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Preparing Activity: USACE

Superseding
UFGS-13202 (August 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMLR dated 22 December 2004

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DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13202

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02/05

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SECTION 13202

FUEL STORAGE SYSTEMS 02/05

NOTE: This guide specification covers the requirements of fuel storage and dispensing systems.

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.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO HB-17 (2002) Standard Specifications for Highway
Bridges

AMERICAN PETROLEUM INSTITUTE (API)

API RP 1110 (1997) Pressure Testing of Liquid
Petroleum Pipelines

API RP 1615 (1996; R 2001) Installation of Underground
Petroleum Storage Systems

API Std 1631 (2001) Interior Lining and Periodic
Inspection of Underground Storage Tanks

API/IP Spec 1581 (2002) Specifications and Qualification
Procedures for Aviation Jet Fuel
Filter/Separators

API Spec 5L (2004) Line Pipe

API Spec 6D (2002) Specification for Pipeline Valves

API Spec 6FA (1999) Fire Test for Valves

API Std 1529 (1998) Aviation Fueling Hose

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

API Std 607 (1993; R 1998) Fire Test for Soft-Seated
Quarter-Turn Valves

API Std 610 (2003) Centrifugal Pumps for Petroleum,
Petrochemical, and Natural Gas Industries

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C203 (2002; A C203a-99) Coal-Tar Protective
Coatings and Linings for Steel Water
Pipelines - Enamel and Tape - Hot-Applied

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1M/A5.1 (2003) Carbon Steel Electrodes for
Shielded Metal Arc Welding

AWS A5.10/A5.10M (1999) Bare Aluminum and Aluminum Alloy
Welding Electrodes and Rods

AWS A5.4 (1992; R 2000) Stainless Steel Electrodes
for Shielded Metal Arc Welding

ASME INTERNATIONAL (ASME)

ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
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
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASTM INTERNATIONAL (ASTM)

ASTM A 167	(2004) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 181/A 181M	(2001) Carbon Steel Forgings, for General-Purpose Piping
ASTM A 182/A 182M	(2004a) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
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 216/A 216M	(2004) Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A 234/A 234M	(2004) Piping Fittings of Wrought Carbon

	Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 27/A 27M	(2003) Steel Castings, Carbon, for General Application
ASTM A 276	(2004) Stainless Steel Bars and Shapes
ASTM A 307	(2004) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 312/A 312M	(2004b) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 356/A 356M	(2004) Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines
ASTM A 358/A 358M	(2004) Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service and General Applications
ASTM A 36/A 36M	(2004) Carbon Structural Steel
ASTM A 403/A 403M	(2004) Wrought Austenitic Stainless Steel Piping Fittings
ASTM A 53/A 53M	(2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 733	(2003) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 743/A 743M	(2003) Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM B 241/B 241M	(2002) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B 26/B 26M	(2003) Aluminum-Alloy Sand Castings
ASTM B 345/B 345M	(2002) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube for Gas and Oil Transmission and Distribution Piping Systems
ASTM B 687	(1999) Brass, Copper, and Chromium-Plated Pipe Nipples
ASTM C 33	(2003) Concrete Aggregates
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a) Preformed Sponge Rubber and Cork

Expansion Joint Fillers for Concrete
Paving and Structural Construction

ASTM D 229	(2001) Rigid Sheet and Plate Materials Used for Electrical Insulation
ASTM D 5677	(2000) Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Pipe Fittings, Adhesive Bonded Joint Type, for Aviation Jet Turbine Fuel Lines
ASTM E 94	(2004) Radiographic Examination
ASTM F 1172	(1988; R 2004) Fuel Oil Meters of the Volumetric Positive Displacement Type
ASTM F 1199	(1988; R 2004) Cast (All Temperatures and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)
ASTM F 1200	(1988; R 2004) Fabricated (Welded) Pipe Line Strainers (Above 150 psig and 150 degrees F)
ASTM F 436	(2004) Hardened Steel Washers
ASTM F 436M	(2004) Hardened Steel Washers (Metric)
ASTM G 62	(1987; R 1998e1) Holiday Detection in Pipeline Coatings

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

NACE INTERNATIONAL (NACE)

NACE RP0169	(2002) Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0185	(1996) Extruded, Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe
NACE RP0274	(1998) High Voltage Electrical Inspection of Pipeline Coatings

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30 (2003) Flammable and Combustible Liquids Code

NFPA 30A (2003) Code for Motor Fuel Dispensing Facilities and Repair Garages

NFPA 70 (2005) National Electrical Code

STEEL TANK INSTITUTE (STI)

STI F894 (2002) ACT-100 (R) Specification for External Corrosion Protection of FRP Composite Steel Underground Storage Tanks

STI F911 (1998) Standard for Diked Aboveground Storage Tanks

STI P3 (2002) STI-P3 (R) System for External Corrosion Protection of Underground Storage Tanks

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6 (2000) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-81380 (Rev D) Monitor, Contamination, Aviation Fuel Dispensing System

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

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

UNDERWRITERS LABORATORIES (UL)

UL 1316 (1994; Rev Apr 1996) Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures

UL 142 (2002) Steel Aboveground Tanks for Flammable and Combustible Liquids

UL 1746 (1993; Rev thru Feb 2002) External Corrosion Protection Systems for Steel Underground Storage Tanks

UL 2085 (1997; Rev thru Dec 1999) Protected Aboveground Tanks for Flammable and Combustible Liquids

UL 330 (1996; Rev thru Feb 2000) Hose and Hose Assemblies for Dispensing Flammable Liquids

UL 567 (2003) emergency Breakaway Fittings,

	Swivel Connectors and Pipe-Connection Fittings for Petroleum Products and LP-Gas
UL 58	(1996; Rev thru Jul 1998) Steel Underground Tanks for Flammable and Combustible Liquids
UL 842	(1997; Rev Oct 1999) Valves for Flammable Fluids
UL 87	(2001) Power-Operated Dispensing Devices for Petroleum Products
UL 913	(2002; Rev thru Dec 2003) Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations
UL FCLGED	(2003) Flammable and Combustible Liquids and Gases Equipment Directory

1.2 SYSTEM DESCRIPTION

NOTE: This specification is intended for systems using factory-fabricated horizontal storage tanks with capacities less than or equal to 200,000 L (50,000 gal). Additional equipment/devices necessary to meet state and local regulations will be added by the designer.

Stage I vapor recovery is the process of recovering vapors when a storage tank is filled. Stage I vapor recovery is mandatory on all Army Facilities. Stage II vapor recovery is the process of recovering vapors during vehicle fueling operations. Stage II vapor recovery is optional and will be included if required by state and local clean air regulations.

The work shall include the design, fabrication and installation of the entire fuel storage and dispensing type system in conformance with pertinent federal, state, and local code requirements. The completed installation shall conform to NFPA 30 and NFPA 30A as applicable.

1.3 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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

SD-02 Shop Drawings

Fueling System[; G][; G, [____]].

Detail drawings of the fueling system including a complete list of equipment and materials, as specified.

Monitoring Systems[; G][; G, [____]].

Detail drawings of the monitoring system including a complete list of equipment and materials, as specified.

SD-03 Product Data

Fueling System[; G][; G, [____]].

Manufacturer's standard catalog data, prior to the purchase or installation of the particular component, highlighted to show brand name, model number, size, options, performance charts and curves, etc., in sufficient detail to demonstrate compliance with contract requirements on all parts and equipment.

Permitting.

[Six] [____] copies of all required federal, state, and local permits.

Registration.

Required tank registration forms, 30 days after contract award, in order for the Contracting Officer to submit the forms to the regulatory agency.

