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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UML dated 23 June 2005

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SECTION 02555

EXTERIOR FUEL DISTRIBUTION

08/04

NOTE: This guide specification covers the requirements for exterior fuel distribution systems, including aboveground piping, piping on piers, piping under piers, piping in trenches on piers, piping in tunnels, piping in manholes, buried piping, and related work.

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

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

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

NOTE: System design must conform to Unified Facilities Criteria (UFC) 3-460-01, "Petroleum Fuel Facilities."

NOTE: The following information shall be shown on the project drawings:

1. Only drawings (not specifications) shall indicate capacity, efficiency, dimensions, details, plan view, sections, elevations, and location of equipment; and space required for equipment maintenance.

2. Configuration, slope, and sizes of piping systems;
3. Details of manholes and piping within manholes;
4. Scale ranges for pressure gages;
5. Whether piping is run aboveground, buried, on piers, under piers, in trenches on piers, or in manholes;
6. Details of expansion joints and expansion loops for piping;
7. Complete details for cathodic protection systems for buried metallic piping when soil resistivity is less than 30,000 ohm-cm.

PART 1 GENERAL

1.1 REFERENCES

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

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

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

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

AMERICAN PETROLEUM INSTITUTE (API)

API BULL 2209	(1978) Pipe Plugging Practices
API RP 1110	(1997) Pressure Testing of Liquid Petroleum Pipelines
API Spec 5L	(2004) Line Pipe
API Spec 6D	(2002) Specification for Pipeline Valves

API Std 594 (1997) Check Valves: Wafer, Wafer-Lug and Double-Flanged Type

API Std 609 (1997) Butterfly Valves: Double Flanged, Lug-and-Wafer Type

ASME INTERNATIONAL (ASME)

ASME B16.11 (2002) Forged Fittings, Socket-Welding and Threaded

ASME B16.3 (1998) Malleable Iron Threaded Fittings

ASME B16.34 (1996) Valves Flanged, Threaded, and Welding End

ASME B16.39 (1998) Malleable Iron Threaded Pipe Unions

ASME B16.5 (2003) Pipe Flanges and Flanged Fittings

ASME B16.9 (2003) Factory-Made Wrought Steel Buttwelding Fittings

ASME B31.3 (2002) Process Piping

ASTM INTERNATIONAL (ASTM)

ASTM A 193/A 193M (2004c) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 194/A 194M (2004a) Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service or Both

ASTM A 36/A 36M (2004) Carbon Structural Steel

ASTM A 53/A 53M (2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM D 229 (2001) Rigid Sheet and Plate Materials Used for Electrical Insulation

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

MSS SP-58 (2002) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69 (2002) Pipe Hangers and Supports - Selection and Application

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2003; R 2004) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30 (2003) Flammable and Combustible Liquids Code

NFPA 70 (2005) National Electrical Code

1.2 SYSTEM DESCRIPTION

Provide [new and modify existing] exterior fuel distribution system complete and ready for operation. System shall include [aboveground piping,] [piping on piers,] [piping under piers,] [piping in trenches on piers,] [piping in tunnels,] [piping in manholes,] buried piping, and related work.

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Pipe

Valves

Strainers

Pipe hangers and supports

Expansion joints

Gages

Fuel meters

Fuel pumps

Including actual diameter of impeller being furnished and manufacturer's certified pump test curves showing the characteristics over the entire operating range.

SD-07 Certificates

Certification of welder's qualifications

SD-10 Operation and Maintenance Data

Fuel pumps, Data Package 2[; G][; G, [____]]

Fuel meters, Data Package 2[; G][; G, [____]]

Submit in accordance with Section 01781 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Certification of Welder's Qualifications

Submit prior to site welding. Certifications shall not be more than one year old.

PART 2 PRODUCTS

2.1 STEEL FUEL PIPE

- a. ASTM A 53/A 53M; Type E (electric-resistance welded, Grade A or B) or Type S (seamless, Grade A or B), black steel. Provide Weight Class STD (Standard) for welding end connections. Provide Weight Class XS (Extra-Strong) for threaded end connections.
- b. API Spec 5L; seamless, submerged-arc weld or gas metal-arc weld; Grade B, black steel. Provide Weight Class STD (Standard) for welding end connections. Provide Weight Class XS (Extra-Strong) for threaded end connections.

