opened until the work is resumed.

e. A swab, with a leather or canvas belt disc to fit the inside diameter of pipe, must be pulled through each length of pipe after welding in place.

f. Obstruction remaining in the pipe after completion of the system must be removed at the expense of the Contractor.

g. Plasma cutters and torches are not to be used to make penetrations in the pipe or to cut pipe.

h. After installation and backfill of the hydrant loop is complete and before fuel is put in the pipe, the pipe will be cleaned using foam swabs and poly coated wire brush pigs and compressed dry gas, residual humidity of not over 20 percent. Ten flights of a combination of swab and brush pigs must be run. During this, low point drains and high point vents must be blown clean.

[3.6.2 Protective Coatings for Buried Stainless Steel Piping

3.6.2.1 Application of Tape Wrapping

Surfaces to receive tape must be clean, dry, grease-free and dust-free. Extruded polyethylene coating and adhesive undercoat surfaces to be tape wrapped must be primed with a compatible primer prior to application of the tape. The primer must be as recommended by the tape manufacturer and approved by the extruded polyethylene coating manufacturer. Weld beads must be wire brushed. Burrs and weld spatter must be removed. Weld beads must be covered with one wrap of tape prior to spiral wrapping. Fittings must be wrapped spirally beginning with one complete wrap three inches back from each edge of the extruded polyethylene coating. For pipe less than four-inch size, one layer half-lapped must be used. For pipe 100 mm 4-inch size and larger, two layers half-lapped must be used, with the second layer wrapped opposite hand to the first. On irregular surfaces one layer must be applied half-lapped and stretched to conform to the surface, followed by a second layer half-lapped and applied with the tension as it comes off the roll.

3.6.2.2 Inspection and Testing

The condition of factory field coated and wrapped piping must be the responsibility of the Contractor and all damage to the protective covering during transit and handling must be repaired at no additional cost to the Government. All field coating and wrapping must be subject to approval by the Contracting Officer. The entire pipe must be inspected as specified in sub-paragraph "Testing of Protective Coatings" under paragraph "Protective Coatings for Buried Steel Piping." The inspection for holidays must be performed just prior to lowering the pipe into the ditch and every precaution must be taken during lowering and backfilling to prevent damage to the protective covering.

3.6.2.3 Damage Repair

Damaged areas of extruded polyethylene coating must be repaired by tape wrapping as specified in the preceding paragraph for fittings. Residual material from the extruded polyethylene coating must be pressed into the break or must be trimmed off; all areas to be taped must be primed, and the tape must be applied half-lapped.

]3.7 INTERIOR EPOXY COATING

When internally epoxy lined pipe is cut, the lining must be ground back from the end a minimum of one inch but not more than 38 mm 1-1/2 inches.

3.8 INSTALLATION OF UNDERGROUND PIPE

Underground fuel pipelines must be pitched as shown on the drawings. Where not indicated they must be pitched a minimum of 50 mm 2 inches per 30.5 m 100 feet. Branch lines to the hydrant pits must slope up to the pit. 50 mmTwo-inch pipe size valved drain connections must be provided at all low points and 38 mm 1-1/2-inch pipe size valved outlet vent connections must be provided at all high points. Vent and drain lines must terminate in male cam-type locking end connectors with matching female dust covers and installed in pits. The pipe must have cover as shown on the drawings. Drain lines must be installed at the slopes indicated.

3.8.1 Pipe Assembly

Pipe must be strung parallel and adjacent to or above a trench. The pipe must be supported on padded skids during welding and inspection of joints. Protective coating must be inspected and repaired prior to lowering the pipe into the trench. The pipe must be lowered using only canvas or nylon slings. The sling must be dug from underneath the pipe after placements and must not be pulled from underneath the pipe while in contact with it. Care must be taken to prevent damage to the pipe, welded joints or coating and any such damage must be repaired as directed by the Contracting Officer. Pressure testing of the pipe must be done after it has been placed in final position in the trench.

3.8.2 Warning Tapes in Earth Trenches

For the purpose of early warning and identification of buried pipes outside of building walls during future trenching or other excavation, continuous identification tapes must be provided in the trench. Provide metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured for the purpose of early warning and identification of utilities buried below the tape. Tape must be at least 75 mm 3 inches in width. Color of tape must be as standard with the manufacturer with respect to the type of utility buried below the tape. Tape must have lettering at least 25 mm 1 inch high with warning and identification imprinted in bold black letters continuously over the entire tape length with not less than the following identification on the tape: BURIED JET FUEL PIPING BELOW. Tape must be installed in accordance with the printed recommendations of the tape manufacturer, as modified herein. Tapes must be buried at a depth of 150 mm 6 inches from the top of the subgrade or 305 mm 12 inches below the top surface of earth. Provide permanent color and printing, unaffected by moisture or soil.

3.8.3 Clearances

Install pipe to be clear of contact with other pipes, pipe sleeves, casings, reinforcing steel, conduits, cables, or other metallic structures. Where pipes cross other pipes or structures with a separation of less than 150 mm 6 inches, install an insulating separator. Protect the pipe from contact with a 305 mm 12-inch square by 25 mm 1 inch thick bituminous-impregnated cane fiber board.