Spare Parts Data.

Spare parts data for each different item of equipment specified.

Installation.

Manufacturer's installation instructions and procedures on all parts and equipment.

Framed Instructions.

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

Monitoring Systems.

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

Filter-Separator Factory Tests.

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

Tests.

A letter, at least [10] [_____] working days in advance of each test, advising the Contracting Officer of the test. Individual letters shall be provided for each test specified herein.

Demonstrations[; G][; G, [_____]].

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

Experience.

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

Welding.

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

welders and their identification symbols.

Radiographic Tests for Aviation Fuel Piping[; G][; G, [____]].

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

Verification of Dimensions.

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

Fuel Supply.

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

Exterior Coating for Belowground Steel Piping.

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

SD-06 Test Reports

Filter-Separator Factory Tests[; G][; G, [____]].

[Six] [____] copies of the report in bound letter-size booklets. Report shall certify compliance with the testing and qualification procedures defined in API/IP Spec 1581. The report shall contain complete records of the tests including data sheets, performance curves, chronological test records, photographs, sample calculations, test procedures, and a description of the test apparatus. The report shall include color photographs of the sample elements before and after tests.

Tests[; G][; G, [____]].

[Six] [____] copies of each test containing the information described below in bound letter-size booklets. Individual reports shall be provided for the storage tank tests, the piping tests, the system performance tests, the high level alarm test, and the system leak tests. Drawings shall be folded blue lines, with the title block visible.

- a. The date the tests were performed.
- b. A list of equipment used, with calibration certifications.
- c. A copy of measurements taken.
- d. The parameters to be verified.
- e. The condition specified for the parameter.

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

g. A description of adjustments performed.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals.

[Six] [_____] complete copies of operation manuals in bound letter-size booklets listing step-by-step procedures required for system startup, operation, and shutdown at least two weeks prior to the demonstrations. The manuals shall include the manufacturer's name, model number, service manual, a brief description of each piece of equipment, and the basic operating features of each piece of equipment. The manuals shall include procedures necessary for annual tightness testing of the storage tanks and secondary containment piping.

[Six] [_____] complete copies of maintenance manuals in bound letter-size booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide at least 2 weeks prior to the demonstrations. The manuals shall include piping, equipment layouts, and simplified wiring and control diagrams of the system as installed.

1.4 QUALIFICATIONS

1.4.1 Experience

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

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

1.4.2 Welding

NOTE: Include necessary safety precautions to be taken if welding is to be performed at an existing tank farm/yard area.

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

members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

1.4.3 Radiographic Tests for Aviation Fuel Piping

NOTE: Radiographic piping tests will only be required for aviation fueling systems which make use of stainless steel or aluminum piping as the primary fuel carrier. Delete this paragraph if inapplicable.

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

1.5 REGULATORY REQUIREMENTS

1.5.1 Permitting

Contractor shall obtain necessary permits in conjunction with the installation of belowground storage tanks as required by federal, state, or local authority.

1.5.2 Registration

Contractor shall obtain and complete all required tank registration forms required by federal, state, and local authorities.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

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

1.7.2 Fuel Supply

Fuel required for the flushing, cleaning, and testing of materials, equipment, piping, meters, pumps, instruments, etc., as specified in this section shall be provided by the Contracting Officer. Fuel will be provided by tank trucks. The Contracting Officer will furnish the tank trucks, operators, equipment, and services required for the tank truck operations. The Contractor shall provide the labor, equipment, appliances, and materials required for the flushing, cleaning, and testing operations. Systems shall not be flushed, cleaned, or tested with any fuel or liquid not intended for final system operation. Fuel used in the system shall remain the property of the Government. Fuel shortages not attributable to normal handling losses shall be reimbursed to the Government.

1.7.3 Safety Requirements

Exposed moving parts, parts that produce high operating temperatures and pressures, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

1.7.4 Spare Parts Data

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

1.7.5 Detail Drawings

1.7.5.1 Fueling System

The Contractor shall submit detail drawings containing the following:

- a. Complete piping and wiring drawings and schematic diagrams of the overall system.
- b. Equipment layout and anchorage.
- c. Clearances required for maintenance and operation.
- d. Any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

1.7.5.2 Monitoring Systems

The Contractor shall submit detail drawings containing the following:

- a. An overview drawing which details the leak detection system operation.
- b. An overview drawing which details the liquid level and setpoint monitoring.
- c. Wiring schematics for each part of the fueling system. The schematics shall indicate each operating device along with their normal ranges of operating values (including pressures, temperatures, voltages, currents, speeds, etc.).
- d. Single line diagrams of the system.
- e. Panel layout along with panel mounting and support details.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a

similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations. The completed installation shall conform to the applicable requirements of NFPA 30 or NFPA 30A, as applicable.

2.2 NAMEPLATES

NOTE: In a salt water environment, substitute acceptable non-corroding metal such as but not limited to nickel-copper, 304 stainless steel, or monel. Aluminum is unacceptable. Nomenclature (or system identification) should be established by the designer.

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

2.3 ELECTRICAL WORK

NOTE: Define electrical requirements in the electrical specifications or drawings. In order to prevent conflict, electrical requirements are not be included in this specification. Coordinate the ignition temperature of the fuel to be handled with the electrical design. Ignition temperatures will be as defined in NFPA 497M. Ignition temperatures will dictate the maximum allowable temperature rating for electrical equipment.

Electrical equipment, motors, and wiring shall be in accordance with Section 16402 INTERIOR DISTRIBUTION SYSTEM. Electrical bonding of materials shall be performed in accordance with NFPA 70.

2.4 MATERIALS IN CONTACT WITH FUEL

NOTE: Include the bracketed information if aviation fuel is to be handled.

Galvanized materials (zinc coated) shall not be allowed in direct contact

with any fuel. [No zinc coated metals, brass, bronze, or other copper bearing alloys shall be used in contact with aviation fuel.]

2.5 ABOVEGROUND STORAGE TANK

NOTE: Two types of aboveground horizontal storage tanks are defined herein: skid-mounted tanks and secondarily contained tanks.

A skid-mounted tank is a simple, single wall tank mounted on skids. Tanks of this type that have a capacity above 2640 L (660 gallons) will be provided with either a dike or a spill containment system. The dike or spill containment system should have enough capacity for the entire contents of the tank plus 10 percent. For dike or spill containment design refer to MILITARY HANDBOOK (MIL-HDBK-1022, Petroleum Fuel Facilities). For dike construction, note that a dike offers poor aesthetics and requires extensive amounts of maintenance following rainfall.

The water and water/fuel mix contained in a diked area must be evaluated after each rain and then properly disposed.

Secondarily contained tanks are provided from the manufacturer with some type of secondary containment. Additional dikes and containment systems are not required for these tanks. Three types of secondarily contained tanks are defined herein: open-top, steel vaulted, and concrete vaulted. The cost of the vaulted type reservoirs is significantly higher than the open-top type; however, the vaulted type may be desired because of maintenance concerns following rainfall. The water and water/fuel mix contained in a open-top reservoir must be evaluated after each rain and then properly disposed. An addition feature of the vaulted tanks is the added vandalism protection. In areas where vandalism is probable, vaulted tanks should be used.

Note that waste oil or hazardous wastes should be stored in aboveground storage tanks. Even though EPA allows the storage of these products below ground, a majority of state and local regulations prohibit belowground storage of such products. If a design requires belowground storage of waste oil or hazardous wastes, confirm that the storage is allowed by state and local regulations. The storage of waste oil or hazardous wastes is bound by the same EPA requirements as is the storage of any other petroleum product.