2.2 FITTINGS

- a. Threaded Fittings: ASME B16.11 or ASME B16.3.

- b. Socket Welded Fittings: ASME B16.11.
- c. Buttwelding Fittings: ASME B16.9. Provide the same material and weight as the piping in which fittings are installed. Backing rings shall conform to ASME B31.3 and be compatible with materials being welded.
- d. Flanges: ASME B16.5, Class 150.
- e. Unions: ASME B16.39, Class 150. Provide electrically isolating (insulating) unions where indicated.

2.3 GASKETS, BOLTS, NUTS, AND WASHERS

- a. Gaskets: Provide one piece, factory cut, 1.60 mm 0.0625 inch thick gaskets resistant to the effects of aviation hydrocarbon fuels and manufactured of fire resistant materials. Provide full-face gaskets for flat-face flanged joints, and ring gaskets for raised-face flanged joints.
- b. Bolts: ASTM A 193/A 193M, Grade B7. Extend no less than two full threads beyond the nut with the bolts tightened to the required torque.
- c. Nuts: ASTM A 194/A 194M, Grade 7, with Teflon coated threads.
- d. Washers: Provide steel flat circular washers under bolt heads and nuts.
- e. Electrical Insulating Gaskets for Flanges: Provide ASTM D 229 electrical insulating material of 1000 ohms minimum resistance. Material shall be resistant to the effects of aviation hydrocarbon fuels. Provide full face, one piece, factory cut insulating gaskets between flanges. Provide full surface 0.08 mm 0.03 inch thick wall thickness, spiral-wound mylar insulating sleeves between bolts and holes in flanges; bolts may have reduced shanks of a diameter not less than the diameter at the root of threads. Provide 3.20 mm 0.125 inch thick high strength phenolic insulating washers next to flanges and flat stainless steel washers over insulating washers and under bolt heads and nuts. Provide bolts 12.70 mm 0.5 inch longer than standard length to compensate for the thicker insulating gaskets and the washers under bolt heads and nuts.

2.4 VALVES

Steel body for working pressure of ASME Class 150, 1896 kPa (gage) at 38 degrees C 275 psig at 100 degrees F. Provide with stems in the horizontal position or not greater than 45 degrees above the horizontal position. Valves shall have flanged end connections, except valves smaller than 65 mm 2.5 inches shall have union end connections, or threaded end connections with a union on all but one side of the valve. Provide Viton or Teflon seals with metal backup. Provide gear operators with weatherproof housing designed to exclude driving rain. [Provide valve in tank fill piping and tank suction piping with factory-installed limit switches that are actuated by the valve operators. When the valves are closed, limit switches shall prevent operation of pumps and shall energize red indicating lights in the control panel.]

2.4.1 Ball Valves

API Spec 6D, steel body, ASME Class 150. Provide nonlubricated double seated type capable of handling two-way shutoff, with weatherproof gear operators, except valves 100 mm 4 inches and smaller may be lever operated with 10 positions or infinitely adjustable positions between full open and full close. Minimum bore size shall be not less than 55 percent of the internal cross sectional area of a pipe of the same nominal diameter. Valves 350 mm 14 inches and larger shall have balls with trunnion type support bearings. Provide chromium-plated or nickel-plated steel balls. Valves shall have stainless steel stems and trim, and Viton or Teflon seats, body seals, and stem seals. [Provide body cavity drain and factory-installed drain valve.]

2.4.2 Plug Valves (Double Block and Bleed Valves)

API Spec 6D, steel body, ASME Class 150. Provide nonlubricated, resilient, double seated, tapered lift, plug type capable of handling two-way shutoff.

