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USACE / NAVFAC / AFCEC **UFGS-33 52 40 (May 2025)**

Preparing Activity: NAVFAC **Superseding**
UFGS-33 52 40 (November 2018)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2025
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DIVISION 33 - UTILITIES

SECTION 33 52 40

FUEL SYSTEMS PIPING (NON-HYDRANT)

05/25

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SECTION 33 52 40

FUEL SYSTEMS PIPING (NON-HYDRANT)
05/25

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NOTE: This guide specification covers the requirements for piping, piping components, testing, valving and miscellaneous accessories for general fueling systems, non-hydrant type and non-service station. Do not use this specification for designs related to pressurized hydrant fueling systems and super refueler fillstands. For such systems, refer 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: Use this UFGS in conjunction with UFC 3-460-01 "Design: Petroleum Fuel Facilities". Include in this specification any additional equipment/devices necessary to meet state and local regulations.

The specification is written around ASME's standard Class 150 rating. For applications requiring higher

pressure ratings (e.g., Class 300), the designer must modify this specification appropriately.

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/dod/non-cos-standards.
****

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

AMERICAN PETROLEUM INSTITUTE (API)

API 570	(2016; Addendum 1 2017; Addendum 2 2018; ERTA 1 2018) Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems
API RP 540	(1999; R 2004) Electrical Installations in Petroleum Processing Plants
API RP 621	(2022; 5th Ed) Reconditioning of Metallic Gate, Globe, and Check Valves
API RP 1110	(2013; R 2018) Recommended Practice for the Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide

API RP 1169	(2020; 2nd Ed) Pipeline Construction Inspection
API RP 1595	(2012; R 2019; 2nd Ed) Design, Construction, Operation, Maintenance, and Inspection of Aviation Pre-Airfield Storage Terminals
API RP 2003	(2015; 8th Ed) Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents
API RP 2009	(2002; R 2007; 7th Ed) Safe Welding, Cutting, and Hot Work Practices in Refineries, Gasoline Plants, and Petrochemical Plants
API RP 2200	(1999; R 2004) Electrical Installations in Petroleum Processing Plants
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	(2021; Addendum 1 2025) Specification for Pipeline and Piping Valves
API Spec 6FA	(1999; R 2006; Errata 2006; Errata 2008; R 2011) Specification for Fire Test for Valves
API Spec 17J	(2016; Errata 2 2017; ADD 1 2017) Specification for Unbonded Flexible Pipe
API Std 594	(2017) Check Valves: Flanged, Lug, Wafer and Butt-Welding
API Std 598	(2009) Valve Inspecting and Testing
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
API Std 1163	(2021; 3rd Ed) In-line Inspection Systems Qualification

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2024) Unified Inch Screw Threads (UN, UNR, and UNJ Thread Form)
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2024) Factory-Made Wrought Buttwelding Fittings

ASME B16.11	(2022) Forged Fittings, Socket-Welding and Threaded
ASME B16.20	(2023) Metallic Gaskets for Pipe Flanges
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B16.48	(2015) Line Blanks
ASME B18.2.1	(2012; R 2021) Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
ASME B18.2.2	(2022) Nuts for General Applications: Machine Screw Nuts, and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B31.3	(2024) Process Piping
ASME B40.100	(2022) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME BPVC SEC V	(2017) BPVC Section V-Nondestructive Examination
ASME BPVC SEC VIII D1	(2023) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C210	(2024) Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines

AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1	(2021) Safety in Welding, Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A105/A105M	(2023) Standard Specification for Carbon

	Steel Forgings for Piping Applications
ASTM A123/A123M	(2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A182/A182M	(2024) Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A193/A193M	(2024a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2024) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A234/A234M	(2024) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A240/A240M	(2025) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A269/A269M	(2024) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A276/A276M	(2024) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2023) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A312/A312M	(2022a) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A358/A358M	(2024a) Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications
ASTM A403/A403M	(2025) Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

ASTM A564/A564M	(2019) Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2022a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B696	(2000; R 2023) Standard Specification for Coatings of Cadmium Mechanically Deposited
ASTM B766	(2023) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM D1418	(2010; R 2016) Standard Practice for Rubber and Rubber Lattices - Nomenclature
ASTM D1655	(2018a) Standard Specification for Aviation Turbine Fuels
ASTM D2487	(2017; R 2025) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D3308	(2012; R 2017) Standard Specification for PTFE Resin Skived Tape
ASTM F336	(2002; R 2023) Standard Practice for Design and Construction of Nonmetallic Enveloped Gaskets for Corrosive Service
ASTM F436	(2011) Hardened Steel Washers
ASTM F2329/F2329M	(2015; R 2023) Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

BRITISH STANDARDS INSTITUTION (BSI)

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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 142	(2007; Errata 2014) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book

IEEE 1100	(2005) Emerald Book IEEE Recommended Practice for Powering and Grounding Electronic Equipment
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1629	(2013) Rubber and Latices - Nomenclature
ISO 9001	(2015) Quality Management Systems-Requirements
ISO ISO/IEC 17025	(2017) General Requirements for the Competence of Testing and Calibration Laboratories

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z87.1	(2020) Occupational and Educational Personal Eye and Face Protection Devices

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

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

NACE INTERNATIONAL (NACE)

NACE SP0188	(2024) Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA IM 60000	(2021) Industrial Laminating Thermosetting Products
NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(2024; TIA 24-1) Flammable and Combustible Liquids Code
NFPA 30A	(2024; ERTA 1 2023) Code for Motor Fuel Dispensing Facilities and Repair Garages
NFPA 70	(2023; ERTA 1 2024; TIA 24-1) National Electrical Code
NFPA 77	(2024; ERTA 1 2023) Recommended Practice on Static Electricity

NFPA 407	(2022; TIA 24-2) Standard for Aircraft Fuel Servicing
NFPA 780	(2023) Standard for the Installation of Lightning Protection Systems

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 5/NACE No. 1	(2007) White Metal Blast Cleaning
SSPC SP 16	(2010) Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS3275	(2009; Rev C) Sheet, Acrylonitrile Butadiene (NBR) Rubber and Non-Asbestos Fiber Fuel and Oil Resistant
SAE J514	(2012) Hydraulic Tube Fittings

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2024) Safety -- Safety and Occupational Health (SOH) Requirements

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-5624	(2024; Rev X) Turbine Fuel, Aviation, Grades JP-4 and JP-5
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
MIL-STD-3004-1	(2018) Quality Assurance for Bulk Fuels, Lubricants and Related Products
UFC 3-460-01	(2019; with Change 3, 2023) Design: Petroleum Fuel Facilities

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-59326	(Rev D) General Specification For Coupling Halves, Quick-Disconnect, Cam-Locking Type

1.2 DEFINITIONS

1.2.1 Anomaly

Unexamined deviation from the norm in pipe material, coatings, or welds, which may or may not be a defect.

1.2.2 Defect

A physically examined anomaly with dimensions or characteristics that exceed acceptable limits.

1.2.3 Designer of Record

The professional engineer designated by the prime contractor to be in multidisciplinary responsible charge of all POL service piping design and repair.

1.2.4 Hot Work

For work covered by this Section, drilling, boring, flame heating, welding, torch cutting, brazing, carbon arc gouging, grinding, abrasive blasting, or any work which produces heat, by any means, of 200 degrees C 400 degrees F or more; or in the presence of flammable material or flammable atmosphere, other ignition sources such as spark or arc producing tools or equipment, static discharges, friction, impact, open flames or embers, nonexplosion-proof lights, fixtures, motors or equipment.

1.2.5 Piping Engineer

One or more licensed professional engineers, or an engineering firm, acceptable to the Contracting Officer who are knowledgeable and experienced in the engineering disciplines associated with evaluating hydraulic, mechanical, and material characteristics which affect integrity and reliability of POL service piping systems. The piping engineer is the piping or pipeline subject matter expert. More than one individual can serve in the role as long as one is designated to be in responsible charge.

1.2.6 POL Service Piping

Pipe, piping, pipeline, fittings, components, assemblies, and appurtenances used for petroleum, oil, or lubricant (POL) conveyance service under pressure or force of gravity, including modifications to existing systems.

1.3 SUBMITTALS

****

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

complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

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

****

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. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with[Section 01 33 00 SUBMITTAL PROCEDURES][Section 01 33 00.05 20 CONSTRUCTION SUBMITTAL PROCEDURES][and Section 01 33 10.05 20 DESIGN SUBMITTAL PROCEDURES]::

SD-01 Preconstruction Submittals

Pigging Plan; G, [_____]

Hydrostatic Pressure Test Plan; G, [_____]

Pneumatic Pressure Test Plan; G, [_____]

Work Plan; G, [_____]

SD-02 Shop Drawings

Pipe Support; G, [_____]

Pigging System Components; G, [_____]

SD-03 Product Data

Carbon Steel Piping; G, [_____]

[Steel Reinforced Flexible Pipe; G, [_____]

][Rock Shield; G, [_____]

] Carbon Steel Fitting; G, [_____]

Ball Valve; G, [_____]

Full Port Ball (DBB) Valve; G, [_____]

Plug (DBB) Valve; G, [_____]

Swing Check Valve

Thermal Relief Valve; G, [_____]

Flexible Ball Joint; G, [_____]

Strainer; G, [_____]

Thermometer; G, [_____]

Sample Connection; G, [_____]

Flexible Hose Connector; G, [_____]

Automatic Air Vent; G, [_____]

Surge Suppressor Tank and Valve; G, [_____]

Buried Utility Warning Tape; G, [_____]

Pipeline Marker; G, [_____]

Flange Gasket, Non-Metallic, Non-Electrically Isolating; G, [_____]

Flange Gasket, Metallic; G, [_____]

SD-06 Test Reports

Coating Holiday Test Results

Pneumatic Test Results

Piping Dehydration Results

Pipe Pigging Verification

DBB Valve Hydrotest

Hydrostatic Test Report; G

SD-07 Certificates

[Water for [Hydrotesting][Pigging]; G, [_____]

] Contractor Qualification; G, [_____]

Pipeline Inventory; G, [_____]

SD-08 Manufacturer's Instructions

Flexible Ball Joint; G, [_____]

SD-09 Manufacturer's Field Reports

Valve Reconditioning Report; G

SD-10 Operation and Maintenance Data

Ball Valve; G, [_____]

Full Port Ball (DBB) Valve; G, [_____]

Plug (DBB) Valve; G, [_____]

Swing Check Valve; G, [_____]

Thermal Relief Valve; G, [_____]

Flexible Ball Joint; G, [_____]

Strainer; G, [_____]

Thermometer; G, [_____]

Sample Connection; G, [_____]

Automatic Air Vent; G, [_____]

Surge Suppressor Tank and Valve; G, [_____]

1.4 SAFETY

Adhere to safety precautions in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, EM 385-1-1, API 570, API RP 2009, NFPA 30, NFPA 30A, and NFPA 407. If a pneumatic test is approved to be performed, ensure the test is incorporated into safety plans and activity hazard analysis fully recognizing the hazard of energy stored in compressed gas.

1.4.1 Control of Hazardous Energy

Provide proper lockout and tagout (LOTO) of piping or pipeline and appurtenances to completely isolate work from fuel, vapors, and sources of energy. Isolate using physical means such as blind flange compliant with ASME B16.5 or solid-plate line blank compliant with ASME B16.48 to prevent fuel or vapor transfer into the workspace. Use isolation means of sufficient strength to withstand pressure which might be exerted by liquid, gas, or vapor in an active pipeline, piping, or tank. Use gaskets on both sides if a line blank is inserted between two flanges. Do not use a valve as sole means of isolation. If LOTO isolates a segment of active fuel piping from thermal relief, install temporary relief capability.

Execute in accordance with accepted Accident Prevention Plan, Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, and EM 385-1-1. Coordinate LOTO installation, maintenance, inspection, and removal with facility fuel system operator.

1.4.2 Hazard of Released Energy

Pneumatic testing involves the hazard of released energy stored in compressed gas. Particular care must be taken to mitigate the hazard. Establish a boundary around the test segment. Restrict access into the boundary to authorized personnel during pneumatic test. Provide pressure control to prevent test pressure in excess of 170 kPa 25 psig.

1.4.3 Preparation for Hot Work

Develop written procedures in accordance with EM 385-1-1, Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, and AWS Z49.1. Test piping for hydrocarbons and purge as necessary. Do not start grinding or welding until vapor-free certification is received from the Marine Chemist and requirements of EM 385-1-1 have been met. See Section 33 52 23.15 POL SERVICE PIPING WELDING for welding safety requirements.

1.4.4 Gas-Free Condition

Degass piping until requirements of Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, the accepted Accident Prevention Plan, and the certified Marine Chemist are met and a gas-free condition is achieved. Obtain gas-free certification from the Marine Chemist. Maintain the gas-free environment. Display the Marine Chemist certificate on-site and available for review at all times during hot work.

1.5 GENERAL REQUIREMENTS

****
NOTE: Coordinate requirements in this Section with those of Section 33 52 23.15 POL SERVICE PIPING WELDING.
****

This section defines requirements for pipe, fittings, piping components, and valves related to non-hydrant, non-service station fuel distribution systems. Such systems include, but are not limited to: marine receipt, pipeline receipt, truck off-loading receipt, pump house, pump pad, truck loading, marine loading, transfer pipeline, product recovery, and other miscellaneous piping systems.