Consider specifying a molded neoprene isolation pad to isolate an aboveground tank from the concrete pad underneath. Steel tank supports specifically are prone to encounter premature rusting due to constant exposure to moisture and their incompatibility with concrete.

2.5.1 Skid-Mounted Tank

Tank shall be constructed of single wall [stainless] steel in accordance with NFPA 30, NFPA 30A, and UL 142. Tank shall be designed and manufactured for horizontal installation. Tank shall be mounted on the tank manufacturer's standard support skid. Skid shall span the entire length of the tank and shall separate the tank from the reinforced concrete slab by a minimum of 200 mm 8 inches. [A molded neoprene isolation pad shall be provided under the skid.]

2.5.2 Secondarily Contained (Open-Top) Tank

Tank system shall include a primary storage tank and an integral open-top secondary containment reservoir. Tank system shall be in accordance with NFPA 30 and NFPA 30A. Tank system shall be designed and manufactured for horizontal installation. Primary storage tank shall be constructed of single wall [stainless] steel in accordance with UL 142. Containment reservoir shall be constructed of single-wall [stainless] steel conforming to STI F911. The volume of the containment reservoir shall be greater than or equal to 110 percent of the primary tank volume. The primary storage tank shall be supported within the containment reservoir with steel tank saddles, or other similar supports, fabricated and attached by the tank manufacturer. [The secondary containment reservoir shall be designed to minimize entry of rain water or blowing debris.] Containment reservoir shall be equipped with a 75 mm 3 inch drain that includes a full line size carbon steel drainage line and a full line size plug valve. Tank system shall be skid mounted and provided with lifting lugs which allow tank relocation. [The tank system shall be provided with the manufacturer's standard ladder and platform assembly, except as modified herein. The assembly shall be constructed of structural steel and shall allow access to the top of the tank system.] [A molded neoprene isolation pad shall be provided under the skid.]

2.5.3 Secondarily Contained (Steel Vaulted) Tank

**NOTE: Include the requirement for a fire inhibitor
if the tank location requires a 2-hour fire rating.**

Tank system shall include a primary storage tank and an integral fully-enclosed secondary containment reservoir. Tank system shall be in accordance with NFPA 30 and NFPA 30A. Tank system shall be designed and manufactured for horizontal installation. Primary storage tank shall be constructed of single wall [stainless] steel in accordance with UL 142. Containment reservoir shall be single-wall steel conforming to UL 142. [The interstitial space between the storage tank and the containment reservoir shall be filled with a 2-hour fire rated inhibitor in accordance with UL 2085. Tank system shall bear the UL 2085 label.] [Containment reservoir shall be provided with an access door to allow visual inspection of the secondary containment.] The volume of the containment reservoir shall be greater than or equal to 110 percent of the primary tank volume. The primary storage tank shall be supported within the containment reservoir with steel tank saddles, or other similar supports, fabricated and attached by the tank manufacturer. Containment reservoir shall be equipped with a 75 mm 3 inch drain that includes a full line size carbon steel drainage line and a full line size plug valve. Tank system shall be

skid mounted and provided with lifting lugs which allow tank system relocation. [Tank system shall include a 19 L 5 gallon overfill containment which contains spillage of fuel during tank filling.] [The tank system shall be provided with the manufacturer's standard ladder and platform assembly, except as modified herein. The assembly shall be constructed of structural steel and shall allow access to the top of the tank system.] [A molded neoprene isolation pad shall be provided under the skid.]

2.5.4 Secondarily Contained (Concrete Vaulted) Tank

Tank system shall be a factory fabricated, concrete encased storage tank with integral secondary containment. Tank system shall be in accordance with NFPA 30 and NFPA 30A. Tank system shall be designed and manufactured for horizontal installation. Primary storage tank shall be constructed of single wall [stainless] steel in accordance with UL 142. The primary tank shall be isolated from the exterior concrete vault with either insulation, an inert material, or minimum 50 mm 2 inch standoffs. Tanks isolated with insulation or an inert material shall then be encased by a minimum of 0.75 mm 30 mil, high density, polyethylene liner. The lined tank shall be encased by a minimum of 150 mm 6 inches of 20.7 MPa 3000 psi strength, monolithically poured, reinforced concrete. Tank system shall have a 2-hour fire rating, and conform to the requirements of UL 2085, and bear the UL 2085 label. No exterior enclosure shall be allowed to cover the reinforced concrete. Tank system shall be skid mounted and provided with lifting lugs which allow tank relocation. [Tank system shall include a 19 L 5 gallon overfill containment to prevent spillage of fuel during tank filling.] [The tank system shall be provided with the manufacturer's standard ladder and platform assembly, except as modified herein. The assembly shall be constructed of structural steel and shall allow access to the top of the tank system.] [A molded neoprene isolation pad shall be provided under the skid.]

2.5.5 Tank Exterior Protective Coating

Tank exterior protective coating shall be [in accordance with Section 09900 PAINTS AND COATINGS] [the manufacturer's standard except as modified herein]. [Concrete vaulted type tanks shall be provided with a white epoxy exterior coating on the top and sides to resist weather and to reflect sunlight.]

2.5.6 Tank Interior Protective Coating

**NOTE: Delete the second set of bracketed sentences
if non-aviation type fuels are to be handled.
Delete the first set of bracketed sentences if
aviation type fuels are to be handled.**

[Tank shall be provided with an interior protective coating in accordance with API Std 1631 from the tank bottom up to 1 m 3 feet off the bottom.]
[Tank shall be provided with an interior protective coating in accordance with Section 09973 INTERIOR COATING OF WELDED STEEL PETROLEUM FUEL TANKS. The entire interior, including tank bottom, tank side walls, interior piping, manway covers, and interior ladders (if provided) shall be coated.]

2.5.7 Tank Manway

NOTE: Indicate on the drawings the number and size of each tank manway required. Tanks of 3,780 to 45,430 L (1000 to 12,000 gallons) capacity will be provided with 760 mm (30 inch) diameter manways. Tanks larger than 45,430 L (12,000 gallons) will be provided with 915 mm (36 inch) diameter manways. Tanks 3,780 L (1,000 gallons) and larger will be provided with a minimum of 1 tank manway to allow for internal tank access. A designer should consider using 2 tank manways (1 manway for access) on tanks larger than 18,900 L (5,000 gallons). Piping will not penetrate through access manways.

Tank manway shall be provided with a manway cover and an interior tank ladder. Tank manway shall have an internal diameter of [760 mm 30 inches] [915 mm 36 inches]. Tank manway shall be provided with a matching flanged watertight manway cover. Manway covers shall be constructed of cast steel in accordance with ASTM A 27/A 27M, grade 60-30 as a minimum. Manhole covers shall be for nontraffic. Pipe connections to a tank through a manway cover shall be [through welded-in-place double tapered NPT couplings] [_____]. Interior tank ladder shall be constructed of either fiberglass or steel. If steel, the ladder shall be completely coated in the same fashion as the interior tank bottom coating. The two stringers shall be a minimum 10 mm 3/8 inch thick and a minimum 50 mm 2 inches wide. The rungs shall be a minimum 19 mm 3/4 inch rod on 300 mm 12 inch centers. Members of the ladder shall be securely affixed. Ladder shall be of sufficient length to extend from the bottom of the tank to the top surface of the tank. Ladder shall be rigidly connected to the tank bottom in accordance with the tank manufacturer's standard. Ladder shall be connected to the top of the tank with pipe guides or slip bars to accommodate expansion of the two stringers.