Provide chrome-plated valve interiors and chrome-plated tapered plug of steel or ductile iron, supported on upper and lower trunnions. Sealing slips shall be steel or ductile iron with Viton seals. Valve design shall permit sealing slips to be replaced from the bottom with the valve mounted in the piping. Valves shall operate from fully open to fully closed by rotation of the handwheel (to lift and turn plug). Valves shall have weatherproof gear operators with mechanical position indicators. Minimum bore size shall be 65 percent of the internal cross sectional area of a pipe of the same nominal diameter, unless the manufacturer can show an equivalent or greater flow rate with a lower percent internal cross sectional area.

- a. Valve Operation: Rotation of the plug toward open shall lift the plug without wiping the seals and retract the sealing slips so that clearance is maintained between sealing slips and valve body. Rotation of the handwheel toward closed shall lower the plug after sealing slips are aligned with the valve body and force the sealing slips against the valve body for positive closure. When valve is closed, slips shall form a secondary fire-safe metal to metal seat on both sides of the resilient seal. Maximum number of turns from full close to full open shall be eight.
- b. Relief Valves: ASME Class 150, steel body. Provide plug valves with automatic thermal relief valves to relieve pressure buildup in the internal body cavity when the plug valve is closed. Relief valves shall open at 172 kPa 25 psi differential pressure, and discharge to the throat of and to the upstream side of the plug valve.
- c. Bleed Valves: ASME Class 150, steel body ball valve or plug valve. Provide manually operated bleed valves that can be opened to verify that double block and bleed valves are not leaking when in the closed position. Provide discharge piping so that released liquid can be contained.

2.4.3 Check Valves

ASME B16.34, Class 150, steel body. Valve shall be spring-loaded, nonsurge globe type with fully guided (top and bottom) disc with Viton renewable seats.

2.4.4 Relief Valves

ASME Class 150, steel body; set relief at pressure indicated.

2.4.5 Globe Valves

ASME B16.34, steel body, Class 150.

2.4.6 Butterfly Valves

API Std 609, Class 150, steel body, bubbletight bidirectional shutoff service at 1896 kPa (gage) 275 psig. Disc shall be Type 304L or Type 316, stainless steel. Stem shall be Type 416 or Type 630, stainless steel. Seal ring shall be Teflon with metal backup. Stem seals shall be capable of withstanding the rated pressure and temperature of the valve seat. Valves 150 mm 6 inches and larger and valves at pump discharge shall have weatherproof gear operators with handwheel; other valves shall have 10-position throttling handles. Install valves between ASME Class 150 flanges. Do not install valves on other flanges such as equipment, strainer, and valve flanges. Provide spool pieces. Provide fusible link type valves where indicated. Provide fusible link and spring assembly to close the valve automatically when the link material melts at 74 degrees C 165 degrees F and to lock valve in the closed position.

2.4.7 Wafer Type Check Valves

API Spec 6D and API Std 594, ASME Class 150. Wafer type check valves may be provided in lieu of swing-check valves in piping sizes larger than 100 mm 4 inches. Valves shall have Grade CF8M stainless steel disc and seal material. Valves shall have Type 316 stainless steel spring, hinge pin, stop pin, and radial-thrust bearing materials. Install valves between ASME Class 150 flanges.

2.4.8 Pump Pressure Relief Valves

ASME Class 150, with flanged end connections, and position indicator. Hydraulically operated, diaphragm type, modulating, globe valve actuated by pipe line pressure through a pilot control system designed to open fast to maintain a constant line pressure but close gradually to prevent surges; fully adjustable, direct acting, spring-loaded, diaphragm type designed to permit flow when the controlled pressure is greater than the predetermined spring setting; aluminum alloy 6061-T6 or 356-T6, stainless steel main valve trim and control pilot system; and rubber parts of Viton or Buna-N. When diaphragm fails, the valve shall close. Provide valve with position indicator, pilot circuit strainer, and pressure gage quick-disconnect fittings located in valve inlet, outlet, and cover.