Provide fuel distribution as a complete and fully operational system. Size, select, construct, and install components and equipment to operate together as a complete system. Substitution of functions specified herein will not be acceptable. Coordinate the work of the system manufacturer service personnel during construction, testing, calibration, and acceptance.

1.5.1 Contractor Qualification and Experience

Contractors performing fabrication and installation work must be experienced and qualified in performance of POL system piping. Experience must include erection of piping, systems, or components in compliance with requirements of ASME B31.3 and NFPA 30.[Personnel, tools, procedures, and equipment used to perform in-line inspection (ILI) and analyze results must be in accordance with API Std 1163.]

Submit a letter listing prior projects, dates of construction, a point of contact for each prior project, brief scope of work for each prior project, and a detailed list of work performed. Provide in the letter evidence of manufacturer training and state licensing. Each contractor providing installation work must have the following minimum level of experience and qualification.

a. Successful completion of at least three projects of similar scope and size (or larger) within the last 6 years

b. Specific installation experience with regard to the piping, system, or component installation work to be performed

c. Successful completion of, if applicable, manufacturer training courses on installation of piping, system, or component work to be performed

d. Meet State licensing requirement, if applicable, for piping, system, or component work to be performed

1.5.2 System Supplier

As per requirements in Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

1.5.3 Protect in Place

Physically verify the location and elevation of existing facilities and utilities prior to starting construction. Protect in place tanks, piping, components, equipment, flanges, gaskets, motors, valves, pumps, impellers, risers, coating, finishes, gauges, alarms, conduit, and conductors. Employ measures to protect people, equipment, and surfaces from damage. Support uncovered pipelines or existing utilities affected by excavation until backfilled.

1.5.4 Fuel for Testing

If fuel is used for[hydrotesting][and][or][cleaning pigging], comply with all the requirements in Section 33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT).

1.6 DESIGN REQUIREMENTS

****
NOTE: Select type of fuel and insert expected temperature extreme.
****

In this Section, the term "as-indicated" is defined as referring to the design or drawings.

a. Design conditions are as provided in this Section and Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT). Refer to Section 01 78 23 OPERATION MAINTENANCE DATA.

b. Design system components and piping to handle a working pressure of [1900][_____] kPa [275][_____] psig at 38 degrees C 100 degrees F. Components specified herein must be compatible with the fuel to be handled. Components must be suitable for outside, unsheltered location, and able to function properly in ambient temperatures between [_____] degrees C degrees F and [_____] degrees C degrees F.

c. Consult with experts experienced in fuel piping or pipeline design. Provide Piping Engineer to design piping or pipeline systems. Produce drawings, details, specifications, and sketches which are complete and usable.

d. Identify on drawings work which requires in-process weld examination.

e. Annotate piping grade (pitch) and grade changes on drawings.

f. Establish fit-up, edge, and end preparation tolerances. Ensure the tolerance is consistent with the WPS for welded joints.

g. If fabrication or shop drawings are prepared by a vendor or subcontractor, provide oversight to the documents to ensure designer intent is met and fabrication tolerances are correct.

1.6.1 Code and Criteria Basis

UFC 3-460-01, API 570, and ASME B31.3 are relevant design codes and criteria. ASME B31.3 incorporates by reference other requirements of ASME BPVC SEC V and ASME BPVC SEC IX. API Std 1163 is the basis for ILI work.

1.6.2 Closure Weld

Design piping and pipeline in a manner which minimizes use of closure welds and maximizes use of hydrostatic means as compliance with leak test requirements in ASME B31.3 Paragraph 345. Designate on drawings or sketches the location of each closure weld and provide notes which state in-process examination requirements in accordance with Section 33 52 23.15 POL SERVICE PIPING WELDING, API 570, and ASME B31.3. Unnecessary closure weld designations are not allowed. Refer to Section 33 52 23.15 POL SERVICE PIPING WELDING for closure weld definition and in-process weld examination requirements.

1.6.3 POL Product

Product[s] to be conveyed in the piping [is][are] [_____][MIL-DTL-5624 Grade JP-4][and][MIL-DTL-5624 Grade JP-5][and][MIL-DTL-83133 JP-8][and][AFLP-3747 Jet A F-24][and][ASTM D4814 Mogas(F-46)][and][Diesel (F-76)]. Unless noted otherwise in the Statement of Work or Project Program, Fluid Service Category is Normal per ASME B31.3.

Components must be suitable for use with[F-24 turbine fuel (Jet A with additives FSII, CI/LE, and SDA); specific gravity 0.81 at 16 degrees C 60 degrees F; viscosity 1.62 CS at 16 degrees C 60 degrees F; Reid vapor pressure less than 0.35 kPa 0.05 psi, ASTM D1655][JP-4 turbine fuel; specific gravity 0.76 at 16 degrees C 60 degrees F; viscosity 0.92 CS at 16 degrees C 60 degrees F; Reid vapor pressure 14 to 21 kPa 2 to 3 psi, MIL-DTL-5624][JP-5 turbine fuel; specific gravity 0.82 at 16 degrees C 60 degrees F; viscosity 1.62 CS at 16 degrees C 60 degrees F; Reid Vapor pressure less than 0.35 kPa 0.05 psi, MIL-DTL-5624][F-76 diesel fuel marine; specific gravity 0.86 at 16 degrees C 60 degrees F; viscosity 1.7 CS at 16 degrees C 60 degrees F; Reid Vapor pressure of 0.0 psi].

1.6.4 Flexibility

Make provisions for absorbing expansion and contraction without excess stress in any part of the system. Do not use flexible connectors in permanently mounted pump suction and discharge lines as means of compensating for piping misalignment. Provide appropriate means of flexibility to eliminate vibration.

1.6.5 Support for Piping

Support piping at no more than the maximum spacing in Table 1. Provide additional pipe supports at locations of concentrated loads (valves).

Provide anchors where required to resist or transmit loads.

Table 1. Maximum Support Spacing

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

Provide supports near each change of direction. Select support components which do not restrict movement of pipe due to thermal expansion. Space supports uniformly, and arrange symmetrically.

1.6.6 Space and Access

Incorporate efficient operations and maintenance access in design. Design piping, valves, control tubing, and components to be close to structures and columns as an efficient use of space. Ensure adequate maintenance access is provided for system components, valves, and gauges. For heavy components such as isolation valves, ensure there is adequate access for lifting equipment and rigging.

1.6.7 Structural Support

Design supplementary or intermediate members as required to transmit loads to the support structure and foundation. Do not support piping from other piping. Specify material used for support in Section 05 12 00 STRUCTURAL STEEL.

1.6.8 Structural Connections

Design connections to concrete and masonry by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Ensure inserts and anchors have a safety factor not less than 5. Do not connect pipe supports to metal decking. For overhead applications, only use masonry anchors of ferrous material. Do not weld attachment studs to any pressure-containing boundary surface.

[1.6.9 Seismic Requirements

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

Support and brace piping, and attach valves to resist seismic loads as specified under Sections 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS[,23 05 48.19 SEISMIC BRACING FOR MECHANICAL SYSTEMS,] and as shown on the drawings. Structural steel required for reinforcement to properly support piping, headers, and system components but not shown must be provided under this section. Material used for support must be as

specified under Section 05 12 00 STRUCTURAL STEEL.

]1.6.10 Size Change

Make changes in pipe size with reducing fittings. Do not use bushings. Make branch connections with butt-welded tees except where the branch is at least two pipe sizes smaller than the run, in which case the branch connection can be made with a forged or seamless branch outlet fitting. Use insert type branch connection fittings designed to be radiographed.

Branch connection fittings may be non-radiographicable type if the following conditions are met.

a. Branch connection is made to aboveground piping

b. Branch outlet size is 65 mm 2.5 inches or less in diameter, and

c. Branch outlet is located in a contained pumphouse, a contained truck fill stand, or other area with spill containment

1.6.11 Direction Change

Make changes in direction of pipes with 1.5 D fittings. Where piping is to be piggable, make changes in direction with 1.5 D fittings [and][or] 3 D sweeps as indicated. For piggable pipelines, do not place 1.5 D fittings back to back. Provide special fittings when required. Make odd-angle offsets with pipe bends or elbows cut to the proper angle. Make changes in direction with fittings, except that bending of pipe 100 mm 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. The centerline radius of bends must not be less than 6 diameters of the pipe if a pipe bender is used.

1.6.12 Pneumatic Pressure Test

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NOTE: Pneumatic testing carries unusual safety risk due to the amount of stored energy that is possible. Intent of a pneumatic test is to detect and locate major leaks. System also must be tested with hydrostatic means at the pressure specified in UFC 3-460-01, so pneumatic test only provides limited information (presence of a gross leak) and does not qualify a piping system. Only perform pneumatic test when approved by the contracting officer and do not exceed 170 kPa 25 psig pneumatic test pressure.

****

A preliminary pneumatic test using air at pressure no greater than 170 kPa 25 psig may be used, if approved by the Contracting Officer, prior to hydrostatic testing and before underground pipe is buried. The intent of the test is to identify and locate a gross leak. If piping pneumatic test is anticipated, request approval from the Contracting Officer in advance. Incorporate hazard mitigation into the Accident Prevention Plan and Activity Hazard Analysis in accordance with paragraph SAFETY. Prepare a test plan which implements requirements of paragraphs PNEUMATIC TEST and PNEUMATIC TEST PROCEDURE.

Request a pneumatic test and provide a Pneumatic Pressure Test Plan to the Contracting Officer no less than 4 weeks prior to the test date.

1.6.13 Hydrostatic Pressure Test Plan

Submit a detailed site-specific plan covering all aspects of pipeline hydrostatic testing operations, including procedures and sequencing of testing, segments of piping to be tested, fluid to be used during testing, equipment removal and isolation, hydrostatic testing pressures, disposal of test fluid, and safety protocols.

Provide a Hydrostatic Pressure Test Plan which will establish tightness and strength of piping. Testing must be compliant with ASME B31.3, API 570, and consistent with API RP 1110. Plan must include site specific procedure, sequence, segment identification, fill points and volume, air bleed, closure means and material specification, valves, flanges, fittings, and instruments in each segment. Provide pre-test review by the Piping Engineer to ensure pipe support and foundation structures are suitable for hydrostatic load. Use fresh water with less than 50 ppm chloride content as the test medium. Designate a test operator in responsible charge of executing the plan, examining for leaks, and certifying results. Acceptance criteria are the no leak condition and unaccountable error less than one degree of temperature change. Dispose of test water in accordance with paragraph HYDROSTATIC TEST WATER DISPOSAL.

[1.6.14 Pigging Plan

****
NOTE: Provide if piping is piggable.
****

Submit a detailed written plan covering all aspects of pipeline pigging operation, both cleaning and ILI. Minimum elements of the plan include the following.

a. Pigging schedule and characteristics of each pig

b. Tool speed

c. Estimate of fuel usage requirements

d. Estimate of fuel storage requirement

e. Propulsion method and means to control pig speed

f. Communications during pigging

g. ILI vendor and tool data sheets

h. Method of ILI tool calibration

i. List of equipment and material to include which party (Government or contractor will provide)

j. List of responsibilities of Government and Contractor during pigging operation

k. Handling of waste product and material

l. Procedures for stuck pig retrieval

m. Proposed propulsion medium

]1.6.15 Pipeline Inventory

Calculate fuel system volume using as-constructed pipe dimensions, inside diameters, fittings, and components. Provide a certified pipeline inventory containing a detailed list with sizes, dimensions, quantities, and volumes for the systems in this project. Provide volume totals for all items containing fuel except tanks which are covered by other specifications. Systems include, but are not limited to: marine receipt, pipeline receipt, truck off-loading receipt, pump house, pump pad, truck loading, marine loading, transfer pipeline, product recovery, and other miscellaneous piping systems.

1.6.16 Piping Identification

Provide piping identification in accordance with MIL-STD-161 unless specified otherwise.

1.6.17 Nameplates

As per requirements in Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

1.6.18 Material and System Component Qualification

As per requirements in Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

1.7 QUALITY ASSURANCE

1.7.1 Construction Inspection

Establish and maintain a program of inspection and testing to control the quality of design and construction. Ensure program and personnel are experienced and qualified to perform inspection and test activities safely and effectively during construction. Perform inspection and examination to ensure contract work conforms to requirements, consistent with principles of API RP 1169, and in accordance with Section 01 45 00 QUALITY CONTROL. Maintain complete records and make them available to the Government.

Contractor is responsible for the quality of all design, layout, fabrication, inspection, examination, testing, records maintenance, and reporting. All materials used in the piping system must be clearly identified and recorded. Inspection, examination, and testing defined in this Section are minimum requirements. Provide additional inspection, examination, and testing when necessary to achieve the required quality of work.

1.7.2 Data Management

Organize underground piping locational data in a non-proprietary management system such as a database or spreadsheet. Establish a piping location identification scheme which uniquely identifies system features, dimensions, location, aboveground markers, and relative position to other

facilities. Provide secure, auditable, and organized data. Cloud-based systems are not acceptable. See paragraph PIPE PIGGING VERIFICATION for pig tool data requirements.