2.5.8 Tank Piping Penetrations

NOTE: Indicate on the drawings the required number, size, and location of tank piping penetrations. Pipe penetrations will enter through the top of a tank. Drains located at the bottom of a primary storage tank will not be allowed.

The number and size of tank piping penetrations shall be provided as indicated. Nylon dielectric bushings shall be provided on all pipe connections to a tank. Pipe connections to a tank shall be through welded-in-place double tapered NPT couplings. The termination of fill lines within a tank shall be provided with an antisplash deflector. [Tank suction line shall be provided with a footvalve to prevent line drainage.]

2.5.9 Tank Cleanout and Gauge Connection

Tank shall be provided with a combination cleanout and gauge connection. The connection shall consist of a 50 mm 2 inch pipe extending downward through the top of the tank to within 75 mm 3 inches of the tank bottom. The entire length of pipe inside the tank shall be provided with 13 mm 1/2

inch wide by 300 mm 12 inches long slots at alternate locations. The top of the pipe shall be provided with a bronze top-seal type adapter with a corresponding locking type cap. Tank shall have an interior striker/impact plate attached directly under the cleanout and gauge connection. The striker/impact plate shall be a minimum of 6 mm 1/4 inch in thickness, be larger in diameter than the tank penetration, and fit the curvature of the tank bottom.

2.5.10 Tank Atmospheric Venting

**NOTE: Indicate on the drawings that vent piping is
to be located at the high end of the tank.**

Vent pipe shall be in accordance with NFPA 30, NFPA 30A, and UL 142. Vent pipe sizing shall be [as indicated] [not less than 32 mm 1-1/4 inches nominal inside diameter].

2.5.11 Tank Emergency Venting

**NOTE: Two types of emergency venting are specified:
rupture disks and emergency venting manways.
Rupture disk type vents will be used for emergency
venting of aboveground tanks 18,900 L (5,000
gallons) or less instead of emergency venting
manways. See API Bulletin 2000 for vent sizing.**

[Vent shall be the rupture disc type calibrated to burst at 13.8 kPa 2 psig pressure, and operate at 80 percent of burst setting. Vent shall comply with NFPA 30. There is no vacuum relief requirement but the disc may be subjected to 1.3 kPa 3 ounces of vacuum. Discs shall be provided with a flanged end connection. Disc holder shall have a nameplate showing design rating.] [Vent shall be the emergency venting, tank manway type designed to relieve at a 13.8 kPa 2 psig pressure. Vent shall comply with NFPA 30. Each manway shall have a watertight, self-closing type manway cover.]

2.5.12 Tank Overfill Alarm System

**NOTE: Indicate on the drawings the location of the
system alarm panel.**

Tank shall be provided with an overfill alarm system. The system shall include a mechanically-actuated float actuator and an alarm panel. The float actuator shall be field adjustable. The alarm panel shall include an alarm light, an audible alarm, and reset capabilities. The alarm panel shall be mounted adjacent to the tank as indicated. The alarm panel shall initiate a minimum [70] [_____] decibel audible alarm when the liquid level within a tank reaches the 90 percent full level. The alarm system shall conform to the requirements of paragraph MONITORING SYSTEM.

2.5.13 Tank Mounted Fuel Dispensing Unit

NOTE: These units are supplied from the

manufacturer with a tank. The units are mounted directly to the tank system. Delete if inapplicable.

Fuel dispensing unit with integral UL labeled suction pump shall be as supplied by the tank manufacturer. Unit shall include all necessary appurtenances for operation. Unit shall include a visible register to indicate individual deliveries up to 1000 liters 100 gallons with a reset meter. Pump shall have a delivery capacity of 0.95 liters/sec 15 gpm. Hose shall be a minimum 19 mm 3/4 inch inside diameter, 4.6 m 15 feet long, and fuel resistant. The dispensing nozzle shall be of the automatic shutoff type with graduated notches for various delivery speeds. Dispensing unit shall provide a means for locking of the nozzle to the pump when the pump is shutoff. [Diesel fuel dispensing unit cabinet shall be painted yellow from the manufacturer.] [Gasoline dispensing unit shall be painted red from the manufacturer.] Units shall be clearly marked for the fuel they are dispensing.

2.6 BELOWGROUND STORAGE TANK

NOTE: Tanks located in areas subject to high water tables or flooding will be provided with a concrete anchor pad. The pad will be properly sized to prevent the tank, either full or empty, from floating during a rise in water level. The tank will be connected to the pad in accordance with the tank manufacturer's recommendations. Refer to PEI/RP 100 "Recommended Practices for Installation of Underground Liquid Storage Systems" for pad design criteria.

2.6.1 Double-Walled Steel Tank

Tank shall be of double-wall type construction around the entire full exterior surfaces in accordance with UL 58, Type II, NFPA 30, and NFPA 30A.

Tank construction shall be steel. The exterior tank walls shall be separated from the interior tank walls by standoffs; thus creating an open space or interstitial. The entire interstitial space shall be easily monitorable for leaks. Tank shall be designed and manufactured for belowground horizontal installation. Tank shall have the UL label affixed to the exterior surface of the tank. A tank requiring concrete anchor pads shall be provided with hold-down straps and accessories made specifically by the tank manufacturer for the tank. Filler strips a minimum 4 mm 5/32 inch in thickness conforming to ASTM D 1751 or ASTM D 1752 shall be used between the tank shell and the metal straps. Concrete anchor pads shall be constructed as indicated. Tanks constructed with lap shell or head joints shall be continuous fillet welded; both on the interior and exterior surfaces.

2.6.2 Double-Walled Fiberglass Reinforced Plastic (FRP) Tank

Tank shall be the double-wall type the full 360 degree circumference in accordance with UL 1316, NFPA 30, and NFPA 30A. Tank construction shall be FRP. The exterior tank walls shall be separated from the interior tank walls by standoffs; thus creating an open space or interstitial. The entire interstitial space shall be easily monitorable for leaks. Tank shall be designed and manufactured for belowground horizontal installation.

Tank shall have the UL label affixed to the exterior surface of the tank. Tanks requiring concrete anchor pads shall be provided with hold-down straps and corrosion resistant accessories in accordance with the manufacturer's recommendation. Concrete anchor pads shall be constructed as indicated.

2.6.3 Tank Exterior Protective Coating

NOTE: FRP tanks will not require an exterior coating. Delete this paragraph if only FRP tanks are specified.

Steel tanks shall have one of the following corrosion protection systems.

2.6.3.1 Fiberglass Reinforced Plastic (FRP) Coating System

Exterior FRP corrosion protection system for storage tanks shall be in accordance with UL 1746 or STI F894. Each tank shall have the UL label affixed to the exterior surface of the tank. The integrity of the entire coating shall be certified by the manufacturer as meeting the thickness requirement and having no flaws prior to shipment. Steel tanks using an FRP coating system do not require any additional cathodic protection systems.

2.6.3.2 STI P3 System

NOTE: An STI P3 system provides an exterior protective coating, cathodic protection, and electrical isolation for corrosion protection. Electrical designer will verify that standard STI P3 protection is adequate for site.

The corrosion protection system shall be in accordance with the STI P3 system except that the cathodic protection system shall be based on protecting 5 percent of the tank's metal surface. Each tank shall have the STI and UL labels affixed and visible.

2.6.4 Tank Interior Protective Coating

NOTE: FRP tanks will not require an interior coating. Delete this paragraph if only FRP tanks are specified. Delete the second set of bracketed sentences if non-aviation type fuels are to be handled. Delete the first set of bracketed sentences if aviation type fuels are to be handled.