2.4.9 Surge Control and Check Valves

ASME Class 150, with flanged end connections and position indicator. Hydraulically operated, pilot controlled, diaphragm type, nonsurge globe valve with closing time of 1 to 5 seconds; locate on discharge side of transfer pump. Valve shall automatically prevent reverse flow and open at a controlled rate to keep pump starting surges from shocking downstream equipment. Opening rate shall be adjustable from 5 to 60 seconds. Aluminum alloy 6061-T6 or 356-T6 valve body, stainless steel main valve trim and control pilot system; and rubber parts of Viton or Buna-N. Provide orifice plates by valve manufacturer. When diaphragm fails, the valve shall open. Valve shall have position indicator, pilot circuit strainer, and pressure

gage quick-disconnect fittings located in valve inlet, outlet, and cover.

2.4.10 Solenoid Control Valves

ASME Class 150, with flanged end connections and position indicator. Hydraulically operated, pilot controlled, diaphragm type globe valve, with a tight shutoff down to 1379 kPa (gage) 200 psig operating pressure. When energized, the solenoid controls shall cause the main valve to open and function normally. When deenergized, the solenoid controls shall cause the main valve to close, providing a driptight shutoff. Provide NEMA 7 solenoids. Aluminum alloys 6061-T6 or 356-T6 valve body; stainless steel main valve trim and control pilot system; and rubber parts of Viton or Buna-N. When diaphragm fails, the valve shall close. Valve shall have position indicator, pilot circuit strainer, and pressure gage quick-disconnect fittings located in valve inlet, outlet, and cover.

2.4.11 Truck Fueling Flow Control Valve

ASME Class 150, with flanged end connections and position indicator. Hydraulically operated, pilot controlled, diaphragm type globe valve, capable of limiting flow rate regardless of varying inlet pressures. Provide with an adjustable low-flow start period, and thermal-relief function. Functions shall be externally adjustable. Provide NEMA 7 solenoids for truck fill high-level shutoff and hand held deadman control system. Aluminum alloy 6061-T6 or 356-T6 valve body, stainless steel main valve trim and control pilot system; and rubber parts of Viton or Buna-N. When diaphragm fails, valve shall close. Valve shall have position indicator and pilot circuit strainer.

2.5 EQUIPMENT

Pressure components of equipment shall be for working pressure of ASME Class 150, 1896 kPa (gage) at 38 degrees C 275 psig at 100 degrees F.

2.5.1 Fuel Meters

Provide meters designed for use with aviation hydrocarbon fuels and working pressure of 1896 kPa (gage) at 38 degrees C 275 psig at 100 degrees F. Meters shall be of the continuous duty, positive displacement type, with electronic thermal compensation capability, flanged end connections, and suitable for outdoor installation. Meter adjustment shall be possible while under pressure, without leakage or loss of product and without requiring disassembly other than removal of the cover plate. Meters shall be capable of momentary overspeeding to 125 percent of maximum rated capacity without damage or impairment of accuracy. Provide meters with a two-stage set stop counter register, with seven-figure nonsetback totalizer and five-figure setback run indicator without the tenth-of-gallon indicator. Provide counter with electrical impulse to solenoid valves that are on two-stage fueling flow control valves. Pressure drop across each meter shall not exceed 41 kPa (gage) 6 psig when operated at rated capacity. Each meter shall be factory calibrated. Provide meter with card printer.

2.5.2 Fuel Pumps

Provide pumps designed for use with aviation hydrocarbon fuels and working pressure of 1896 kPa (gage) at 38 degrees C 275 psig at 100 degrees F. Design shall provide for nonoverloading characteristics throughout entire head capacity curve under operating conditions. Pump motors shall conform

to NEMA MG 1, Design B; NFPA 70, Class I, Division 1, Group D, explosion- and weather-proof, squirrel cage induction type, rated for continuous duty based on 55 degrees C 99 degrees F temperature rise and Class B insulation.

Motors shall have built-in, nonsparking, nonreverse ratchet type mechanism to prevent reversal of pump shaft. Centrifugal pumps shall be base mounted. Turbine pumps shall have antivortex device which permits pump removal without entering the tank.

2.6 ELECTRICAL COMPONENTS

Provide explosion proof motors, controllers, contactors, and disconnects conforming to NFPA 70, Class I, Division 1, Group D, except where NFPA 70, Class I, Division 2, Group D is indicated. Furnish motors, controllers, contactors, and disconnects with respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Division 16, "Electrical."