1.7.3 Work Plan

Submit a comprehensive Work Plan that provides sufficient detail to demonstrate a thorough understanding of the project. Coordinate the plan with requirements of Section 33 52 23.15 POL SERVICE PIPING WELDING. Document that all piping, systems, or components to be provided will function together and produce the result expected by the Government. Include proposed dates for piping system outages. Plan must demonstrate contractor ability to complete the work within the allotted outage period. For work that requires support of Government system operations, provide proposed dates and the nature of support that is required. Include a list of personnel, spare materials and system components that will be on hand for each phase of work. Describe in detail the means to accomplish the following.

a. Coordinating work with Government and third parties.

b. Preparing for safe piping repair work.

c. Pneumatic pressure testing new piping sections.

d. Hydrostatic pressure testing new piping sections.

e. Purging piping.

f. Vapor monitoring.

g. Preparations for containing and disposing of residual fuel.

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

i. Welding tie-ins in place.

j. Examining repair section tie-in welds.

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

[l. Dehydrating lines after water was introduced for [hydrotesting][hydrotesting and pigging][pigging]

][m. Interrupting or isolating an existing fuel service or system.

][1.7.4 Water for [Hydrotesting][Pigging]

Submit results of water testing and amount of water required.

]1.8 DELIVERY, STORAGE, AND HANDLING

1.8.1 Material Control

Protect system components and materials to prevent damage before, during, and after installation in accordance with this Section and manufacturer instructions.

a. Inspect material and components for damage upon arrival. Reject

materials which are mechanically damaged.

b. Inspect the condition of shop-applied coating upon arrival. Identify damage to the protective costing system. Notify the Contracting Officer of material with damaged shop-applied coating. Provide corrective action plan by which the damage will be repaired.

c. Store and handle material in method and environment compliant with manufacturer instructions.

d. Replace damaged or defective components and material.

e. Clean surfaces of all dirt, debris, or foreign substances. Verify condition and cleanliness of material prior to handling for installation.

1.8.2 Proper Storage

a. Store all valves, tubing, accessories, and components with protective covering to prevent internal contamination by any substance or liquid. Protect from damage by plant or animal. Store elevated from the ground surface and covered with secured tarps. Store in a manner and location which protects material from damage.

b. Store pipe or piping on blocks or dunnage racks at least 450 mm 18 inches above the ground and adequately supported to prevent sagging. Use padded blocks or dunnage racks for coated pipe. The method, environment, and height of storing coated pipe must be in accordance with the coating manufacturer's instructions. Pipe ends must be protected and capped at all times, except to accommodate immediate installation.

c. Use plugs, covers or other methods to secure the cleanliness of piping materials during storage. Maintain secure covers at all times during storage and prior to installation.

d. For material, components, or equipment which are received with factory-applied shrink preservation wrap, maintain the covering intact during storage to prevent ingress. Repair minor damage to shrink wrap with manufacturer-supplied preservation tape.

e. For piping and materials which are stored without protective coating, provide means to ensure external surfaces are protected from precipitation and rust.

f. When work is not in progress, close and secure coverings on stored materials so that water, contamination, or other foreign substances can not enter.

g. See paragraph CLEANING OF PIPING for storage and cleanliness requirements during and after installation.

PART 2 PRODUCTS

2.1 MATERIALS

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NOTE: Contact Service Headquarters Cathodic Protection Expert for direction on pipeline cathodic

protection.

****

Pipe and fittings in contact with fuel must be stainless steel, interior epoxy coated carbon steel, or interior uncoated carbon steel as indicated on the drawings or as specified herein. Zinc coated metal, brass, bronze or other copper bearing alloys must not be used in contact with fuel. Steel underground piping and all carbon steel must have an exterior protective coating. Material for manual valves must be as specified in this Section. Do not use aluminum valves.

All carbon steel and stainless steel underground piping must be cathodically protected in accordance with Section[26 42 13 GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM][26 42 17 IMPRESSED CURRENT CATHODIC PROTECTION (ICCP) SYSTEM]. Cathodic protection for metal components that attach to a storage tank must be coordinated and compatible with the corrosion control system of the tank.

2.1.1 Carbon Steel Piping

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

a. Piping 300 mm 12 inches and Larger: API Spec 5L Product Specification Level (PSL) 1, Grade B,[seamless][seamless or electric welded][submerged-arc welded or gas metal-arc welded]; or ASTM A53/A53M Grade B,[seamless][seamless or electric welded][submerged-arc welded or gas metal-arc welded]; all having a nominal wall thickness of no less than 9 mm 0.375 inch.

b. Piping 65 through 250 mm 2-1/2 through 10 inch: Schedule 40, API Spec 5L Product Specification Level (PSL) 1, Grade B,[seamless][seamless or electric welded][submerged-arc welded or gas metal-arc welded] Grade B; or Schedule 40, Seamless, ASTM A53/A53M Grade B.

****

NOTE: Use schedule 80 for most piping 2 inches and smaller and low point drain pipe; For extreme/high corrosion environments such as the tropics use Schedule 160 for aboveground and underground piping.

****

c. Piping 50 mm 2-inches and Smaller: Schedule [80][160], API Spec 5L Product Specification Level (PSL) 1, Grade B,[seamless][seamless or electric welded][submerged-arc welded or gas metal-arc welded] Grade B; or Seamless, Schedule [80][160] ASTM A53/A53M Grade B.

****

NOTE: Coating carbon steel pipe interior surfaces is difficult to execute and can result in fuel quality problems. Use the following guidance when considering interior coating:

Do not specify interior pipe coating unless all feasible materials alternatives have been exhausted.

Do not interior coat carbon steel piping before receipt filtration.

Do not interior coat carbon steel piping for products other than aviation jet fuel.

Do not interior coat carbon steel piping in jet fuel service at bulk operations such as bulk fuel storage, Defense Fuel Support Points, marine pier receipt/issue, intraterminal transfer pipelines, and interterminal transfer pipelines.

Only specify interior coating on carbon steel piping systems in jet fuel service that 1)directly load aircraft, or 2)fill aircraft refueler trucks after issue filtration.

****

[d. Internal Pipe Coating (Epoxy Lining) for carbon steel piping 90 mm 3.5 inches and larger: Epoxy coating system in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEMS. Leave uncoated a distance not less than 25 mm one-inch but not more than 40 mm 1-1/2 inches from the end of a pipe joint for welding.

]2.1.2 Stainless Steel Piping

****

NOTE: Do not use Schedule 10S piping without performing analysis to ensure there is sufficient allowance for pipe wall thickness in pressure design. Provide resiliency in the design for the possibility of corrosion pits because instances of chloride stress corrosion have been experienced in some environments. For most pressure Class 150 systems, Schedule 40S pipe is recommended.

****

a. Piping:

(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 standard must include the Contracting Officer as a party to the agreement. All longitudinal piping welds must receive 100 percent radiographic examination, 100 percent liquid penetrant examination, 100 percent visual inspection and all tests as required by the applicable ASTM standard. All other welds must be inspected and examined per Section 33 52 23.15 POL SERVICE PIPING WELDING. ASTM A312/A312M seamless piping must be provided with minimum schedule [10S][40S] wall thickness for pipe 200 mm 8 inches and larger; minimum schedule 40S for pipe smaller than 200 mm 8 inches (except for threaded pipe which must be minimum Schedule 80S).

(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.

****

NOTE: Do not require Factory Testing and Inspection Records be provided if calculations show that the

maximum normal system operating pressure, pump deadhead pressure, or any thermal relief valve setpoint is 100 psig or less and the system surge pressure does not exceed 150 psig.

****

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

b. 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 a minimum of 1.2 mm 0.049-inch.

[2.1.3 Steel Reinforced Flexible Pipe

****

NOTE: Service Headquarters must approve use of HDPE steel reinforced flexible pipe. Do not use HDPE steel reinforced flexible pipe aboveground or any application in which the pipe is not continuously supported.

It must be made clear to all parties that the construction of steel reinforced flexible pipe relies on an inner polymeric pressure sheath as the only layer that seals the conveyed fluid within the pipe structure. Performance of the polymeric material is highly susceptible to detrimental effects of ageing due to loss of mechanical properties. Numerous effects such as temperature, product, pressure, chemical exposure, pH, and mechanical damage to the outer sheath control the rate of ageing and service life.

The use of steel reinforced flexible pipe in lieu of traditional double-walled underground piping on projects in States that require double-walled underground piping must be coordinated between the system designer and the State agency that regulates underground piping. The piping supplier must provide a plan to monitor the effects of PA-11 ageing as discussed in API Technical Report 17TR2. The protocol to test the integrity of steel reinforced flexible pipe must be provided by the piping supplier and be accepted by the state regulatory agency as equivalent to the traditional

double-walled underground piping test protocol required by that agency.

****

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

]2.1.4 External Protective Coating for Aboveground Piping

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

[2.1.5 External Protective Coatings for Buried Steel Piping

2.1.5.1 Carbon Steel

a. New pipe and fittings must be factory coated in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEM.

b. Field joints and repairs must be in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEMS.

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

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

[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.

]2.1.5.2 Stainless Steel

****

NOTE: Use AWWA C210 liquid-epoxy coating system when piping is to be installed in non-fuel contaminated soil. For fuel contaminated soil, external coating system must be in accordance with 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES, however, application of the polyurethane top coat is not required.

****

Provide exterior coating of piping with factory coated AWWA C210 Liquid-Epoxy Coating System.[Provide exterior coating of piping with an epoxy coating system in accordance with 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES. For buried piping systems omit the polyurethane topcoat.]

a. Repair to Damaged Areas of Pipe Coating: Provide exterior coating of

piping with AWWA C210 Liquid-Epoxy Coating System.[Provide exterior coating of piping with an epoxy coating system in accordance with 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES. For buried piping systems omit the polyurethane topcoat.]

b. Fittings, Couplings, and Regular Surfaces: Provide exterior coating of piping with AWWA C210 Liquid-Epoxy Coating System.[Provide exterior coating of piping with an epoxy coating system in accordance with 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES. For buried piping systems omit the polyurethane topcoat.]

[2.1.5.3 Rock Shield, Direct Buried Piping

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

Provide a minimum 10 mm 3/8-inch-thick perforated rock shield around buried piping. Rock shield must consist of a polyethylene outer surface bonded to a closed cell foam substrate with uniform perforations intended for use with cathodic protection systems. Rock shield must overlap on itself no less than 150 mm 6 inches. Secure rock shield tightly to the pipe using either strapping tape or plastic ties. Air filled cell type rock shield is prohibited.

]]2.1.6 Fittings

2.1.6.1 General

Welding elbows, caps, tees, reducers, must be of materials compatible for welding to the pipeline in which they are installed, and wall thickness, pressure and temperature ratings of the fittings must be not less than the adjoining pipeline. Unless otherwise specified herein or required by the conditions of installation, all elbows must be the 1.5 diameter (D) 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. Welded branch fittings must be insert type suitable for radiographic inspections specified herein.

See paragraph SIZE CHANGE for conditions under which a non-radiographicable fitting can be used.

2.1.6.2 Carbon Steel Fitting

****
NOTE: Select option for piggable fittings if line is piggable.
****

a. Fittings 65 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.

b. Fittings 50 mm 2 inches and Smaller: Forged, butt weld or socket welded (except flanges, see below). If specifically indicated on drawings, non-flange fittings may be threaded. Socket welded or

threaded fittings must be Class 3000, conforming to ASTM A105/A105M, Grade 2 and ASME B16.11. Threaded fittings must only be used for above grade applications. Pipe and fittings of all sizes used underground, in pits, in low point drains, or on waterfront facilities must be butt welded.

c. Flanges: Class 150 weld neck, butt weld, forged flanges conforming to ASTM A105/A105M, and ASME B16.5 except flanges that are to be connected to pumps must match the pump flanges rating. Threaded and slip-on flanges are not allowed. Flanges to be 2 mm 1/16-inch raised face with modified spiral serrated gasket surface finish, except where required otherwise to match system components furnished. Match flange face to valves or system components furnished. Flange face must be machined to match valves or system components furnished. Use of spacing rings or gaskets discs are not allowed. Detectable flaws will not be accepted. For flanges 50 mm 2 inches 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), Class 150, conforming to ASTM A105/A105M, and ASME B16.5. In pits, vaults, on thermal relief valve piping for pipeline routes, and other uncontained locations the flanges must be radiographicable, butt welded, weld neck type.

[d. Piggable System

(1) Provide barred tees on all branch outlets 50 mm 2-inch and larger when within 6.1 meters 20 feet of pig launcher or receiver barrel, including the barrels. Provide barred tees on all size outlets greater than 50 mm 2-inch in size with any part of the outlet on the bottom half of the pipe. Provide barred tees on all branch connections equal to or greater than 50 percent of piggable line size.

(2) Use 1.5 D elbows, or 3 D sweeps between pig launchers and receivers. Do not place 1.5 D elbows back to back.

] e. Interior Epoxy Coating System must be applied to the fittings as specified in paragraph CARBON STEEL PIPING.