3.8.4 Protective Coating

When the protective coating on pipe is damaged, the Contracting Officer must be notified and must inspect the pipe before the coating is patched. If the damage to the pipe is deeper than 1.2 mm 0.050-inch, the damage must be repaired by welding in accordance with paragraph "WELDING". If the pipe is dented, out of round or damaged to the point that welding will not make it good as new, the length of pipe must be rejected.

3.9 TESTING

Piping must be tested by pneumatic and hydrostatic pressure. Testing must comply with applicable requirements of ASME B31.3, NFPA 30 and the requirements specified herein. Hydrostatic testing must be performed using fuel as the liquid. Water must not be introduced into the system for testing. Pneumatic and hydrostatic testing must be performed only after welding inspection has been completed.

3.9.1 Pneumatic Test

Piping to be installed underground must not receive field applied protective covering at the joints or be covered by backfill until the piping has passed the pneumatic test described herein. To facilitate the tests, isolate various sections of the piping system and test each one separately. Where such sections terminate at flanged valve points, the line must be closed by means of blind flanges in lieu of relying on the valve. Furnish tapped flanges that can be attached to the end of the section of line being tested, and that will permit a direct connection between the piping and the air compressor and/or pressurizing pump. No taps in the permanent line will be permitted. Furnish all necessary equipment for testing; all gauges must be subject to testing and approval of the Contracting Officer. The air used for pneumatic testing must have a dew point of no more than 5 degrees C. 41 degrees F. Provide dehumidifying equipment on the suction or discharge side of the air compressor used to provide air for testing. Pressurizing pump must not exceed 4.7 L/s 10 cfm.

3.9.1.1 Pneumatic Test Procedure

Special safety measures, including the wearing of face mask, must be taken during testing under pressure. Only authorized personnel must be permitted in the area during testing. The pneumatic test pressure must be applied in increments. A preliminary 167 kPa 25 psig test must be applied. Examine joints with soap solution. Leaks revealed by this test must be repaired. The full test pressure must then be applied. Unless otherwise directed by the Contracting Officer, all piping must be tested at a pressure of [333][667]kPa[50][100]psig for not less than 2 hours, during which time there must be no drop in pressure, only pressure rises with temperature. The pressure source must be disconnected during the final test period. Any leaks revealed by the test must be repaired and the test repeated.

3.9.1.2 Hydrostatic Test

Upon completion of pneumatic testing and after backfilling, hydrostatically test each piping system with fuel at [2][____]MPa[275][_____]psig in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gauge pressure for four hours. Furnish electricity, instruments, connecting devices, and personnel for test.

Fuel must be furnished by the Government. Defects in work must be corrected at the Contractor's expense, and the test repeated until the work is proven to be in compliance with the Contract requirements.

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NOTE: If the SME directs the Designer to hydrostatically test the system to 1.5 times the design pressure, exceeding the flange rating, the Designer will be required to write the commissioning hydrostatic testing procedures; removing all ball valves, control valves, and instructing the testing people what valves to close, where to connect the hydrostatic test pump, blind flange placements, and other safety requirements.

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3.9.2 Performance Testing

After the system is completed (including pneumatic and hydrostatic testing) the fuel system must be cleaned and performance tested as specified in Section 33 08 53 AVIATION FUEL DISTRIBUTION SYSTEM START UP. All control valves, both manual and automatic, must be checked for leaks (any area wetted with fuel) and proper operation and adjusted, repaired or replaced to correct any defects.

3.10 PIPELINE PIGGING VERIFICATION

3.10.1 Geometry/Ultrasonic Tool Reports

After the system is installed and prior to performance testing, a field/preliminary report must be issued and a debrief given to Government personnel onsite on the condition of the fuel hydrant loop. This must be comprised of raw data in the form of a PC download or equivalent which shows a continuous scan of each data unit output. Results of a preliminary interpretation of the data must be reported. These must include as a minimum all critical anomalies. A final report must include a description of the principle of operation, explanation of raw data, presentation of raw data, data to be clearly marked with distance traveled scale with classified anomaly location and all identifiable pipeline features, and all anomalies to be classified with locations in summary tabular form, pipe wall thickness survey, as well as the software necessary to read the data. Submittal must be in the form of digital media copied to a CD or DVD (flash drives are unacceptable).