Controllers and contactors shall have a maximum of 120-volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.

2.7 PIPING SYSTEM COMPONENTS AND ACCESSORIES

Design pressure and temperature ratings shall be working pressure of ASME Class 150, 1896 kPa (gage) at 38 degrees C 275 psig at 100 degrees F.

2.7.1 Pipe Hangers and Supports

MSS SP-58 and MSS SP-69, adjustable type, except as modified herein or indicated otherwise. Provide steel pipe hangers and supports. Finish of rods, nuts, bolts, washers, hangers, and supports shall be hot-dip galvanized. Cast-iron rollers and bases may be painted with two coats of aluminum paint in lieu of hot-dip galvanized.

- a. Pipe Rollers: Provide pipe rollers one pipe size larger than the pipe which the roller supports. Provide stainless steel axles for cast-iron rollers.
- b. Pipe Protection Shields: MSS SP-58 and MSS SP-69, Type 40, except material shall be Type 316 stainless steel. Provide at each roller type and slide type pipe hanger and support.
- c. Low-Friction Supports: Provide self-lubricating antifriction bearing elements composed of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates, prebonded to appropriate backing steel members. Coefficient of static friction between the material shall be 0.06 from initial installation for both vertical and horizontal loads and shall not deform more than 0.05 mm 0.002 inch under allowable static loads. Bond between material and steel shall be heat cured, high temperature epoxy. Design pipe hanger and support elements for the loads applied. Antifriction material shall be a minimum of 2.30 mm 0.09 inch thick. Steel supports shall be hot-dip galvanized. Units shall be factory designed and manufactured.
- d. Miscellaneous Metal: ASTM A 36/A 36M, standard mill finished structural steel shapes, hot-dip galvanized.

- e. Anchors, Bolts, Nuts, Washers, and Screws: Hot-dip galvanized steel, except provide Type 316 stainless steel under piers.

2.7.2 Strainers

ASME Class 150, steel body, with flanged end connections. Provide "S" or "T" pattern [, duplex type]. Strainers shall have removable baskets of 7-mesh, Type 316 stainless steel wire screen unless other mesh is indicated. Pressure drop for clean strainer shall not exceed 21 kPa (gage) 3 psig at design flow rates. Provide strainer with air eliminator.

2.7.3 Gages

Provide single style pressure gage for fuel with 115 mm 4.5 inchdial, brass or aluminum case, bronze tube, stainless steel ball valve, and pressure snubbers. Provide scale range suitable for intended service.

2.7.4 Flexible Ball Joints

Provide chromium plated steel balls capable of 360 degree rotation plus 15 degree angular flex movement, ASME Class 150 with flanged end connections. Provide pressure molded composition gaskets resistant to the effects of aviation hydrocarbon fuels and manufactured of fire resistant materials. Joints shall be designed for working pressure of 1896 kPa (gage) 275 psig.

2.7.5 Bellows Expansion Joints

Provide Type 304 stainless steel corrugated bellows, reinforced with rings, internal sleeves, external protective covers, and ASME Class 150 with flanged end connections. Provide limit stops to limit total movement in both directions. Cold set the joints to compensate for temperature at time of installation. Joints shall withstand 10,000 cycles over a period of 20 years, at a working pressure of 1896 kPa (gage) 275 psig. Provide single or double bellows expansion joint as indicated. Provide first pipe alignment guide no more than four pipe diameters from the expansion joint. Provide second pipe alignment guide no more than 14 pipe diameters from the first guide.

2.7.6 Pipe Sleeves

Provide where piping passes entirely through walls and floors. Provide sleeves of sufficient length to pass through entire thickness of walls and floors. Provide 25 mm one inch minimum clearance between exterior of piping and interior of sleeve or core-drilled hole. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

- a. Sleeves in Masonry and Concrete Walls and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron pipe sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are grouted smooth.
- b. Sleeves in Other Than Masonry and Concrete Walls and Floors: Provide 26-gage galvanized steel sheet.