2.1.6.3 Stainless Steel Fitting

****
NOTE: Select option for piggable fitting if line is piggable.
****

a. Fittings 65 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.

b. Fittings 50 mm 2 inches and Smaller: Forged Type 304 or 304L , butt weld, or socket welded (except flanges, see below). If specifically indicated on drawings, non-flange fittings may be threaded. Socket welded or threaded fittings must be Class 3000 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 A182/A182M, Grade 304 or 316.

****

NOTE: Type 304L stainless steel flanges are prohibited and must not be specified.

****

d. Flanges. Class 150 weld neck, butt weld, forged Type 304 stainless steel flanges conforming to ASTM A182/A182M and ASME B16.5, except flange that are to be connected to pumps must match the pump flanges rating. Threaded and slip-on flanges are not allowed. Flanges to be 2mm 1/16-inch raised-face with modified spiral serrated gasket surface finish, except where required otherwise to match system components furnished. Flange face must be machined to match valves or system components furnished. Match flange face to valves or system components furnished. For flanges 50 mm 2 inches 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), Class 150, conforming to ASTM A182/A182M and ASME B16.5. In pits, vaults, on thermal relief valve piping for pipeline routes, and other uncontained locations the flanges must be radiographicable, butt welded, weld neck type.

[e. Piggable System:

(1) Provide barred tees on all branch outlets 50 mm 2-inch and larger when within 6 m 20 feet of pig launcher or receiver barrel, including the barrels. Provide barred tees on all size outlets greater than 50 mm 2-inch in size with any part of the outlet on the bottom half of the pipe. Provide barred tees on all branch connections equal to or greater than 50 percent of piggable line size.

(2) Use 1.5 D elbows, or 3 D sweeps between pig launchers and receivers. Do not place 1.5 D elbows back to back.

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

[2.1.6.4 Steel Reinforced Flexible Pipe Fitting

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

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

]2.1.7 Insulating Flange Kit (Electrically Isolating)

****

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

a. Where piping transitions from aboveground to underground.

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

c. On both sides of motorized valves in underground valve vaults.

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

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

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

****

Material must be resistant to the effects of aviation and non-aviation hydrocarbon fuels. Provide dielectric gaskets that are full face ANSI/NEMA IM 60000 Grade G-10 glass reinforced epoxy, to match pipe flange type and pressure rating, with a Viton seal. Do not use graphite seal elements in dielectric gaskets. Provide ANSI/NEMA IM 60000 Grade G-10 glass reinforced epoxy dielectric bolt sleeves. The dielectric bolt sleeves must be of sufficient length to pass through the flanges, over-voltage protector brackets, both dielectric washers, and both steel backer washers. Provide 3 mm 0.125-inch thick high-strength ANSI/NEMA IM 60000 Grade G-10 reinforced epoxy 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. Bolts may have reduced shanks of a diameter not less than the diameter at the root of threads. Above grade flanges separated by electrically insulating flange kits must be provided with weatherproof lightning surge arrester devices. The surge arrester must bolt across flanges separated by insulating gasket kits per detail on contract drawings. Provide with flange protector as described in this Section. The arrestor must have the following features.

a. Weatherproof NEMA 250 Type 6P enclosure.

b. Bidirectional and bipolar protection.

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

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

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

terminals (zero lead length).

f. A UL listed arrester for installation in Class 1, Division 1 and 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 mm 2 inch	16 mm 5/8 inch
65 mm 2.5 inch	16 mm 5/8 inch
80 mm 3 inch	16 mm 5/8 inch
100 mm 4 inch	16 mm 5/8 inch
150 mm 6 inch	19 mm 3/4 inch
200 mm 8 inch	19 mm 3/4 inch
250 mm 10 inch	22 mm 7/8 inch
300 mm 12 inch	22 mm 7/8 inch
350 mm 14 inch	25 mm 1 inch
400 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.	

2.1.8 Bolts, Nuts and Washers

a. Bolts and nuts for pipe flanges, flanged fittings, valves and accessories must conform to ASME B18.2.1 and ASME B18.2.2, except as otherwise specified.

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

c. Bolts must be regular hexagonal bolts conforming to ASME B18.2.1 with material conforming to ASTM A193/A193M, Class 2, Grade B8, stainless steel, when connections are made where a stainless steel flange is involved, and Grade B7, chromium molybdenum alloy, when only carbon steel flanges are involved. Bolts and nuts chosen must have sufficient strength to seat gasket types chosen. Bolts must be threaded in accordance with ASME B1.1, Class 2A fit, Coarse Thread Series, for sizes 25 mm one-inch and smaller and Eight-Pitch Thread Series for sizes larger than 25 mm one-inch.

d. Nuts must conform to ASME B18.2.2, hexagonal, heavy series with material conforming to ASTM A194/A194M, Grade 8, stainless steel for stainless steel bolts, and Grade 7, chromium molybdenum allow for chromium molybdenum alloy bolts. Nuts must be threaded in accordance with ASME B1.1, Class 2B fit, Coarse Thread Series for sizes 25 mm one-inch and smaller and Eight-Pitch Thread Series for sizes larger than 25 mm one-inch.

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

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

2.1.9 Flange Gasket, Non-Metallic, Non-Electrically Isolating

ASME B16.21, composition ring, using a Nitrile Rubber such as Buna-N and NBR, polytetrafluoroethylene (PTFE), or a fluoro rubber such as FKM, FPM and Viton©. The gasket must be 3 mm 0.1250-inch thick. Gaskets must be resistant to the effects of aviation and non-aviation hydrocarbon fuels and manufactured of fire-resistant materials. Full-face gaskets must be used for flat-face flanged joints. Ring gaskets must be used for raised-face flanged joints. Gaskets must be of one piece factory cut. Select a gasket suitable for the working and test pressure of the fluid.

2.1.9.1 Nitrile Butadiene (Buna-N)

Provide Buna-N material that conforms to SAE AMS3275.

2.1.9.2 Acrylonitrile Butadiene Rubber (NBR)

Provide NBR material that conforms to SAE AMS3275.

2.1.9.3 Polytetrafluoroethylene (PTFE)

Provide PTFE material that conforms to ASTM F336.

2.1.9.4 Fluoro Rubber FKM

Provide FKM material that conforms to ASTM D1418.

2.1.9.5 Fluoroelastomer FPM

Provide FPM material that conforms to ISO 1629.

2.1.10 Flange Gasket, Metallic

****
NOTE: Inner rings are mandatory for Class 900 and higher flanges.
****

****
NOTE: Metallic Gaskets are not to be used where electrical isolation is required.
****

ASME B16.20, spiral-wound metal gaskets with[inner and] outer rings. Gaskets must be suitable for use on flat-face and raised-face flanges. The winding material is stainless steel 304 or 316L. The filler material is graphite or PTFE. The gasket must be in accordance with Military Specification MIL-G-24716. Select a gasket suitable for the working and test pressure of the fluid.

2.1.11 Flange Protector

****

NOTE: Provide at all cathodic protection isolation flanges from shorting out due to debris collecting in/on flange. Use the UV plastic type if possible as the stainless steel bands sometimes "ground out" the insulating flange.

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

Many facility operators do not want grease filled flange protectors. Ensure these are acceptable to the end user. In hot climates, grease from flange protectors can melt and drip, giving false indication of a pipe weep.

****

Protectors must protect the bolts, studs, nuts, and gaskets of a flanged end connection from corrosion or damage due to exposure to the environment. Protectors must be weather and ultraviolet (UV) resistant. Protectors must allow for quick and easy removal and re-installation by maintenance personnel. Corrosion inhibitor grease must be non-expansive and designed for the service and ambient temperatures.

2.2 MANUAL VALVES

****

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

****

****

NOTE: Select option for piggable valves if line is piggable.

****

All portions of a valve coming in contact with fuel in stainless steel pipelines or epoxy lined carbon steel pipelines must be of noncorrosive material. Valves in stainless steel pipelines or epoxy lined carbon steel pipelines 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. Valves installed more than 2.4 m 8 feet above finished floor standing platform must have chain operators and a position indicators visible from ground (standing) level. Sprocket wheel for chain operator must be aluminum.[Valves in the piggable line flow path between the pig launchers and the pig receivers, including the valves in the isolation valve pits 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. Valves must be true full bore with no projections extending into the flow path of the pig train.]

2.2.1 Ball Valve

Ball valves must be fire tested and qualified in accordance with the requirements of API Std 607 and API STD 608. Seal material for the fire test must be graphite, seal material for the project must be as indicated below. Ball valves must be nonlubricated valves that operate from fully open to fully closed with 90-degree rotation of the ball. Valves 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. The balls in valves 250 mm 10 inches and larger full port and 300 mm 12 inches and larger regular port and larger must have trunnion type support bearings. Except as otherwise specified or indicated, reduced port or full port valves may be provided at the Contractor's option. Balls must be solid, not hollow cavity.

2.2.1.1 Materials

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

2.2.1.2 V-Port Ball Valve

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

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

2.2.1.3 Full Port Ball (DBB) Valve for Piggable Lines

****
NOTE: Select option for piggable valves if line is piggable. Verify valve pressure class meets system MAWP and change to another pressure class if necessary.
****

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 indicated below. Valves must be trunnion-mounted with independent spring and hydraulically actuated, floating,[single piston effect with external relief to the[upstream][downstream] side][double piston effect with external relief to[upstream][downstream] side,] 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 PTFE 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.

2.2.1.4 Electric Valve Actuator

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

2.2.2 Plug (DBB) Valve

****
NOTE: Select option for piggable valves if line is piggable.
****

API Spec 6D, API Spec 6FA, ANSI Class 150, non-lubricated, resilient, double seated, trunnion mounted, tapered lift plug capable of two-way shutoff. Valve must have tapered plug of steel or ductile iron with chrome or nickel plating and plug supported on upper and lower trunnions. Sealing slips must be steel or ductile iron, with Viton seals which are held in place by dovetail connections. Valve design must permit sealing slips to be replaced from the bottom with the valve mounted in the piping. Valves must operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valves must have weatherproof operators with mechanical position indicators. Indicator shaft must be stainless steel. Minimum bore size must be not less than 65 percent of the internal cross sectional area of a pipe of the same nominal diameter unless bore height of plug equals the nominal pipe diameter and manufacturer can show equal or better flow characteristics of the reduced bore size design.[Valves in the piggable line flow path between the pig launchers and the pig receivers, including the valves in the isolation valve pits, in fuel piping between the pig launchers and the pig receivers must be full bore, piggable. Valves must be true full bore with no projections extending into the flow path of the pig train. Full port plug valves in distribution piping must be provided with a 15 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 contacts, 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. Valve must operate from fully open to fully closed by rotation of the stem (via handwheel or motor operator) to lift and turn the plug. Rotation towards open must lift the plug without wiping the seals, and retract the seal slips so that clearance is maintained between the slips and the valve body. Rotation towards closed must lower the plug after seal slips are aligned with the valve body and then force the slips against the valve body for positive closure. When valve is closed, slips must form a secondary fire-safe metal to metal seat on both sides of the resilient seal.

2.2.2.3 Relief Valve

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 and upstream side of the plug valve.

2.2.2.4 Bleed Valve

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

****

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

****

The actuator, controls and accessories must be the responsibility of the valve-actuator supplier for sizing, assembly, certification, field-testing and any adjustments necessary to operate the valve as specified. The electric valve actuator must include as an integral unit the electric motor, actuator unit gearing, limit switch gearing, position limit switches, torque switches, drive bushing or stem nut, declutch lever, wiring terminals for power, remote control, indication connections and handwheel. The electrically actuated plug valve must be set to open and close completely in 30 to 60 seconds against a differential pressure of 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 [_____] [minus 38 to 70 degrees C] [minus 22 to

158 degrees F].

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

b. The electric motor must be specifically designed for valve actuator service and must be totally enclosed, non-ventilated construction. The motor must be capable of complete operation at plus/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 Valve

****

NOTE: Limited to size NPS 2 and smaller. Used in underground PRT fill line.

****

Swing check valves must conform to ASME B16.34 and API Spec 6D, regular type, ANSI Class 150 with flanged end connections. Discs and seating rings for valve sizes NPS 2 or larger 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 Valve

Spring assisted, wafer/tapped lug pattern, butterfly check with or globe type 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

****

NOTE: Not permitted on Air Force projects.

The sole function of the valve is to provide a separate shutoff of the supply and return piping at each pantograph assembly in the event of a fire. Consult with Service Headquarters before using this type of valve. There are specific locations this valve is to be used on Navy projects in accordance with UFC 3-460-01.

****

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 71 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 system components, piping, piping components, or valves.

2.2.6 Globe Valve

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

2.3 THERMAL RELIEF VALVE

2.3.1 Valve Material

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

2.3.2 Thermal Relief Valve (ASME Type)

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

2.3.3 Thermal Relief Valve (Balanced Type)

****

NOTE: Verify relief capacity meets system requirements. Verify set pressure and edit as necessary.

****

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

Thermal relief valves must be the fully enclosed, spring loaded, angle pattern, single port, fully balanced type (back pressure must not affect relief pressure) back pressure regulator/relief valve. Set valve at pressure indicated on drawings. Valve body must have 25 mm one-inch (minimum) raised face flange connections unless otherwise indicated. Orifice must have a minimum orifice size of 15 mm 0.500-inch in diameter. Valve must have bubble-tight piston and seat design with stainless steel piston and Viton seat. Valve must be selected for the nominal flow condition of: pass a minimum of 18 liters per minute 5 gallons per minute, at a differential pressure of 380 kilopascal 55 psig, with a nominal set pressure of [345][_____] kilopascal [50][_____] psig. Valve must be factory configured to open at required set pressure but must be field adjustable by means of an enclosed adjusting screw.