[Steel tanks shall be provided with an interior protective coating in accordance with API Std 1631 from the tank bottom up to 1 m 3 feet off the bottom.] [Steel tanks shall be provided with an interior protective coating in accordance with Section 09973 INTERIOR COATING OF WELDED STEEL PETROLEUM FUEL TANKS. The entire interior, including tank bottom, tank side walls, interior piping, manway covers, and interior ladders (if provided) shall be coated.]

2.6.5 Tank Manway

NOTE: Indicate the number, size, and location of each tank manway required. Tank manways will be used as the primary point of entry for piping penetrations. Pipe penetrations into a tank are the most likely place for a leak to occur. Designing pipe penetrations to enter a tank manway allows each of the penetrations to be contained in a manway containment sump. The sump provides containment for each of the penetrations and allows easy access.

Tanks of 3,780 to 45,430 L (1,000 to 12,000 gallons) capacity will be provided with 760 mm (30 inch) diameter manways. Tanks larger than 45,430 L (12,000 gallons) will be provided with 915 mm (36 inch) diameter manways. Tanks between 3,780 and 18,900 L (1,000 and 5,000 gallons) will be provided with a minimum of 1 tank manway. Tanks larger than 18,900 L (5,000 gallons) will be provided with a minimum of 2 tank manways (1 access manway). Access manways on tanks larger than 5,000 gallons will be installed with any piping

Tank manway shall be provided with a manway cover and an interior tank ladder. Tank manway shall have an internal diameter of [760 mm 30 inches] [915 mm 36 inches]. Tank manway shall be provided with a matching flanged watertight manway cover. Manway covers shall be constructed of cast steel in accordance with ASTM A 27/A 27M, grade 60-30 as a minimum. Manhole covers shall be for nontraffic. Pipe connections to a tank through a manway cover shall be through welded-in-place double tapered NPT couplings. Nylon dielectric bushings shall be provided on all pipe connections to a tank. The termination of fill lines within a tank shall be provided with an antisplash deflector. Tank suction line shall be provided with a [footvalve] [_____] to prevent line drainage.

2.6.6 Internal Tank Ladder

NOTE: Tanks larger than 18,900 L (5,000 gallons) will be provided with an internal tank ladder. Internal ladders may not be appropriate on smaller tanks with only 1 manway. Coordinate the need of an internal ladder with the user. Indicate on the drawings which tank manway is to be provided with an internal ladder.

Interior tank ladder shall be constructed of either fiberglass or steel. If steel, the ladder shall be completely coated in the same fashion as the interior tank bottom coating. The two stringers shall be a minimum 10 mm 3/8 inch thick and a minimum 50 mm 2 inches wide. The rungs shall be a minimum 19 mm 3/4 inch rod on 300 mm 12 inch centers. Members of the ladder shall be securely affixed. Ladder shall be of sufficient length to extend from the bottom of the tank to the top surface of the tank. Ladder shall be rigidly connected to the tank bottom in accordance with the tank manufacturer's standard. Ladder shall be connected to the top of the tank

with pipe guides or slip bars to accommodate expansion of the two stringers.

2.6.7 Manway Containment Sump

Sump shall be provided above each tank manway and shall provide a watertight connection either directly to the exterior of the tank or to the flanged manway opening. Each sump shall extend upward from the tank to just below the street manhole cover and permit access to the interior of a tank without disturbing backfill. Each sump shall be constructed of fiberglass reinforced plastic and be chemically compatible with the type of products being handled within the tank. A sump shall not be connected in any way to the street manway cover or concrete above. Rainfall drainage from the street manhole above shall not drain into the sump. Each sump shall be larger in diameter than the tank manway below. Each sump shall be capable of withstanding underground burial loads to be encountered.

2.6.7.1 Piping Penetrations

The sides of a containment sump shall allow the penetration of carrier pipes, exterior containment pipes, conduits, and vapor pipes as required. Penetrations in the containment sump sides shall be booted or sealed to ensure that liquid will not escape from the sump in the event that the liquid level within the sump rises above the pipe penetration. Boots and seals used shall be compatible with the fuel to be handled. Boots and seals shall be water resistant to the influx of ground water. Boots and seals shall be designed and installed to accommodate the anticipated amount of thermal expansion and contraction in the piping system.

2.6.7.2 Access Cover

NOTE: Require watertight covers if high ground water is a problem and frequent access to the manway below is not necessary. Watertight covers are generally bolted down. Friction fit covers will prevent the influx of rainwater and are easily removable by hand.

Where indicated, the entire top of a containment sump shall be capped with a [friction fit] [watertight] access cover. Cover shall be constructed of the same material as the sump. Cover shall have a larger diameter than the tank manway cover below. Cover shall be easily removable through the street manway above.

2.6.8 Tank Striker/Impact Plates

Tank shall have an interior striker/impact plate attached directly under each tank manway and pipe connection. The striker/impact plate shall be a minimum of 6 mm 1/4 inch in thickness, be larger in diameter than the tank penetration, and fit the curvature of the tank bottom.

2.6.9 Tank Cleanout and Gauge Connection

NOTE: These connections will be shown on the drawings to penetrate a tank through a tank manway if space allows.

Tank shall be provided with a combination cleanout and gauge connection as indicated. The connection shall consist of a 50 mm 2 inch pipe extending downward through the top of the tank to within 75 mm 3 inches of the tank bottom. The entire length of pipe inside the tank shall be provided with 13 mm 1/2 inch wide by 300 mm 12 inches long slots at alternate locations. The top of the pipe shall be provided with a bronze top-seal type adapter with a corresponding locking type cap.

2.6.10 Tank Atmospheric Venting

**NOTE: Indicate on the drawings that vent piping is
to be located at the high end of the tank.**

Vent pipe shall be in accordance with NFPA 30 and UL 142. Vent pipe sizing shall be [as indicated] [not less than 32 mm 1-1/4 inches nominal inside diameter].

2.6.11 Tank Overfill Prevention Valve

**NOTE: These type valves will not be used in
combination with any type of unloading pump
(including truck mounted pumps). Use these valves
only in combination with gravity unloading systems.**

Valve shall be placed within the tank interior and be an integral part of the fill tube. Valve shall be a float actuated shutoff valve. Valve shall be constructed of the same material as the fill tube. Valve shall have 2 stages of shutoff. In the first stage the valve shall restrict the flow of fuel into the tank to approximately 0.3 L/s 5 gpm when the liquid level rises above 95 percent of tank capacity. In the second stage the valve shall completely stop the flow of fuel into the tank when the liquid level rises above 98 percent of tank capacity.

2.6.12 Tank Overfill Alarm System

**NOTE: Indicate on the drawings the location of the
system alarm panel. If a tank overfill prevention
valve is specified, the overfill alarm system is not
required.**

Tank shall be provided with a overfill alarm system. The system shall include a mechanically-actuated float gauge and a alarm panel. The float actuator shall be field adjustable. The alarm panel shall include an alarm light, an audible alarm, and reset capabilities. The alarm panel shall be mounted adjacent to the tank as indicated. The alarm panel shall initiate a minimum [70] [_____] decibel audible alarm when the liquid level within a tank reaches the 90 percent full level. The alarm system shall conform to the requirements of paragraph MONITORING SYSTEMS.

2.7 TANK GAUGES

NOTE: Tank gauges will be provided to meet Federal, state and local requirements for aboveground and belowground tanks. Digital tank gauges may be used as the primary alternative for meeting the regulatory requirements; however, for small fueling systems (i.e. single building's heating supply) where a digital tank gauge and panel are not economical, alternative designs may be presented. For belowground tanks, new tank gauge alternatives must follow the requirements of 40 CFR 280.