2.7.7 Escutcheon Plates

Provide split hinge type metal plates for piping entering walls and floors of buildings.

2.7.8 Flexible Pipe Connectors

Stainless steel, single braided, close helical type hose with ASME Class 150 end connections. Connectors shall have sufficient length to absorb 3.20 mm 0.125 inch lateral movement. Hose shall have working pressure of 1896 kPa (gage) at 38 degrees C 275 psig at 100 degrees F.

2.7.9 Temporary Conical Strainers

Provide steel pipe spool piece 300 mm 12 inches long with ASME Class 150 flanges on each end of the spool piece, and of the same diameter as the ASME Class 150 flanges on the connecting piping. Strainers shall be designed to be installed between flanges, with strainer body within the spool piece. Strainer shall be constructed of stainless steel with 6.40 mm 0.25 inch diameter holes, and lined with 60 mesh stainless steel wire screen.

2.8 PROTECTIVE COATINGS FOR BURIED PIPING

Provide protective coatings for buried piping [and for piping under piers].

Provide pipe with factory applied adhesive undercoat and continuously extruded plastic resin coating system; minimum thickness of plastic resin shall be 0.60 mm 23 mils for pipe sizes smaller than 150 mm 6 inches, and 0.90 mm 36 mils for pipe sizes 150 mm 6 inches and larger. Tape shall be elastomeric film backing of polyethylene or plasticized polyvinyl chloride coated on one side with homogenous pressure sensitive waterproof adhesive. Surfaces to receive tape wrapping and existing piping affected by the Contractor's operations shall be clean, dry, grease free, and primed before application of tape. Tape shall overlap pipe coating not less than 76.20 mm 3 inches. Waterproof shrink sleeves may be provided in lieu of tape, and shall be heated by electric heating. Sleeves shall overlap pipe coating not less than 150 mm 6 inches. Extruded coating and adhesive undercoat surfaces to be wrapped with tape shall be primed with a compatible primer prior to application of tape. Primer shall be as recommended by tape manufacturer and approved by extruded coating manufacturer. [Provide extruded coating on piping under piers with finish paint coat as approved by extruded coating manufacturer.]

- a. Damaged Areas of Extruded Coating: Provide 0.50 mm 20 mils nominal thickness tape over damaged areas. Residual material from coating shall be pressed into the break or trimmed off. Tape shall be applied spirally with one-third overlapped as tape is applied. A double wrap of one full width of tape shall be applied at right angles to the axis to seal each end of the spiral wrapping.
- b. Fittings, Couplings, and Regular Surfaces: Provide 0.50 mm 20 mils nominal thickness tape overlapped not less than 25 mm one inch over damaged areas. Initially stretch and apply first layer of tape to conform to component's surface. Apply and press a second layer of tape over first layer of tape.
- c. Flanges, Valves, and Irregular Uncoated Surfaces: Provide cold-applied coal tar mastic painting system to a minimum dry film thickness of 0.80 mm 30 mils.

2.9 CATHODIC PROTECTION

Provide cathodic protection systems for buried metallic piping systems when soil resistivity is less than 30,000 ohm-cm.

2.10 METALS CONTACTING FUEL

Zinc, zinc coated steel, zinc coated cast iron, brass, copper, and copper bearing alloys contacting the fuel shall not be permitted, except under the following conditions:

- a. Brass contacting the fuel shall be permitted up to a maximum of 0.5 percent of the total fuel wetted surface area in each system.
- b. Aluminum casting containing up to a maximum of 10 percent copper contacting the fuel shall be permitted.
- c. Carbon steel containing up to a maximum of one percent copper contacting the fuel shall be permitted in carbon steel piping systems.
- d. Brass hose fittings and couplings will be permitted.

2.11 BONDING

NFPA 70 for materials and workmanship. All parts of the fuel piping system shall be bonded in metallic contact to provide electrical continuity to fixed and moving components for grounding the entire system. Provide jumpers to overcome insulating effects of gaskets, paints, and nonmetallic components. Ground conductor shall be not less than No. 6 size, single covered, flexible, stranded, copper conductor, Type RR-USE.