2.4 PIPING ACCESSORIES

2.4.1 Flexible Ball Joint

****

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

****

Flexible ball joints must be[stainless steel][carbon steel with electroless nickel-plating to a minimum of 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 pressure molded composition 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 Bellows Expansion Joint for Axial Movement

****

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

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

****

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

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

2.4.3 Mechanically Adjustable Segmented Elastomeric Seal

Mechanically adjustable segmented elastomeric seals must be constructed of fuel resistant Buna-N elastomers and Type 316 stainless steel fasteners and hardware.

2.4.4 Pipe Sleeve

Install pipe sleeves where indicated on design and at all points where piping passes through concrete construction. 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 wrap around Buna-N (Viton when exposed to sunlight) end seal (boot) and secured to the pipe sleeve and piping with adjustable stainless steel hose clamps. Sleeves where piping passes under roads or piping indicated to be double walled must be standard weight carbon steel pipe with a protective coating. Alignment of the sleeve and piping must be such that the pipe is accurately centered within the sleeve by a nonconductive positioning element. The sleeve must be securely anchored to prevent dislocation. Close the space between the pipe and sleeve with a mechanically adjustable segmented elastomeric seal. The seal must be installed so as to be flush.

2.4.5 Strainer

2.4.5.1 Basket Type

****

NOTE: Provide 4-basket type at receipt line when that line is receiving fuel: from a interterminal pipeline, from a installation pipeline from Bulk Storage, from a marine receipt (barge or ship), and all other applications when receipt of fuel with large amounts of particulates is expected.

Provide single basket strainer when relatively clean fuel is expected.

Arrange two strainers in duplex fashion when relatively dirty fuel is expected.

****

Strainer must be[single][multi (four)] basket type arranged in a[simplex][duplex] configuration in compliance with MIL-PRF-13789. Strainer end connections must be designed in accordance with ASME B16.5, Class 150. Strainer body material must be the same as the material specified for manual valves. Strainers must have removable baskets of [7][40][60][100] [_____] mesh wire screen with larger wire mesh reinforcement; wire must be stainless steel, Type 316. Pressure drop for clean strainer must not exceed 21 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 in accordance with Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

2.4.5.2 Cone Type

Strainer must be stainless steel type 304 or 316,[7][40][60][100] [_____] 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. Pump suction strainer must have a[7][40][60][100] [_____] 100 mesh screen with not less than 300 percent open area (ratio of the strainer open area to the cross section of pipe).

2.4.6 Thermometer

****

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

****

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

2.4.7 Pressure Gauge

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

2.4.8 Pipe Support

****

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

For waterfront and projects in the tropics with condensing chloride environments, select galvanized options.

****

2.4.8.1 General

Pipe supports must conform to MSS SP-58. Design pipe supports to meet the applicable requirements of ANSI/ASME B31.3 or ANSI/ASME B31.4. Provide hot-dip galvanized finish on rods, nuts, bolts, washers, and supports.[Provide Type 316 stainless steel nuts, bolts, washers, and screws when located at a pier.] Provide miscellaneous metal that conforms to ASTM A36/A36M, standard mill finished structural steel shapes, hot-dipped galvanized.[Provide galvanizing in accordance with ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, Z275 G90.]

2.4.8.2 Adjustable Type

Adjustable types consist of a bearing surface such as a saddle or low friction half-round and u-bolt supported by 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.

2.4.8.3 Low Friction Type

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

2.4.8.4 U-bolt Half Round Type

Supports must have anti-friction bearing half-round in contact with the bottom of the pipe. Provide polytetrafluoroethylene or like hydrophobic, anti-corrosive material half-round with a minimum compressive strength of 69 mPa 10 ksi or greater as indicated. U-bolts must be installed in either a loose or limited guide configuration. Provide hot-dip galvanized u-bolts with seamless non-metallic low friction coating. U-bolt connection must be double nutted on the bottom and single bolted on top.

2.4.8.5 Concrete and Grout

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

2.4.9 Sample Connection

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 25 mm 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.

[2.4.10 Sight Flow Indicators

****
NOTE: Sight flow indicators are seldom used as they tend to leak when subjected to cyclic pressure spikes. Do not use without permission of the Service Headquarters or officially designated alternate.
****

Sight flow indicators must be ANSI Class 150 and must have flanged end connections. Sight flow indicators must consist of a housing containing a rotating propeller that is visible through a glass observation port. The housing must be stainless steel when installed in stainless steel lines and carbon steel when installed in carbon steel lines. The glass in the indicator must also meet the Class 150 rating.

]2.4.11 Quick Disconnect Coupler and Adapter

Couplers and adapters must be quick disconnect, cam type, that conforms to CID A-A-59326.[Provide coupler with a stainless steel dust plug and a stainless steel hanging eye for truck offloading systems.]

2.5 PIGGING SYSTEM COMPONENTS

****
NOTE: Select option for piggable system components if line is piggable.
****

2.5.1 Maintenance Pig Launcher and Receiver

Construct of the same materials as the pipe, valves and fittings for a Class 150 system. The length of the straight barrel and the line size section must be 1.5 meters 5 feet each. Provide associated launcher

kicker piping and receipt bypass piping, not less than 80 mm 3-inch in size for 150 mm 6-inch lines and 100 mm 4-inch for up to 250 mm 10-inch and 150 mm 6-inch for up to 350 mm 14-inch pipelines.

2.5.2 Smart Pig Launcher and Receiver

Construct of the same materials as the pipe, valves and fittings for a Class 150 system. The length of the straight barrel and the line size section must each be 4.5 meter 15-feet. Provide associated launcher kicker piping and receipt bypass piping, not less than 80 mm 3-inch in size for 150 mm 6-inch lines and 100 mm 4-inch for up to 250 mm 10-inch and 150 mm 6-inch for up to 350 mm 14-inch pipelines.

2.5.3 Launcher and Receiver 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 or Viton. Eye bolts must be pinned to lugs on the hub.

2.6 FLEXIBLE HOSE CONNECTOR

a. Flexible hoses connectors for fueling pumps must have ANSI Class 300 or 150 flanges to mate directly to the pump and Class 150 flanges to the system flanges. Flanges must be stainless steel and must conform to ASME B16.5. These units must have an inner stainless steel or Inconel, corrugated tube with external stainless steel braid, and all components must be rated for not less than 1.90 mPa 275 psig at 37 degrees C 100 degrees F. Face to Face dimension must be as recommended by the manufacturer. Use Inconel 625 inner bellows in coastal environments or where chlorides are present in the atmosphere.

b. For sizes larger than 150 mm 6 inches, connectors must incorporate the use of Lo-corr, multi-ply bellows, without external braid, with bellows rating of 300 psig and overall rating consistent with the flange ANSI class. Flanges must be plate type, Vanstone design, with axial movement control rods.

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

2.7 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 positive. 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.

2.8 SURGE SUPPRESSOR TANK AND VALVE

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NOTE: Seldom used device, typically on truck fillstands that are located a very long way from the pump house on a dead end line. Seek guidance from

the Service Headquarters or officially designated alternate.

****

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 550 KPa 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 suppressor 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.

2.9 MISCELLANEOUS ACCESSORIES

2.9.1 Concrete Anchor Bolt

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

2.9.2 Coating for Bolts, Studs, Nuts, and Washers

Carbon steel bolts, studs, nuts, and washers must be provided with a factory applied[cadmium coating that conforms to ASTM B696 or ASTM B766][hot-dipped zinc coating that conforms to ASTM F2329/F2329M].

2.9.3 Polytetrafluoroethylene (PTFE) Tape

Tape must conform to ASTM D3308.

2.9.4 Pipe Sleeve

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

2.9.5 Escutcheon

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

2.9.6 Pipe Casing

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NOTE: Cased pipe crossings must be specifically designed for the purpose, including depth of burial versus pipe wall thickness calculations using API

criteria and pipe wall thickness required for installation method (such as jack and bore). Appropriate exterior coatings must be considered for the casing. Casings must be designed to be isolated from the piping cathodic protection system, and include a test station for confirmation testing of isolation between pipeline and casing. Project drawings must fully detail method of centering pipe in casing, use of casing segmented seals, and boot to protect the segmented seal from soil backfill.

****

Provide carbon steel casings in accordance with paragraph MATERIALS. Provide coating in accordance with Section 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEMS. Alignment of the casing and piping must be such that the pipe is accurately centered within the sleeve by a nonconductive centering device specifically manufactured for the purpose. Closure of space between the pipe and the casing must be by means of a mechanically adjustable segmented elastomeric seal. The casing must be provided with a wraparound Buna-N end seal (boot), (Viton when exposed to sunlight) and be secured to the piping with adjustable stainless steel hose clamps. Sleeves where piping passes under roads must be not less than standard weight carbon steel pipe with a protective coating. Provide cathodic test station, leads and bonding to the pipe and casing such that the isolation between the casing and piping CP system can be verified.

2.9.7 Buried Utility Warning Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape, acid and alkali resistant, polyethylene plastic warning tape for warning and identification of buried piping. Tape must be detectable by an electronic detection instrument and manufactured for the purpose of early warning and identification of buried utilities.

Tape must be at least 80 mm 3 inches in width with a minimum thickness of 0.08 mm 0.003 inch and a minimum strength of 10.3 MPa 1500 psi lengthwise, and 8.6 MPa 1250 psi crosswise, with maximum 350 percent elongation. Provide printed warning and identification lettering at least 25 mm one-inch in height, imprinted with bold black letters continuous over the entire length of tape. Warning and identification to read "CAUTION, BURIED (intended service) LINE BELOW" or similar. Provide permanent color and printing, unaffected by moisture or soil.

2.9.8 Sand Bedding

Clean, coarse-grained well-graded sand classified as SW in accordance with ASTM D2487 and suitable for for bedding.

2.9.9 Pipeline Marker

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

2.10 FINISHES

2.10.1 Factory Applied

2.10.1.1 Valves

Valve surfaces must be blasted clean according to SSPC SP 5/NACE No. 1. Valve surfaces must be primed and coated in accordance with Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES as required in the Statement of Work or Project Program.

2.10.1.2 Equipment and Components

****

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

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

****

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

PART 3 EXECUTION

3.1 GENERAL

Provide installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing in accordance with ASME B31.3 and NFPA 30 except as modified herein. Strictly observe safety rules as specified in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, EM 385-1-1, NFPA 30, and NFPA 407. Never direct bury threaded connections, socket welded connections, unions, flanges, valves, air vents, or drains. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.

3.2 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.

3.3 CLEANLINESS OF PIPING

Inspect the cleanliness of piping, fittings, and components before placing into position. Clean the interior of each length of pipe, fitting, and component before and after installation to ensure surfaces are free of

water, slag, debris, particulates, or foreign material. See paragraph PROPER STORAGE OF MATERIAL for pre-installation storage requirements. Section 33 08 55 contains further cleaning requirements.

Keep the interior and ends of all piping, fittings, or components which are part of or affected by construction thoroughly cleaned of foreign material and water before and after installation. Use plugs, covers or other approved methods to keep piping systems clean. When work is not in progress, close and secure openings in pipe, piping systems, fittings, and components to prevent ingress of water, contamination, or foreign substances. See paragraph PIPE PIGGING - CLEANING for post-installation cleanliness requirements.

3.3.1 Dehydration of Piping

For piping containing water, remove all water and open all low point drains to confirm water removed. Provide mechanical dehydration with either dehumidification equipment, forced air, or vacuum extraction. Verify that dehydration is complete by measuring dew point of exhausted air. Dry and dehumidify piping using air with a dew point less than minus 29 degrees C minus 20 degrees F, until no residual water accumulates in low points and the dew point of the air at the outlet is less than minus 23 degrees C minus 10 degrees F. Do not allow water to remain in piping for more than 48 hours. Submit Piping Dehydration Results prior to filling pipelines with fuel.

3.4 ELECTRICAL

****

NOTE: Show electrical characteristics on the drawings.

Coordinate the ignition temperature of the fuel(s) to be handled with the electrical design. Ignition temperatures will be as defined in NFPA 497M. Fuel ignition temperatures will dictate the maximum allowable temperature rating of the electrical system components. Coordinate the area classification and the electrical design with UFC 3-460-01.

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

****

3.4.1 General

Provide wiring for motors, manual or automatic motor control system components (except where installed in a motor control center), and protective or signal devices required for operation specified in this Section in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide wiring required for operation specified in this Section but not shown on electrical drawings in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM[, Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION][, Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION].

3.4.2 Grounding and Bonding

Ground and bond as indicated on the drawings and in accordance with NFPA 70, NFPA 77, NFPA 407, NFPA 780, API RP 540, API RP 2003, IEEE 142, and IEEE 1100. Provide jumpers to overcome the insulating effects of gaskets, paints, or nonmetallic components.