The analog tank gauge, the hydrostatic tank gauge system, and the digital tank gauge system are all optional gauges and may be deleted if not wanted or required. Stick gauges and tank calibration charts will be specified for all tanks.

2.7.1 Stick Gauge

Tank shall be provided with 2 stick gauges graduated in m and mm feet, inches, and eighths of an inch. Stick gauge shall be of wood and treated after graduating to prevent swelling or damage from the fuel being stored.

2.7.2 Tank Calibration Charts

Tank shall be furnished with 2 copies of calibrated charts which indicate the liquid contents in L gallons for each 3 mm 1/8 inch of tank depth.

2.7.3 Analog Tank Gauge

Each storage tank shall be provided with an automatic analog reading gauge which is directly mounted to a tank's manway cover. Gauge shall be a level sensing, mechanically actuated device which provides the necessary readout in a sealed glass cap contained in a gauge box. Gauge shall be accurate to plus or minus 6 mm 1/4 inch and be capable of measuring the liquid level over the full range of a tank's height. Gauge shall have vapor tight seals to prevent condensate from fogging the viewing glass.

2.7.4 Hydrostatic Tank Gauge System

System shall be the dial type calibrated in L gallons. Gauge shall be manually actuated using a built-in hand pump. The transmission line from the gauge to the tank shall be seamless copper tubing run in Schedule 80 PVC carrier pipe. The tank assembly (fittings, air bells, and tubing) shall be installed according to the gauge manufacturer's recommendations.

2.7.5 Digital Tank Gauge System

Gauge shall be mechanically or electronically actuated and include a sending unit that transmits a digital signal to a liquid level electronic panel. The electronic panel shall be capable of providing a liquid level readout for each tank in terms of mm and L inches and gallons. Gauge shall be accurate to plus or minus 2 mm 1/16 inch and be capable of measuring a tank's liquid level over a tank's full usable liquid level range. Gauge construction shall be compatible with the fuel to be handled. Gauge shall be capable of measuring water accumulation in mm inches from 20 to 125 mm 3/4 to 5 inches off the bottom of a storage tank. Gauge shall be capable of constantly sensing the fuel level in a storage tank as well as

acknowledging 2 programmable liquid level setpoints. The electronic panel shall activate an audible and visual alarm when each setpoint is monitored. The 2 liquid level setpoints to be monitored shall include a tank's 90 percent liquid level (Setpoint 1) and a tank's 95 percent liquid level (Setpoint 2). The panel shall have a means of delineating between the individual setpoints and the individual tanks.

2.8 ADAPTERS AND COUPLERS

2.8.1 Tight-Fit Fill Adapter

NOTE: Determine the type of fill coupling on the delivery hose to be used, either a top seal or a side seal, in order to determine the type of tight-fit fill adapter needed. The adapter and the coupling must be compatible.

Adapter shall be bronze and be fitted with a Buna-N or Viton gasket. Adapter shall be the API standard [75] [100] mm [3] [4] inch size. Adapter shall be a [top seal] [side seal] adapter and provide a tight-fit connection to prevent vapor emissions during filling. The adapter shall be provided with a locking cap. The cap shall mate with the adapter and have a latching mechanism which provides a water tight seal. The cap shall provide some type of locking provision and be easily attachable and removable. The cap shall be attached to the tight-fit vapor recovery adapter by a 300 mm 12 inch section of brass cable or fuel resistant rope.

2.8.2 Tight-Fit Vapor Recovery Adapter

NOTE: Delete this paragraph if a vapor recovery system is not required.

Adapter shall be bronze and be fitted with a Buna-N or Viton gasket. Adapter shall be the API standard [75] [100] mm [3] [4] inch size. Adapter shall provide a tight-fit connection to prevent vapor emissions during filling. Adapter shall have an internal spring loaded poppet which prevents vapor emissions from the storage tank when the locking cap is removed. The poppet shall open immediately during tank fill. The poppet shall operate at a lower pressure/vacuum than the tank's pressure/vacuum relief vent in order for vapors to return to the delivery truck instead of exiting through the vent piping. The poppet, the poppet stem, and the poppet spring shall be stainless steel. The adapter shall be provided with a locking cap. The cap shall mate with the adapter and have a latching mechanism which provides a water tight seal. The cap shall provide some type of locking provision and be easily attachable and removable. The cap shall be attached to the tight-fit vapor recovery adapter by a 300 mm 12 inch section of brass cable or fuel resistant rope.

2.8.3 Belowground Spill Container for Adapters

Each fuel [and vapor recovery] adapter shall be contained within an individual spill container. Container shall be constructed of fiberglass reinforced plastic and be compatible with the type of fuel being handled. Container shall have a minimum 19 L 5 gallon fuel storage capacity. Container shall form a water-tight seal around the fuel or vapor piping to

prevent spilled fuel from entering the soil. Container shall not be provided with any type of drain. Container shall have an easily removable cover constructed of either cast aluminum or cast iron. Covers shall be weather-resistant and shall prevent the influx of water.

2.8.4 Dry-Break Coupler

Coupler shall be an API standard and provide a tight-fit connection to prevent vapor emissions during fuel transfer. Coupler shall be compatible with the fuel product being handled and be a female connection. Seals within the coupler shall be Buna-N or Viton. Coupler shall have an internal manually operated shutoff valve. The valve shall have an external operating handle with the valve's position (open or close) clearly labeled.

The internal valve shall not be capable of being manually opened unless the coupler is properly connected to a tank truck's tight-fit adapter.

2.9 VEHICLE DISPENSING UNIT

**NOTE: Dispenser suction pumps will only be used in
conjunction with belowground storage tanks.**

Unit shall be a power-operated dispensing device and shall be in accordance with UL 87, except as modified herein. Unit shall be factory fabricated and include but not limited to a base, housing, pedestal, pressure-relief device, strainer, air eliminator, meter, valves as required, hose-nozzle valve, motor control, locking mechanism, emergency shutoff valve, filter, and electrical wiring. Unit shall [contain an integral dispenser suction pump] [be supplied with fuel by the corresponding tank pump or pumps]. Each unit shall include but not be limited to an accounting meter, product hoses and nozzles, and necessary electrical controls.

2.9.1 Accounting Meter and Display

Meter shall be a positive displacement type in accordance with UL 87, except as modified herein. Meter output displays shall be [a mechanical] [an electronic] [lighted] [unlighted] display, visual from [only one side] [both sides] of the dispenser. Displays shall indicate the cost per liter gallon of fuel, the cost of fuel delivered, the amount of fuel delivered, and the total amount of fuel delivered over the life of the unit. The manual adjustment for the cost per liter gallon display shall be located in a lockable housing.

2.9.2 Product Hose

Hose shall conform to UL 330. Each hose shall be [3] [3.5] m [10] [12] feet long, shall be resistant to the fuels to be handled, have static grounding, and remain flexible in temperatures as low as minus 40 degrees C F. A breakaway coupling, leakproof and corrosion resistant, shall be installed into each product hose. Couplings shall automatically pull apart and shut off flow to prevent product spill and damage to the hose or dispenser in the event of a "drive-away".

2.9.3 Nozzles

Nozzles shall be manually activated to start the fuel flow and have a latch-open device integral to the assembly. Nozzles shall be the automatic shutoff type. Nozzles shall be constructed of lightweight aluminum and be

provided with a full hand insulator. The flow rate of any nozzle shall not exceed 0.6 L/s 10 gpm. Nozzles which exceed the maximum allowable flow rate shall be provided with a flow limiter. [Nozzles shall have an integral vapor valve and coaxial hose connections to allow Stage II vapor recovery. Stage II vapor recovery nozzles shall be California Air Resources Board (CARB) certified and installed in conformance with the CARB requirements.]