2.12 BURIED WARNING AND IDENTIFICATION TAPE

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 80 mm 3 inches minimum width, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read CAUTION BURIED FUEL PIPING BELOW OR similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.13 CONCRETE MANHOLES

Provide under this section as specified in Section 03300N CAST-IN-PLACE CONCRETE, except as modified herein. Concrete shall be of 30 MPa 4000 psi minimum 28 day compressive strength, air-entrained admixture (133 grams per cubic meter 3.6 ounces per cubic yard), with water-reducing admixture (814 grams per cubic meter 22 ounces per cubic yard), reinforced with deformed steel bars. Construct manhole sides by one monolithic pour. Cast-iron steps with nonslip surfaces, spaced 300 to 400 mm 12 to 16 inches on centers shall be firmly embedded in concrete walls for access to bottom of manholes. Provide top of manhole as indicated.

2.14 MANHOLE DRAINERS (SUMP PUMPS)

Provide factory assembled and tested submersible pumps for operation under water. Provide pump complete with nonferrous casing and impeller, stainless steel shaft, sealed heavy duty ball bearings, water-cooled hermetically sealed electric motor, built-in automatic reset thermal protection, float switches, high water alarm, and waterproof three-conductor cables with grounding plugs.

2.15 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers, and valves. Nameplates shall be melamine plastic, 3.20 mm 0.125 inch thick, black with white center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 25 by 65 mm one by 2.5 inches. Lettering shall be minimum of 6.40 mm 0.25 inch high normal block style. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass, and locate near each system as directed by Contracting Officer. Furnish two copies of each chart and schedule.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of exterior fuel distribution systems including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.3.

Install piping straight and true to bear evenly on supports and sand bedding material. Install valves with stems horizontal or above. Provide flanges or unions at valves, strainers, connections to equipment, and as indicated.

- a. Fire Protection: Conform to safety and fire regulations of the Station Fire Department when work is in progress. Obtain a "Hot Work" permit each day before performing welding or burning. Piping and the surrounding area shall be inspected for explosive vapors prior to work and frequently during the course of the work. If, in the opinion of the Contracting Officer, a hazardous condition exists, work shall cease until such condition has been corrected.
- b. Safety: NFPA 30; safety rules shall be strictly observed. Flashpoints of fuels in degrees Centigrade Fahrenheit are as follows:

<u>Fuels</u>	<u>Flashpoints</u>
Aviation Gasoline (Avgas)	Minus 45.90
Jet Fuel JP-4	Minus 28.90
Jet Fuel JP-5	Plus 60.90
Jet Fuel JP-7	Plus 65.50

<u>Fuels</u>	<u>Flashpoints</u>
Aviation Gasoline (Avgas)	Minus 50
Jet Fuel JP-4	Minus 20
Jet Fuel JP-5	Plus 140
Jet Fuel JP-7	Plus 150

Fuels

Flashpoints

- c. Cutting Existing Pipe: Perform initial cutting of existing pipe with a multiwheel pipe cutter, using a nonflammable lubricant. After cut is made, seal interior of piping with a gas barrier plug in accordance with API BULL 2209. Interior of piping shall be purged with carbon dioxide or nitrogen during the welding process. Complete method of cutting, sealing, and welding shall be approved in advance of the actual work.
- d. Cleaning of Piping: Keep interior and ends of new piping and existing piping affected by the Contractor's operations thoroughly cleaned of water and foreign matter during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of pipe and fittings to prevent entry of water and foreign matter. Inspect piping before placing into position.
- e. Demolition: Remove materials to avoid damaging remaining materials. Replace existing work damaged by the Contractor's operations with new work of the same construction.

3.2 PIPING

Test, inspect, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for connections. Reducing branch connections in steel piping may be made with forged branch outlet reducing fittings for branches two or more pipe sizes smaller than mains. Branch outlet fittings shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Stub type connections will not be permitted. Jointing compound for pipe threads shall be Teflon pipe thread paste. Pipe nipples 150 mm 6 inches long and shorter shall be Schedule 80 steel pipe. Make changes in piping sizes through tapered reducing pipe fittings.