3.5 EXCAVATION, TRENCHING, AND BACKFILL

Overexcavate trench to ensure sufficient space for material required in paragraph INSTALLATION OF UNDERGROUND PIPE. Conform excavation, trenching, filling, compaction, and backfill to EM 385-1-1, Section 31 00 00 EARTHWORK, and the following requirements.

a. Excavate for the full length of each section of pipe which does not have protective coating in order to allow access to install protective coating.

b. Pipe that has the grade or joint disturbed after laying, must be taken up and relaid.

c. Dewater trench to remove standing or intruding liquid.

d. See paragraph PIPE BEDDING for haunching and bedding requirements. See paragraphs BURIED WARNING AND IDENTIFICATION TAPE for pipeline location warning tape requirements.

e. Place and compact backfill material in accordance with Section 31 00 00 EARTHWORK.

3.6 PIPING LAYOUT REQUIREMENTS

Determine and provide an efficient pipe routing. Use offsets, fittings, and accessories required to eliminate interference, efficiently match existing system configuration, optimize operability and maintenance access, and minimize alignment stress.

3.6.1 Service and Maintenance Access

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

3.6.2 Pipe Fabrication

a. Fabricate piping to measurements established on the project site and within design tolerances.

b. Position piping into place without cold spring, bending, or forcing. Do not use heat to obtain alignment.

c. Distortion of piping to correct misalignment for joint assembly is prohibited.

d. Prepare pipe or component ends to be smooth and true.

e. Remove slag from surfaces cut by oxygen or thermal arc means.

f. Inside surfaces of components at ends to be joined in girth or miter

groove welds must be aligned within the dimensional tolerance in the WPS and the design.

g. Do not tack welded alignment lugs to pipe for fit-up or fabrication.

3.6.3 Interference and Measurement

Verify dimensions before commencing work. Submit discrepancies for clarification to the Contracting Officer before proceeding with installations.

3.6.4 Structural Attachment

Provide structural steel attachments and connections required to support piping system, headers, accessories, and components. This includes elements not shown on design drawings. Material used for support must be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.6.5 Grade Tolerance

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.

3.6.6 Grade Survey

When backfilling has been completed to top of pipe, perform a relative positional survey of the horizontal and vertical alignment and elevation at each joint or change in direction. Record measurements with an associated odometer reading. See paragraph DATA MANAGEMENT for database requirements. Before backfilling can continue, submit Grade Survey to the Contracting Officer.

3.6.7 Threaded End Connections

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NOTE: Avoid threaded end connections. Threaded end connections may be used in certain aboveground applications if specifically indicated on the drawings. Never direct bury a threaded end connection.

****

Provide threaded end connections only on piping 50 mm 2 inches in nominal size or smaller, and only where indicated on the drawings. Provide threaded connections with PTFE tape or equivalent thread-joint compound applied to the male threads only. Not more than three threads must show after the joint is tightened.

[3.6.8 Existing Pipe System

****

NOTE: Delete this paragraph if connections to existing piping systems are not required. Indicate on the drawings the approximate location of each connection point between new and existing piping systems. If closure welds are required to finish connecting new and existing piping, ensure closure weld requirements of this Section and Section

33 52 23.15 POL SERVICE PIPING WELDING are fully incorporated into the design.
****

Do not interrupt or isolate an existing fuel handling service or system unless the actions are appropriately documented in an approved work plan. Perform initial cutting of existing fuel pipe with a multiwheel pipe cutter, using a nonflammable lubricant. After cut is made, seal interior of piping with a gas barrier plug. Refer to API RP 2009 and API RP 2200. Purge interior of piping with carbon dioxide or nitrogen prior to performing any welding process. See paragraph CLOSURE WELDS for requirements in the event a closure weld is required. See Section 33 52 23.15 POL SERVICE PIPING WELDING for welding safety and closure weld requirements.

]3.6.9 Bolted Connection

For each bolted connection of stainless steel components (pipes, piping components, valves, system components) use stainless steel bolts or studs, nuts, and washers. For each bolted connection of carbon steel components, use carbon steel bolts or studs, nuts, and washers. See paragraph BOLTS, NUTS AND WASHERS for fastener requirements. Prior to installing nuts, apply a compatible anti-seize compound to the male threads.

3.6.10 Flange and Union

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

3.6.11 Flange Protection

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NOTE: See Note at paragraph FLANGE PROTECTOR in PART 2 of this Section.
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Provide flange protectors[on each electrically insulating flange connection][on each flanged end connection, including valves and system components][where indicated on the drawings].[Provide protectors that allow visual inspection of flange gasket without removal.][Fill flange cavity of electrically insulating flange connections with a corrosion inhibitor type grease.] Provide grease filled bolt caps.

3.6.12 Manual Valve

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

Install isolation plug or ball valve on each side of system equipment, at the midpoint of a looped main, and at other points indicated or required to be drained, isolated, or sectionalized. Install valve with stem in the

vertical position unless otherwise indicated. Provide individual support and anchor for each valve.

3.6.13 Air Vent

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

3.6.14 Drain

Provide [_____] [50 mm] [2 inches] drain at all low points and where indicated to ensure complete piping can completely drain.

3.6.15 Bellows Expansion Joint

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

3.6.16 Thermometer

Provide thermometer with separable socket. Install separable socket in pipeline in a manner to sense the temperature of flowing fluid and minimize obstruction to flow.

3.6.17 Pipe Sleeve

Provide a pipe sleeve around any pipe that penetrates a wall, floor, or slab. Do not install sleeves in structural members except where indicated or approved. Install pipe sleeve in masonry structures at the time of the masonry construction. Sleeve must be of such size as to provide a minimum of 12 mm 1/2-inch all-around clearance between bare pipe and the sleeve. Align sleeve and piping such that the pipe is accurately centered within the sleeve by a nonconductive centering element. Securely anchor the sleeve to prevent dislocation. Close the space between the pipe and the pipe sleeve with a mechanically adjustable segmented elastomeric seal. Install seal to be flush. For wall or floor penetration, extend each sleeve through the respective wall or floor and cut flush with each surface. Seal around sleeves that penetrate through valve or fuel related pits with a Buna-N casing seal. Seal around sleeves that penetrate through non-fire-rated walls and floors in accordance with Section 07 92 00 JOINT SEALANTS. Seal around sleeves that penetrate through fire-rated walls and floors as specified in Section 07 84 00 FIRESTOPPING.

3.6.18 Escutcheon

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

3.7 WELDING

3.7.1 General

All joints, unless indicated otherwise, in carbon steel and stainless steel piping systems must be welded. Do not weld carbon steel to stainless steel. Ad-hoc or field-determined closure welds are not

allowed. Welding of fuel pipe joints must comply with Section 33 52 23.15 POL SERVICE PIPING WELDING.

3.8 VALVE REFURBISHMENT

a. Provide professional valve reconditioning services in accordance with API Std 598 and API RP 621. Provide services from an independent reconditioning facility with a documented and established quality assurance program which includes essential elements described in the ISO 9001 standard, and has written procedures compliant with API RP 621.

b. Disassemble, clean, and inspect all components for dimensional accuracy, surface condition, mating fit, and mechanical integrity. Use PT examination procedures in accordance with this Section and API RP 621. Provide supplementary PT examination of castings or forgings in accordance with Part 8 of ASME B16.34. Replace slips, soft seats, bonnet and cover fasteners, packing, gaskets, and grease fittings. Recondition valves to manufacturer standards and API RP 621. Pressure test each assembled valve compliant with API Std 598. Recoat exterior valve surfaces in accordance with Project Program.

c. Provide Valve Reconditioning Report and DBB Valve Hydrotest Report for each valve in accordance with paragraph SUBMITTALS. Reinstall valves with new fasteners and gaskets. Commission valves back into service. Verify proper operation through the entire range. Ensure plug rotation towards open lifts the plug without wiping the seals and retracts the sealing slips so clearance is maintained between the slips and valve body. Verify full range of operation.

3.8.1 Valve Operation

Adjust motor operator limit switches and torque settings to provide proper operation. Verify operation through its entire range and demonstrate to Government proper operation prior to requesting return to service.

3.9 COATING

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NOTE: Damage to buried piping or its protective coating is the largest source of construction defects. Ensure QC oversight is rigorous and provides meaningful contractor control over the quality of installed work.
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3.9.1 Field Applied

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

Painting required for surfaces not otherwise specified must be field painted as specified in[Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES][Section 09 90 00 PAINTS AND COATINGS], the Project Program, or Statement of Work. Do not paint aboveground stainless steel and aluminum surfaces. Do not coat equipment or components provided with a complete factory coating. Prior to any field painting, clean surfaces to remove dust, dirt, rust, oil, and grease.

For field repairs to hot dip galvanized steel, omit application of the zinc-rich epoxy primer coat from Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES. Apply only the epoxy intermediate coat and polyurethane topcoat to these surfaces.

3.9.2 Pipe Supports

When hot dip galvanized pipe support steel must be field coated, prepare surfaces to SSPC SP 16 Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals. Once the steel is prepared, apply only the epoxy intermediate coat and polyurethane topcoat per Section 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES.

3.9.3 Buried Piping Including Stainless Steel

3.9.3.1 Coating System Application

Apply coating system in accordance with 33 52 80 LIQUID FUELS PIPELINE COATING SYSTEMS.[Apply coating system in accordance with 09 97 13.27 HIGH PERFORMANCE COATING FOR STEEL STRUCTURES.] The condition of coated piping is the responsibility of the Contractor. Damage to protective coating during transit or handling must be repaired at no additional cost to the Government. Take every precaution during lowering and backfilling to prevent damage to the protective coating.

3.9.3.2 Inspection and Testing

Following coating installation, test the exterior coating of direct buried piping for holidays using high-voltage spark testing in accordance with NACE SP0188. Repair holidays and retest to confirm holiday-free coating. Test must include all existing underground piping exposed for the project. Submit Coating Holiday Test Results. Perform holiday test on the entire length of pipe immediately prior to lowering pipe into the trench.

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 6,275 times the square root of the average coating thickness in mils. Tester must be a type so fixed that field adjustment cannot be made. Calibration by tester manufacturer must be required at 6-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.

3.9.4 Interior Epoxy

When internally epoxy lined pipe is cut, the lining must be ground back from the end a minimum of 25 mm one-inch but not more than 38 mm 1-1/2 inches.

3.9.5 Damage Repair

When the protective coating on pipe is damaged, notify the Contracting Officer and inspect the pipe before coating is patched. Repair and inspect damaged areas of coating pursuant to all requirements in this Section for coating application.

3.10 INSTALLATION OF UNDERGROUND PIPE

Pitch underground fuel pipelines to grades shown on the drawings. Where not indicated, pitch the installation a minimum of 50 mm 2 inches per 30.5 m 100 feet. 50 mm Two-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.

3.10.1 Precautions

Take special care to ensure that the protective coating on buried pipe is not damaged during handling or installation. Ensure the completed system is not contaminated by dirt, sand, rocks, water, weld slag, or foreign material such as construction debris. Take the following steps.

a. Handle or rig coated pipe only with fabric or nylon slings or padded clamps. Repair coating damaged by improper handling or storage.

b. Review bedding and haunching material before installation to ensure no foreign or deleterious objects are present.

c. Make visual inspection of the inside of each length of pipe to ensure that it is not fouled and is clean prior to installation.

d. Close any open ends of the pipe system at the end of each work day, or when work is not in progress. Use expansion plugs or fitted covers. Do not open until work resumes.

e. Pull through each length of pipe a swab with a leather, canvas, or foam disc that fits the inside diameter, after welding into place. Remove foreign objects and material with the swab.

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

g. Do not use plasma cutters or torches to make penetrations in pipe or to cut pipe.

h. See paragraph PIPE PIGGING - CLEANING.

3.10.2 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.

Take care to prevent damage to the pipe, weld joints, or coating. Inspect the installation prior to burial. Ensure the gross leak test (pneumatic) occurs early in order to perform rework (if necessary) outside of a trench. See paragraph TIMING. Report any damage to the Contracting Officer. Repair damage pursuant to applicable provisions of this Section.

3.10.3 Clearances

Install pipe to be clear of contact with other pipes, pipe sleeves, casings, reinforcing steel, conduits, cables, rocks, or other metallic structures. Where pipes cross other pipes or structures with a separation of less than 300 mm 12 inches, install an insulating separator mat. Center insulating mat at the point of intersection. Insulating mat must be neoprene or butyl rubber, not less than 900 mm 36 inch in any length dimension, and at least 3 mm 1/8 inch thick.

3.10.4 Buried Warning and Identification Tape

In order to identify buried pipe during future underground utility locator work, provide continuous identification tape in the backfill of excavated trenches. Install tape in accordance with manufacturer recommendations as modified herein. Bury tape at depth no less than 300 mm 12 inches below finish grade but no closer to pipe than 300 mm 12 inches from top.