2.9.4 Electrical Controls

NOTE: Delete the last sentence if dispenser suction pumps are not used.

The installation of electrical equipment at the dispensers, motors, and pump starter controllers shall be in compliance with Class 1, Group D hazardous location. Each dispenser outlet shall be provided with an operating lever for starting the pump through a pump starter controller. The pump starter controller shall be mounted adjacent to the power panel box. The power panel box shall be equipped with an external emergency pushbutton to shut off the power to all pump starter motor controllers and dispensers. The power panel box shall be located not more than 30 m 100 feet from the dispensers. [A weatherproof power panel box, pump starter controllers, and emergency push-button shutoff control shall be provided.]

2.9.5 Emergency Shutoff Valve

Valve shall meet the requirements of UL 842 and be compatible with the intended fuels to be handled. Valve shall provide complete shutoff of a fuel line in the event a dispenser is dislocated or overturned due to a sudden impact. Valve shall provide a secondary poppet to limit spillage from the dispenser after a knockdown or during installation.

2.9.6 Dispenser Sump

Sump shall be installed under each dispensing unit. Each sump shall provide convenient service access to all piping components enclosed in the sump. Sump shall be constructed of fiberglass-reinforced plastic. Sump shall be chemically compatible with the fuel to be handled by the dispensing unit and any connecting piping. Sump shall prevent fuel from escaping to the soil and ground water from entering the sump. Sump shall provide a liquid-tight termination point for secondary containment piping which allows for the anticipated expansion and contraction of the piping system. Sump shall withstand maximum burial loads. Sump shall mount directly to the bottom of the dispensing unit with a centering ring or stabilizer bar to assure proper shearing action for the emergency shutoff valve.

2.10 PUMPS

NOTE: Appendix A of API Std 610 allows lesser tolerances for pumps. These type pumps are well suited for small applications at a substantial cost savings. The type of pumps specified should be evaluated by the designer. Require stainless steel or aluminum pump construction only if aviation fuel is the product to be handled. Indicate the control

sequences for pumps on the drawings.

Pump shall conform to API Std 610, [Appendix A,] except as modified herein. Mechanical seals within the pump shall be Buna-N or Viton. Pump casing, bearing housing, and impellor shall be [close grained cast iron] [stainless steel ASTM A 743/A 743M GR CF8M or GR CA6NM or aluminum ASTM A 356/A 356M GR T6]. Pump shaft shall be stainless steel ASTM A 276 Type 410 or 416. Pump baseplate shall be of cast iron construction. Internal pump components in direct contact with the fuel to be handled shall be of compatible construction. Pump assembly shall be statically and dynamically balanced for all flow rates from no flow to 120 percent of design flow. Pump bearings shall be selected to give a minimum L-10 rating life of 25,000 hours in continuous operation. Pump shall be driven by an explosion-proof motor for Class I, Division 1, Group D hazardous locations as defined in NFPA 70. Pump shall be accessible for servicing without disturbing connecting piping. Pump control panel shall include on and off indication lights for each pump. The panel shall contain an adjustable control logic for pump operation in accordance with the indicated operation. The panel shall also have a manual override switch for each pump to allow for the activation or deactivation of each pump. Panel, except as modified herein, shall be in accordance with Section 16402 INTERIOR DISTRIBUTION SYSTEM.

2.10.1 In-Line Centrifugal Pump

Pump shall be the in-line, split-case, double suction, single stage, self-priming, centrifugal type. Pump motor shall be mounted horizontal to the pump housing and be provided with flanged end connections.

2.10.2 Submersible Pump

NOTE: Delete this paragraph if dispenser suction pumps are used in place of submersible pumps. Submersible pumps may be used for both above and belowground tanks. Check manufacturer's data since these type pumps may only be capable of handling gasoline or diesel fuels.

Pump shall be a [single-] [multi-] stage vertical pump and extend inside the tank to within 150 mm 6 inches of the striker/impact plate. Pump and motor combination shall operate totally submerged in the product of the storage tank. Pump fuel inlets shall be horizontal. Pump, motor, and column pipe assemble shall mount through a NPT pipe penetration in a tank's manway cover. Pump mounting shall completely support both the weight and vibration of the pump. The unit shall be provided with a steel lifting lug capable of supporting the weight of the entire pump and motor assembly. Pump shall include a vertical solid shaft motor, base mounting flange, horizontal pump discharge, low net positive suction head (NPSH) first stage impellers, dynamic and thrust balancing of impellers, and a stainless steel one piece pump shaft. Pump shall be provided with [threaded] [flanged] end piping connections.

2.11 SUPPLEMENTAL COMPONENTS

2.11.1 Earthwork

NOTE: For belowground tank installations, the designer developing the earthwork specifications will evaluate the need for a filter fabric to be installed between the native soil and the new backfill material. The intent of a filter fabric would be to prevent the displacement of new backfill material with native soil due to a high water table.

If the new backfill material is displaced, it could affect the structural integrity of the tank specifically if the new tank(s) is the FRP type. If a filter fabric is determined to be necessary, include the requirements for the new fabric in the excavation and backfilling specifications.

Excavation and backfilling for [tanks and] [piping] shall be as specified in Section 02300 EARTHWORK, except as modified herein. Backfill for FRP tanks and pipe shall be pea gravel or crushed stone. Backfill for steel tanks and pipe, aluminum pipe, and stainless steel pipe shall be pea gravel, crushed stone, or sand.

2.11.1.1 Pea Gravel

Pea gravel shall be between 3 and 20 mm 1/8 and 3/4 inch diameter.

2.11.1.2 Crushed Stone

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

2.11.1.3 Sand

Sand shall be fine sand aggregate in accordance with ASTM C 33, washed and thoroughly dried, contain no more than 500 PPM chlorides, contain no more than 500 PPM sulfates, and have a pH greater than 7.

2.11.2 Street Manway Assembly

NOTE: Style A frames are for manways up to 760 mm (30 inches) in diameter. Style B frames are for manways between 915 and 1070 mm (36 and 42 inches) in diameter.

Round street manhole frames and covers shall be the straight traffic type. Frames and covers shall be constructed of [cast iron in accordance with ASTM A 27/A 27M, grade 60-30 as a minimum] [aluminum in accordance with ASTM B 26/B 26M, with the cover being a minimum of 8 mm 5/16 inch thick]. Covers shall be the solid plate type with a checker pattern. Covers shall form a watertight seal with the manhole frame to prevent surface water inflow. Frame and cover assembly shall be rated to withstand H-20 highway loading as defined by AASHTO HB-17.

2.11.3 Inspection Well

NOTE: Delete this paragraph if belowground storage tanks are not included in the project. Each site should have a maximum of 2 inspection wells located at opposing corners of the storage tank site. Sites with one storage tank should only require one inspection well. Inspection wells will not be used as monitoring wells. Inspection wells can serve as an inexpensive means of providing secondary verification of a leak as well as serving as a pump-out well for contaminated sites.