3.10.2 Pipeline Internal Inspection Operations

3.10.2.1 General

The following pigs will be propelled through the pipeline with product in order to inspect the pipeline: 1.7 kg 5 pound density foam swab, combination poly scraper-magnetic, stainless steel wire brush (plastic brush for internally lined piping), aluminum plate gauge, and geometry/ultrasonic tool. Tracking devices must be used on all pigs. At a minimum, the sequence of pig runs must be as follows: 1) foam swab for proving and cleaning, 2) wire brush for cleaning, 3) scraper-magnetic for cleaning, 4) aluminum plate gauge for gauging internal anomalies, 5) scraper-magnetic for cleaning, 6) wire brush for cleaning, 7) scraper-magnetic for cleaning, 8) foam swab for cleaning, (Note: the number of pig flights of each type of cleaning pigs must be determined by

the amount and type of debris removed. The conclusion of the cleaning process must be when debris recovered is only that from the pigs themselves. This determination will be determined by the project's system supplier and the Contracting Officer), 9) geometry/ultrasonic tool. The pipe wall must be continuously monitored on a real-time basis during the geometry/ultrasonic pig run. Anomalies such as patches, couplings, or flanges must also be identified, and the wall thickness given. The geometry/ultrasonic pig's technician will determine if additional runs are necessary. A permanent data set of internal inspection survey findings must be generated.

3.10.2.2 Preparatory Work

The Government will bring to the attention of the Contractor all statutes, rules and regulations relevant to the performance of the work on the site (on Government property) and will also provide the Contractor with a copy of its own site regulations (if any). Provide the pigging vendors with all-available pipeline records and drawings.

3.10.2.3 Pig Load And Launch

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NOTE: If pig a launcher and a receiver are not provided in the contract, portable ones will be by the Contractor during pigging operations.

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The pig must be loaded into the pig launcher by the Contractor. The method of loading and lodging the front pig cup into the launcher must not involve the use of uncontrolled mechanical force applied to the rear of the pig.

3.10.2.4 Pipeline Operation During Pigging

All pig runs must be made with the line packed with product. The system pumps will be used to propel the pig. The new pig traps will be used for pig launch and retrieval.

3.10.2.5 Brush and Gauging Survey

Run a brush pig at least as often as previously indicated. The brush pig must be designed and provided by the geometry/ultrasonic pig vendor. Additional runs may be required based upon the amount of debris found in the pipeline. The onsite geometry/ultrasonic pig vendor's personnel and COR must determine if additional runs are required. Immediately following the brush pig run and immediately prior to the geometry/ultrasonic survey, run, as a minimum, a single batching pig fitted with a gauge plate equal to 90 percent of the pipeline normal inside diameter. The plate is to be a segmented aluminum disk of 3 mm 1/8 inch thickness. The plate gauge pig must also include a tracker and tracking equipment. Track the pig assembly above ground during the operation.

3.10.2.6 Geometry/Ultrasonic Survey

After a satisfactory gauging pig run, the pipeline geometric defects must be determined by a geometry/ultrasonic tool. The geometry/ultrasonic tool must provide accurate geometric anomaly detection, and bend radius measuring capability. The data obtained must be presented in a PC software format to allow user friendly analysis and presentation. The

geometry/ultrasonic tool assembly must be capable of:

a. Operating in hydrocarbon liquid environment, specifically jet fuel, at a pressure of up to ANSI 300 rating.

b. Traversing the pipeline with nominal wall thickness and possible bore restrictions down to 90 percent of nominal pipe inside diameter.

c. Traversing the pipeline length at a speed of between 60 and 100 m/min 3 and 5 ft/sec when propelled by pumped jet fuel. Pressure differential across pig not to exceed 34 kPa 50 psi.

d. Traversing through smooth pipe bends as small as 1.5D (1.5 pipe diameters) radius and single miter bends of up to 10 degrees change of direction.

e. Include a tracker and tracking equipment. Track the pig assembly above ground during the operation. The battery life of the tracker must not be less than 72 hours.

f. Manual loading into the new horizontal pig trap.

The geometry/ultrasonic tool assembly instrumentation performance must be capable of:

a. Battery life to be minimum 18 hours at operating conditions.

b. Principle of operation to be electronically stored geometry system.

c. Geometry sensing to span full circumference and length of pipe, with associated distance measuring method.

d. Geometry system must be capable of:

(1) positive location and identification of each geometric anomaly.

(2) positive location and identification of each bend.

(3) positive location and identification of distance marker reference points of either magnetic or electronic type placed on or above the pipe.

e. Classification of geometric anomalies to be as minimum:

(1) discrimination between ovality and intrusion anomalies.

(2) mechanical damage such as mill defects, dents, internal gouges, and buckles.

(3) pipeline weld defects (such as excess weld penetration).

(4) geometric thickness anomalies. As a minimum, these must be reported in the following categories within the listed accuracy.

(aa) magnitude of anomaly (+/- 25 mm1 inch)
(bb) span of anomaly (+/- 25 mm1 inch)
(cc) ovality (+/- 2.5 mm0.1 inch)
(dd) span of ovality (+/- 25 mm1 inch)
(ee) anomaly station (+/- 1:2,000)

f. Pipe Wall Thickness Survey:

The geometry/ultrasonic tool must provide accurate measurement of pipe wall thickness (+/- 0.25 mm). 0.01 inch). The data obtained must be presented in a PC software format to allow user friendly analysis and presentation.

3.10.2.7 Lost Pig

The Contractor is responsible for a lost pig, finding the pig, retrieval of the pig, and all repairs, radiographs to the pipeline system and the pig.

-- End of Section --