- a. Fittings and End Connections: For sizes less than 25 mm one inch, provide threaded fittings and end connections. For sizes 25 to 50 mm one to 2 inches provide threaded or socket-welding or butt welding fittings and end connections; provide threaded connections for threaded valves, strainers, and threaded connections to equipment. For sizes 65 mm 2.5 inches and larger, provide butt welding fittings and end connections; provide flanged connections for flanged valves, traps, strainers, and flanged connections to equipment.
- b. Welding: ASME B31.3, metallic arc process, including qualifications of welder.
- c. Pipe Hangers and Supports: Provide additional pipe hangers and supports for concentrated loads in piping between pipe hangers and supports, such as for valves. Provide ASTM A 36/A 36M miscellaneous steel shapes as required. [After installation of piping under piers, provide pipe hangers and supports including rods, bolts, nuts, and washers, with two coats of cold-applied coal tar mastic painting system applied to a minimum total dry film thickness of 0.80 mm 30 mils.] Support piping as follows:

Nominal Pipe Size (mm)	25 and Under	40	50	80	100	150	200	250	300
Maximum Pipe Spacing (Meter)	2.10	2.70	3.00	3.70	4.30	5.20	5.80	6.70	7.00
Nominal Pipe Size (Inches)	1.0 and Under	1.5	2	3	4	6	8	10	12
Maximum Pipe Spacing (Feet)	7	9	10	12	14	17	19	22	23

- d. Buried Piping System: Installation including field joints, bedding, and initial backfill shall be in accordance with ASME B31.3 and NFPA 30.

3.3 FIELD QUALITY CONTROL

3.3.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.3.2 Tests

NOTE: On projects that provide modifications to existing piping systems, pneumatic pressure testing and hydraulic pressure testing of newly installed piping is much more difficult than the same testing on a complete new system. Therefore, by means of the following design techniques, provide for the Contractor a piping modification design that facilitates acceptance testing: piping design which includes flanges at appropriate locations for flanged blanks to be installed for testing; specifications which include requirements for how the modified piping shall be pressure tested; specifications shall specify which pipe sections shall be pressure tested in the shop if absolutely necessary.

- a. Piping Tests: Before final acceptance of the work, test each system as in service to demonstrate compliance with contract requirements. Hydrostatically test each piping system at not less than 2861 kPa (gage) 415 psig in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gage pressure for 4 hours. Flush, clean, and dry piping before placing in operation. Flush piping at a minimum velocity of 2.40 meters per second (m/s) 8 fps. Correct defects in work and repeat tests until the work is in compliance with contract requirements. Furnish potable water, electricity, instruments, connecting devices, and personnel for tests. Remove items from the system that may be damaged by water used for testing.
- b. Protective Coatings of Buried Piping System Tests: Perform test on protective coatings with a silicone rubber electric wire brush

or an electric spring coil flaw tester of an approved type. Tester shall 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 $6274 \sqrt{1000}$ times the square root of the average coating thickness in mm mils. Tester shall be a type so fixed that field adjustment cannot be made. Calibration by tester manufacturer shall be required at 6 month intervals. Maintain the battery at ample charge to produce the crest voltage during tests. Areas where arcing occurs shall be repaired by using material identical to that being used for field joints. After installation, retest exterior surfaces, including field joints, for holidays. Promptly repair holidays.

- c. Cathodic Protection Tests: Perform test to prove continuity of electrical connections prior to backfill.

NOTE: At the text below, write detail acceptance
test for each item of equipment.

- d. Equipment Acceptance Tests: [____].

3.4 FIELD PAINTING

Coat piping and appurtenances in accordance with Section 09971 EXTERIOR COATING SYSTEM FOR WELDED STEEL PETROLEUM STORAGE TANKS.

3.5 CONNECTIONS TO EXISTING SYSTEMS

Notify the Contracting Officer in writing at least 15 days prior to the date the connections are required. Obtain approval before interrupting service. Provide materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required.

-- End of Section --