3.10.5 Pipe Bedding

Embed piping in compacted sand material. Provide sand bedding on the subgrade, below the pipe invert, in the haunch, and above the pipe. Fully encircle piping with sand bedding material. Conform bedding to Section 31 00 00 EARTHWORK and the following requirements.

a. Provide testing and application of protective coating to joints before starting side bedding or backfill.

b. Haunch the pipe in sand bedding to the springline at least 150 mm 6 inches thick, compacted in accordance with Section 31 00 00 EARTHWORK, paragraph "FILLING AND COMPACTION". Exercise care and do not come into contact with protective coating if rodding or shovel slicing is used to move and compact sand into the haunch area.

c. Material requirements of sand bedding material are those of Section 31 00 00 EARTHWORK, paragraph SELECT GRANULAR MATERIAL.

d. Pipe that has its grade or joint disturbed after laying, must be taken up and relaid.

e. Do not place pipe in standing water or when the trench or weather conditions are unsuitable for such work.

f. Place and compact sand bedding above springline to a thickness at least 300 mm one foot above top of pipe.

3.10.6 Damage To Buried Pipe

Repair damage to pipe or coating in accordance with paragraphs CORRECTION AND REWORK and WELDING. If pipe is dented or out of round past the new material tolerance, or damaged more than welding can repair, the length of pipe must be rejected.

3.10.7 Pipe Casing

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

The use of casings on underground pipelines is highly discouraged due to increase problems with pipe corrosion and inability to provide cathodic protection to the pipe in the sleeve. Use steel casing sleeves only for those crossings where sleeves are required by authorities having jurisdiction (i.e., Airfield Managers), or where it is necessary to place stainless steel lines bore under the roadway or railroad tracks to while avoiding interference with traffic, or where boring is the most economical construction method. Consider installing carbon steel and stainless steel pipelines under roadways by the traditional trenching method, or use alternative trenchless pipe construction methods for carbon steel pipelines to avoid the need for a casing. Do not use directional drilling for stainless steel lines. When using alternative trenchless methods for carbon steel lines, provide supplemental abrasion resistant coatings applied in addition to the fusion bonded epoxy exterior pipe coating. When required to construct planning construction of open trench cased crossings, consider the economics of installing spare casing sleeves to eliminate excavating for future fuel lines.

Locate crossings at a minimum depth of 900 mm 36 inches beneath the bottom of drainage ditches. If this depth cannot be obtained, install above, but not in contact with, the casing or pipe, a 150 mm 6-inch thick reinforced concrete slab of adequate length and width to protect the casing or pipe from damage by equipment such as ditch graders and mowers.

In areas with high normal or seasonal groundwater tables consider the use of a water excluding casing fill material. Refer to API RP 1102 for additional information on the use of casings.

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Casing must be continuous for the entire crossing as well as extend a minimum of 150 mm 6 inches beyond both sides of the crossing. Casings must be of such size as to provide a minimum of 12 mm 1/2-inch all-around

clearance between bare pipe and the casing. Alignment of the casing and piping must be such that the pipe is accurately centered within the casing by nonconductive centering spacers properly spaced in the casing, and within 300 mm 12 inches of casing ends. Provide seals at each end of the casing. Include a vent on the higher end of each casing and a low point drain on the lower end of the casing. Ensure that the casing design electrically isolates fuel-carrying pipes from contact with the casing pipes. Provide cathodic protection test leads to the pipe and casing to monitor for electrical isolation.[Fill casing with water excluding casing fill material.]

3.10.8 Pipeline Markers

Provide aboveground markers over buried fuel piping spaced every 90 meters 300 feet, at tees, and at changes in direction. For sections of underground piping less than 90 meters 300 feet long, place at midpoint. Provide directly above pipe for single lines and between pipes where pipes run in pairs. Provide additional marker over each mid-line fitting connections for steel reinforced flexible pipe. Cast marker into 450 mm 18-inch diameter, 300 mm 12-inch thick concrete plug unless it is set in an area with concrete paving in which case it must be cast into the concrete paving.

3.10.9 Steel Reinforced Flexible Pipe

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

****

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

3.11 CORRECTION AND REWORK

Defects in work, disqualifying or rejectable inspection findings or examination results, and installation damage must be completely removed and repaired as specified in ASME B31.3, unless stated otherwise in this Section. Follow Section 33 52 23.15 POL SERVICE PIPING WELDING for weld repair, inspection, rework, and examination requirements.

3.12 SYSTEM COMMISSIONING

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

3.13 TESTING

****

NOTE: Hydrostatic testing with water requires explicit, written Service Headquarters approval except in the case of fuel piping systems containing fuels with a flash point of less than 38 degrees C 100 degrees F (i.e., JP-4, Mogas, Avgas, etc.); without that approval, hydrotesting with water is forbidden. Pressure testing of new Mogas, Avgas, and JP-4 pipelines must be with water.

Pneumatic testing carries unusual safety risk due to the amount of stored energy that is possible. Only perform pneumatic test when approved by the contracting officer and do not exceed 25 psig pneumatic test pressure. Intent of a pneumatic test is to detect and locate major leaks. System must be tested with hydrostatic means at the qualifying pressure specified in UFC 3-460-01, so pneumatic test provides limited information.

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Piping must be tested by hydrostatic[and pneumatic] pressure. Testing must comply with applicable requirements of ASME B31.3, NFPA 30 and requirements specified herein. Perform hydrostatic test using[fuel][water] as the liquid[with Service Headquarters approval]. Do not perform pressure testing until weld inspection and NDE have been successfully completed. Furnish labor, material, equipment, electricity, repair, and retesting necessary to achieve successful results. Schedule work so tests are in accordance with paragraph TIMING.

a. Provide means to brace piping and prevent displacement during testing.

b. Keep personnel clear of piping during testing. Control access to only permit authorized personnel in the area during testing.

c. Isolate system components such as pumps, strainers, instruments, tanks, filter separators, and meters from test pressure.

d. Do not exceed the pressure rating of any component in the piping system during testing.

e. Following satisfactory completion of each test, relieve pressure and seal the pipe immediately.[When water is authorized for hydrostatic testing [and][or] pigging of fuel piping, ensure that all water is removed from the piping by a combination of pigging the piping, followed by mechanical dehydration. See paragraph DEHYDRATION OF PIPING. Do not allow water to remain in piping for more than 48 hours after test.]

3.13.1 Timing

Plan work to properly time pipe assembly, inspection, NDE, joint coating, and test activities. Use caution when timing the gross leak test, placing pipe into the trench, and coating joints. Avoid rework performed inside a trench.

Do not leave fuel piping in trench with exposed welds for longer than 30

days. Do not backfill piping before completing weld inspection, weld NDE, pneumatic test, coating (of welds) application and testing, and other quality control work have been successfully completed. For piping that will be pneumatically tested, do not apply protective coating on welds until successful test results are achieved. Schedule hydrotest such that the pipeline can be filled with fuel as soon as possible after test is complete. Fill line with fuel no more than two weeks following draining of water and dehydration of piping.

3.13.2 Pneumatic Test

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NOTE: Do not pneumatically test piping unless approved by the Contracting Officer.
****

Test must be in accordance with an approved plan required in paragraph PNEUMATIC TEST PLAN. Furnish all equipment necessary for a safe and successful test. Do not begin pneumatic test until permission is granted by the Contracting Officer. Only authorized personnel are permitted in the area during pneumatic test.

a. Isolate piping into segments and conduct separate tests.

b. Isolate using physical means such as blind flange compliant with ASME B16.5 or solid-plate line blank compliant with ASME B16.48. Use means of sufficient strength to withstand test pressure. Do not use a valve as means of isolation.

c. Provide pressure gauges with current calibration certificate.

d. Furnish tapped flange or blank that will permit a direct connection between the test segment and the compressed air source. Do not install a tap in the permanent piping.

e. Air used for pneumatic testing must have a dew point of no more than 5 degrees C 41 degrees F.

f. Provide dehumidifying equipment on the discharge side of the compressor used to provide test air.

g. Pressurizing pump must not exceed 4.7 L/s 10 cfm.

h. Provide a pressure relief device with set pressure above the test pressure but no more than 207 kPa 30 psig.

i. Provide mechanical means to isolate test segment from source of pressure. Provide means to slowly relieve excess pressure during test period.

3.13.2.1 Pneumatic Test Procedure

Pneumatic test must contain, at minimum, the following elements.

a. Special safety measures to include wearing personnel face protection in accordance with ANSI/ISEA Z87.1 during test.

b. Designate a competent test operator who is in responsible charge of the test. Test operator must control or direct application and

release of pressure, verify connections are secure, ensure test segment and area is safe and clear of unauthorized personnel, and remain in constant communication with observers.

c. Stage observers at appropriate locations from which a major leak can be safely detected and reported to the test operator.

d. Apply pressure to test segment in increments. Gradually increase pressure to 0.5 test pressure and stop. Verify conditions with observers. Slowly increase pressure at approximately 1/10 increments until 170 kPa 25 psig is reached. Isolate segment from source of pressure.

e. Monitor pressure gauge while applying a bubble forming solution on welds and any area of suspect integrity. While applying the solution, visually inspect the entire segment of piping for leaks (bubble formation).

f. If leaks are discovered, discontinue the test and repair the piping. Inspect and perform NDE on the repair. Restart the test on the repaired segment. Repeat process until system is leak-free. See paragraph CORRECTION AND REWORK.

g. Monitor pressure for a 2 hour test period during which there must be no drop. Pressure can rise due to ambient temperature change. Carefully relieve excess pressure as-needed to maintain test. Ensure segment remains isolated from pressure source during test period.

h. Acceptable results are the no leak condition with no appreciable pressure drop during the test period.

i. Report Pneumatic Test Results through the Quality Control program.

3.13.3 Hydrostatic Test

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NOTE: Unless otherwise directed by the Service Headquarters, hydrostatically test new piping systems to qualify operations up to the (design pressure) maximum allowable working pressure (MAWP) of ASME B16.5 piping system flanges. This qualification requires test pressure of 1.5 times MAWP of the ASME B16.5 piping system flanges at 38 degrees C 100 degrees F. Qualification at lower test pressure will derate the system maximum operating pressure. Refer to UFC 3-460-01 for more guidance.

Hydrostatically testing the system to 1.5 times the flange rating, will require the designer to write commissioning hydrostatic test procedures. These will specify removal of system components (i.e., ball valves, control valves, meters). Test procedures should include valves to close, test pump location, segment isolation, blind flange placement, high point vent and low point drain configuration, datalogging, acceptance criteria, and other requirements.

NOTE: Hydrostatic testing with water requires explicit, written Service Headquarters approval except in the case of fuel piping systems containing fuels with a flash point of less that 38 degrees C 100 degrees F (i.e., JP-4, Mogas, Avgas, etc.); without that approval, hydrotesting with water is forbidden.

NOTE: If hydrostatic testing with water, perform soak test after initial introduction of fuel as described in Section 33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT).

****

Upon successful completion of pneumatic testing and after backfilling, hydrostatically test piping system with[fuel][water] at [1.9][2][2.9][3.1][_____] MPa [275][285][425][450][_____] psig in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gauge pressure. Furnish electricity, instruments, connecting devices, and personnel for test.[Fuel must be furnished by the Government.][If fuel is used for testing, comply with all the requirements in Section 33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT).][In cases where it is not specified, water must be potable and treated and must meet all requirements of water used for hydrostatic testing in API 570.] 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.

a. Duration of the test must be a minimum of [4][8] hours.

b. Designate a competent test operator who is in responsible charge of the test. Test operator must control or direct application and release of pressure, verify connections are secure, ensure test segment and area is safe and clear of unauthorized personnel, and remain in constant communication with observers.

c. Upon successful completion of hydrostatic testing, perform Soak Testing of the piping systems per API RP 1595.

d. Only authorized personnel are permitted in the area during hydrostatic testing.

e. If leaks are discovered, discontinue the test and repair the piping. Inspect and perform NDE on the repair. Restart the test on the repaired segment. Repeat process until system is leak-free. See paragraph CORRECTION AND REWORK.

3.13.3.1 Instruments

a. Instruments must be clean, in good working order, and within the calibration interval. Instruments without a calibration certificate must not be used.

b. Calibrate all test instruments against a standard by a laboratory A2LA accredited to ISO ISO/IEC 17025. Calibration must have taken place no more than 6 months prior to the hydrostatic testing. Calibration certificates must include the Model, Serial Number, date of certification and must be signed by the testing company. Provide

current Instrument Calibration Certificate for measurement instruments.

c. Provide indicating pressure test gauge connected directly to the segment and readily visible to the operator controlling pressure for the duration of the test. Analog type gauges must be compliant with ASME B40.100 Grade 3A, accurate to plus or minus 0.25 percent full scale, graduated over a range not less than 1-1/2 times nor more than 4 times the test pressure, and incremented no greater than 0.5 psi.

d. Digital type pressure gauge must be integral transducer type, compliant with ASME B40.100 Grade 3A, and accurate to plus or minus 0.25 percent full scale.

e. Provide digital contact thermometer incremented to 0.1 degree F or less. Memorialize pressure data with analog chart recorder. Transducers must have a range not less than 1.5 times and not greater than 4 times the pressure being tested.

f. Use calibrated continuous recorders (dataloggers) with adequate storage capacity to record temperature and pressure data. Synchronize the time interval for both measurements.

g. Measure the volume of test medium with a calibrated meter.

3.13.3.2 Procedure

a. For inaccessible segments, account for the volume of any test medium added or removed by measuring with a calibrated meter.

b. After filling has been completed, allow the test section to stabilize at 25 percent of the test pressure for 24 hours or until a temperature-time plot is asymptotic to ground temperature. Start pressure and temperature recorders prior to pressurization and run throughout the stabilization period to ensure proper stabilization has taken place before starting the hydrotest.

c. Maintain segment at a steady test pressure condition for a minimum of 15 minutes prior to initiation of examination for leakage. Examine piping, joints, and connections of accessible piping for leaks while maintaining test pressure. Leakage of temporary gaskets and seals, installed for the purpose of conducting the hydrostatic test and which will be replaced later, is permitted unless the leakage rate precludes maintenance of system test pressure for the required duration. Personnel performing the examination for leaks must be qualified for visual examination. Extend the test interval as needed to ensure positive reconciliation of test data. Monitor temperature and pressure. Analyze consistent error, inconsistent error, the magnitude of any lost volume, and pressure versus temperature data trends.

3.13.3.3 Hydrostatic Test Water Disposal

Remove test water from segment upon completion of test. For large volume tests, apply for coverage under a State permit authorizing discharge of hydrotest water. Sample, test, and characterize the water pursuant to the permit. Provide Test Water Characterization results to the Contracting Officer. If test results exceed allowable discharge limits in the permit, dispose of the water off Installation in an appropriate manner. If discharge is allowed under the permit, provide a Test Water Disposal Plan to the Contracting Officer for approval. Water discharged on the surface

must be in a slow and controlled manner which will not result in erosion or migration outside the disposal area.

3.13.3.4 Test Report

Provide certification from the hydrostatic test examiner the piping segments are either pass or fail. Inconclusive results are not acceptable. Prepare a pressure test report consistent with API RP 1110 to serve as the permanent qualification record, demonstrate the operating pressure limit and includes test drawings and logs of recorded test data. Provide written Hydrostatic Test Report.

3.13.4 Soak Testing

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NOTE: Perform soak test after initial receipt of fuel as described in Section 33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT). The timing of the initial receipt of fuel will depend on where water is used for just hydrotesting, or hydrotesting and pigging.

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[Upon completion of hydrostatic testing with fuel, perform Soak Testing of the piping systems per API RP 1595. Duration of the test must be a minimum of 4 days and maximum of 7 days.][Upon completion of initial receipt of fuel, perform "Soak Testing" of the piping systems per API RP 1595. Duration of the test must be a minimum of 4 days and maximum of 7 days.]

3.13.5 System Integrity Check

After system installation, inspection, NDE, and pressure testing are complete, check flanges, valves, fittings, joints, gaskets, connections, and components for visible weep, leak, or any area wetted with fuel. Replace, repair, or tighten to establish integrity. Re-check system to verify.

3.13.6 Performance Testing

After fuel system testing is completed (including integrity check), flush, clean, and performance-test as specified in Section 33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT). Verify proper operation of all valves, pumps, controls, and motors. After start-up is complete, re-check the system for leaks and proper operation. Repair or replace to correct any defects.

[3.14 PIPE PIGGING - CLEANING

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NOTE: Select bracketed paragraph if system is designed to be piggable. Standard cleaning pig runs are recommended on all systems.

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The objective of cleaning is to remove all debris and particulates from inside the piping or on pipe wall surfaces, independent from verification and inspection technology to be used. Use progressive techniques to achieve the objective.

****

NOTE: Pigging with water is not recommended is not allowed in systems which contained fuel previously. Exercise caution pigging with water because serious consequences can result from introducing or leaving water in piping. Microbiologically influenced corrosion can be severe and rapid if water is allowed to persist in piping. Ensure proper means exist to dehydrate piping and verify dryness.

Pneumatic propelled cleaning pigs will almost always be used before any other pigs are run. Fuel propelled pigs may always be used.

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3.14.1 General

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NOTE: Include bracketed text for non-stainless piping systems, or if excessive contamination is anticipated.

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[Install contractor-provided launching and receiving barrels.]Use aboveground markers at no less than 805 m 1/2-mile increments but at no less than four locations, to monitor progress during operation. Use tracking equipment with battery life not less than 72-hours. Propellant must be pressurized[fuel][water] using[the main system delivery pumps][portable pumps]. Prepare a contingency plan for retrieving a stuck pig and repairing any piping damage or deformation. Determine the sequence of runs, the type of tool to be used in each run, and acceptable results of each run. See paragraph PIGGING PLAN for submittal requirements.

Numerous pig runs could be required. Clean the piping system to be suitable to use verification and data collection tools, and to be of suitable cleanliness for the fuel service in which the piping will be used. The number of flights of each type of cleaning tool must be determined by the quantity and type of debris removed. The cleaning process is complete when debris recovered is only from the tool itself. This determination will be made by the Contracting Officer. Table 2 lists tool types and expected performance.

Table 2

Tool Type	Performance
Gel or light foam disc	Proving, cleaning
Plastic brush	Cleaning
Wire brush	Cleaning
Poly scraper magnetic	Cleaning

Table 2	
Tool Type	Performance
Gel or medium foam disc	Cleaning

[3.14.2 Use of Fuel in Cleaning Pigging

Cleaning pigging with fuel will take place after the initial receipt of fuel as per Section 33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT). Ensure that fuel returned to storage during the pig runs is free of gross contamination and passes the color assessment method, and meets the requirements of MIL-STD-3004-1. Provide temporary storage tanks for the high particulate and dark color fuel that accumulates in front of and behind each pig. The contractor is responsible for[cleaning the off-spec fuel in order to meet requirements of MIL-STD-3004-1][, disposal of off-spec fuel off-base][, obtaining permission from the Contracting officer to downgrade fuel and dispose into appropriate storage].

][3.14.3 Use of Water in Cleaning Pigging

Ensure that the water, in cases where it is not specified, is potable and treated, and meets requirements of water used for hydrostatic testing in API 570. Dispose of the water in accordance with applicable Installation, city, county, state, and federal regulations.

]3.14.4 Proving Operations

Provide an initial proving run to ensure the system is fully piggable using a light density foam tool (32 kg/m^{3}2 lb/ft^3). Examine the tool after the initial run for signs of possible piping damage, interior slag, or other adhered material. Assess results to determine whether pigging can continue.

3.14.5 Cleaning Operations

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NOTE: Use wire brush cleaning pig if slag or other adhered material are suspected on the pipe interior. Require stainless steel brushes on stainless steel piping systems. Use plastic bristle brush tools on interior coated pipe.

Never perform wire brush cleaning pig on interior epoxy coated piping systems.

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Upon successful proving run, provide thorough cleaning of the interior of the piping system using cleaning tools. Examine the debris and material retrieved by the tool to ascertain effectiveness.

3.14.5.1 Brush Run

Use a brush style tool to remove weld slag and adhered particles from the system. Brush pig can be bi-directional disc style or directional cup style with circular[stainless] steel wire brushes. Use a plastic bristle brush for internally lined piping. The pig body must include bypass

nozzles and transmitter cavity. Brush tool can be paired with medium density foam (81 kg/m^{3}5 lb/ft^3) or gel pigs. Perform brush runs until the amount of collected material or cleanliness is acceptable, as determined by the[Contracting Officer][System Supplier]. Provide sufficient cleaning in the pipeline, as determined by ILI vendor, to be suitable for the data collection tool.

3.14.5.2 Debris Removal

After pigging, flush valves, strainer, gauges, flow indicator, low points, and small bore piping of particulates and debris. Clean plug valves of debris using the drain port at the bottom of the valve.

3.14.6 Lost Pig

Contractor is responsible for a lost pig, finding and retrieval of the pig, repairs and NDE on the pipeline system as a result of the lost pig, and damage to the pig itself.

]3.15 PIPE PIGGING - VERIFICATION

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NOTE: Remove ILI requirements if system is not designed to be smart-piggable. ILI runs are necessary to identify construction defects, verify geometry, and set the metal thickness baseline for use in pipeline integrity management. Corrosion-based metal loss should not be present in the new system, so rigorous ILI vendor corrosion data analysis is not necessary. In general, ultrasonic technology will be sufficient for the wall thickness survey.

****

The objective of verification is to ensure piping system is installed as-designed (bore validation), is free of defects, and to establish a baseline set of geometry and thickness data using inline inspection (ILI). Both ultrasonic and magnetic flux leakage type of ILI tools are acceptable.

3.15.1 General

[Install contractor-provided launching and receiving barrels.]Use aboveground markers at no less than 805 m 1/2-mile increments but at no less than four locations, to monitor progress during operation. Use tracking equipment with battery life not less than 72-hours. Propellant must be pressurized [fuel][water]. Prepare a contingency plan for retrieving a stuck pig and repairing any piping damage or deformation. After pigging, flush plug valves of debris using the drain port at the bottom of the valve. Determine the sequence of runs, the type of tool to be used in each run, and acceptable results of each run. See paragraph PIGGING PLAN for submittal requirements.

Several pig runs could be required. Inspect the piping system using ILI data collection tools. The ILI process is complete when a full and competent dataset is acquired. This determination will be made by the ILI vendor.

[3.15.2 Use of Water in Verification Pigging

****

NOTE: Pigging with water is not allowed in systems which contained fuel previously. Exercise caution pigging with water because serious consequences can result from introducing or leaving water in piping. Microbiologically influenced corrosion can be severe and rapid if water is allowed to persist in piping. Ensure proper means exist to dehydrate piping and verify dryness.

****

Ensure that the water, in cases where it is not specified, must be potable and treated and must meet all the requirements of water used for hydrostatic testing in API 570. Dispose of the water in accordance with applicable Installation, city, county, state, and federal regulations.

]3.15.3 Internal Inspection Operations

3.15.3.1 General

Propel pigs through the pipeline with[fuel][water] in order to inspect the pipeline. The ILI technician will determine if additional runs are necessary to acquire sufficient data. Generate a permanent set of baseline internal inspection, geometry, and mapping data.

3.15.3.2 Preparatory Work

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

3.15.3.3 Pig Load And Launch

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NOTE: If pig launcher and a receiver are not provided in the contract, portable ones must be used 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.

3.15.3.4 Pipeline Operation During Pigging

All pig runs must be made with the line packed with[fuel][water]. Use[system pumps][portable pumps] to propel tools. Use pig traps to launch and retrieve.

3.15.3.5 Gauging

Run gauging tool through the pipeline to identify the presence of obstructions or ovality. Provide tool from or determined to be acceptable by the ILI vendor. Gauge plate must be equal in size to 90 percent of the

pipeline nominal inside diameter and comprised of segmented aluminum fins of 3 mm 1/8-inch thickness.

3.15.3.6 Geometry and Anomaly Survey

After cleaning and satisfactory gauging pig run, survey the pipeline with ILI to find geometric anomalies, perform bore validation, and document pipeline geometry. The ILI tool must provide accurate detection of geometric anomalies, measure distances and radii, and establish a set of feature coordinates. Provide data in spreadsheet source format. The ILI tool must be capable of the following.

a. Operating safely in[hydrocarbon liquid environment, specifically[jet fuel] [_____]][water], at a pressure of up to ANSI 300 class rating.

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

c. Traversing pipeline at speed between 0.4 and 1.5 m/sec 1.5 and 5 ft/sec when propelled by pumped[fuel][water]. Pressure differential across pig not to exceed 34 kPa 50 psi.

d. Traversing pipe bends as small as 3D (3 pipe diameters) radius and single miter bends of up to 10 degrees change of direction.

e. Detection, location, and identification of anomalies such as excess weld penetration, material lamination, ovality, dent, wrinkle, buckle.

f. Manual loading and unloading from horizontal pig traps.

g. Battery life sufficient for minimum 18-hours at operating conditions.

h. Locating and identifying geometric anomalies, pipeline features, and aboveground markers.

i. Global position and inertial mapping to establish accurate coordinates for pipeline features.

3.15.3.7 Wall Thickness Survey

Provide baseline pipe wall thickness using a tool with measurement accuracy of plus minus 0.25 mm 0.01-inch. Provide data in spreadsheet source format. See paragraph DATA MANAGEMENT.

3.15.3.8 Lost Pig

Contractor is responsible for a lost pig, finding and retrieval of the pig, repairs and NDE on the pipeline system as a result of the lost pig, and damage to the pig itself.

3.15.4 Geometry and ILI Reports

After cleaning and verification pigging are complete, brief the Contracting Officer on preliminary results of the pigging. This can consist of preliminary interpretation of data with emphasis on anomalies, indications of defects, or unexpected results.

Provide a final Pipe Pigging Verification that identifies critical anomalies or defects, and delivers geometry, mapping, thickness, and

pipeline features data. Provide software necessary to read or view proprietary data. Data submittal must be in the form of a physical disc, either CD or DVD (flash drives are unacceptable). See paragraph DATA MANAGEMENT. Include at minimum the following contents.

a. Run performance (AGM detection, speed, propulsion quantities, pipe cleanliness).

b. Description and definitions for anomaly severity classifications and ranking.

c. List of anomalies and data loss, ranked and with corresponding location coordinates.

d. Tally of pipeline features and components with corresponding location coordinates.

e. Metal thickness data in source file spreadsheet format with corresponding location coordinates.

f. Mapping data

3.16 DEMONSTRATIONS

As per requirements in Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

3.17 POSTED OPERATING INSTRUCTIONS

As per requirements in Section 33 57 55 FUEL SYSTEM COMPONENTS (NON-HYDRANT).

-- End of Section --