Each well shall be constructed of Schedule 40 PVC pipe and shall be 150 mm 6 inches in diameter. Well shall be factory slotted from the bottom to within 300 mm 12 inches of grade. With the pipe installed vertically, slots shall be horizontal and have a width of 0.5 mm 0.02 inches with not less than 30 slots per 300 mm foot. Slots shall encompass at least 80 percent of the pipe's 360 degree perimeter with the pipe maintaining its structural integrity. Slots shall allow fluid within the soil to infiltrate into the pipe without allowing sediment to fill the pipe. Each well shall extend down 600 mm 2 feet below the deepest buried storage tank. Well shall have a permanently fixed bottom cap. Well shall have a removable top cap that is protected from traffic with a watertight street manway and cover as indicated. Well shall have a 10 mm 3/8 inch vent hole located directly below the top cap to vent the well. The top cap of each well shall be accessible from the surface through a 300 mm 12 inch diameter manhole. The manhole shall be constructed of steel or fiberglass, have a cast iron cover, be a minimum of 300 mm 12 inches deep, and be capable of withstanding H-20 highway loading as defined by AASHTO HB-17. Each manhole cover shall have the words "DO NOT FILL - INSPECTION WELL" cast permanently into the top. The letters shall be a minimum of 13 mm 1/2 inch in size.

2.11.4 Piping Containment Sump

NOTE: Sumps will be used as a collection point for potential piping leaks. All product piping will be sloped to either manway containment sumps, dispenser sumps, or piping containment sumps. Use piping containment sumps for product piping at all low points and all aboveground to belowground transitions. Sumps will be used in combination with leak sensors to makeup the belowground pipe monitoring system. Indicate on the drawings the size, location, and depth required for each piping containment sump.

Sump shall be constructed of fiberglass reinforced plastic and be chemically compatible with the fuels to be handled. Sump shall not be connected in any way to the street manway cover or concrete above. The top of a containment sump shall be capped with a [friction fit] [watertight] access cover. Cover shall be constructed of the same material as the sump. Cover shall have a minimum diameter of 550 mm 22 inches. Cover shall be easily removable through the street manway above. Rainfall drainage from the street manhole above shall not drain into a sump. Sump shall be

capable of withstanding underground burial loads to be encountered. The sides of a containment sump shall allow the penetration of carrier pipes, exterior containment pipes, conduits, and vapor pipes as required. Penetrations in the containment sump sides shall be booted or sealed to ensure that liquid will not escape from the sump in the event that the liquid level within the sump rises above the pipe penetration. Boots and seals used shall be compatible with the fuel to be handled. Boots and seals shall be water resistant to the influx of ground water. Boots and seals shall be designed and installed to accommodate the anticipated amount of thermal expansion and contraction in the piping system.

2.11.5 Cathodic Protection

Buried metallic components including pipe, anchors, conduit, etc., shall be provided with a cathodic protection system in accordance with [Section 13110A CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [and] [Section 13112A CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)]. Cathodic protection for metal components that attach to a tank shall be coordinated and compatible with the tank corrosion control system.

2.11.6 Fuel Oil Meter

NOTE: Fuel oil meters are mandatory for all Air Force fuel oil projects. For each meter indicate the maximum flow rate to be metered as well as the allowable pressure drop at the maximum flow rate.

Meter shall be the volumetric positive displacement type in accordance with ASTM F 1172, except as modified herein. Meter shall indicate the fuel oil flow rate in L/s gpm. Meter shall be provided with overspeed protection and a water escape hole. If meter is not mounted in-line with the piping, then the Contractor shall provide an appropriate pedestal for mounting. Meter installation shall be in accordance with manufacturer's recommendations. Meter shall be capable of providing a 4-20 mA analog output signal for the fuel flow rate. [The output signals shall be compatible with the base's existing Energy Monitoring and Control, System (EMCS).]

2.11.7 Electrically Isolating Flanges

NOTE: Indicate the locations of each electrically isolating connection.

Flanges shall be provided with an electrical insulating material of 1000 ohms minimum resistance conforming to ASTM D 229. The material shall be resistant to the effects of the type of fuel to be handled. Gaskets shall be full face and be provided between flanges. Flanges shall have full surface 0.75 mm 0.03 inch thick, spiral-wound mylar insulating sleeves between the bolts and the holes in the flanges. Bolts may have reduced shanks of a diameter not less than the diameter at the root of the threads. High-strength 3 mm 1/8 inch thick phenolic insulating washers shall be provided next to the flanges with flat circular stainless steel washers over the insulating washers. Bolts shall be long enough to compensate for the insulating gaskets and stainless steel washers.

2.11.8 Electrically Isolating Union

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

Union shall be provided with an electrical insulating material of 1000 ohms minimum resistance conforming to ASTM D 229. The material shall be resistant to the effects of the type of fuel to be handled.

2.11.9 Concrete Anchor Bolts

Concrete anchor bolts shall be group II, Type A, class 2 in accordance with ASTM A 307.

2.11.10 Bolts

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

2.11.11 Nuts

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

2.11.12 Washers

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

2.11.13 Exterior Coating of Miscellaneous Items

Steel surfaces to be externally coated or painted shall be cleaned to a commercial grade blast cleaning finish in accordance with SSPC SP 6 prior to the application of the coating. Exterior surfaces, other than stainless steel pipe and flexible connectors, which are not otherwise painted and do not require the application of an exterior coating, as well as all items supplied without factory-applied finish paint, not including primer only items, shall be painted as specified in Section 09900 PAINTS AND COATINGS.

2.11.14 Buried Utility Tape

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

2.12 BULK FUELING

2.12.1 Truck Loading Arm Assemblies

Truck loading arm assemblies shall be standard commercial units. Each arm shall be the bottom loading type. Adjacent arms shall have crossover capability. The materials of construction of each arm shall be suitable for the fuel to be handled and be compatible with connecting piping. Seals and gaskets in the assembly shall be Buna-N or Viton. The assembly shall

be either counterweighted or spring balanced to allow easy handling of the assembly during operation. Each arm shall be provided with necessary swivel joints, boom assemblies, riser standpipe, dry-break coupler, and fueling hoses. Swivel joints shall be flanged and be capable of rotating 360 degrees. Welded swivel joints and welding of swivel joints to the pipe will not be permitted. Swivel joints shall be of the non-lubricated type with non-lubricated bearings.

2.12.2 Fueling Hose

Hose shall be in accordance with API Std 1529, Grade 3, Type A or C, semi-hardwall. Hose shall be compatible with the specified fuel and withstand a working pressure of 2070 kPa 300 psig. Hose shall be constructed of braided synthetic cord surrounded by an interior rubber tube and an exterior rubber cover. Each fueling hose shall be provided with a stainless steel hose tray. The hose tray shall provide support for the entire length of the fueling hose, allow for draining of rainwater, support the fueling hose at the height indicated, protect the hose from the sun's ultraviolet rays, and allow for easy insertion and removal of the fueling hose

2.12.3 Fuel Meter For Truck Fill Stand

NOTE: For each meter indicate the maximum flow rate to be metered as well as the allowable pressure drop at the maximum flow rate. Fuel meters will be provided at each truck fill stand to meet the requirements of Military Handbook (MIL-HDBK-1022 Petroleum Fueling Facilities).

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

seven-figure nonsetback totalizer and a five-figure setback flow indicator without the mL tenth-of-gallon indicator. Digits on a meter register shall be a minimum 19 mm 3/4 inch in height. Meter error shall not exceed 0.1 percent for any one predetermined flow rate and accuracy setting. The maximum meter error shall not exceed 0.3 percent for any one given accuracy adjustment at any flow rate ranging from 2 to 38 L/s 30 to 600 gpm.

2.12.4 Fuel Quality Monitor

**NOTE: Fuel quality monitors are only for systems
which handle aviation fuels. Delete this paragraph
if inapplicable.**

Monitor shall be in accordance with MIL-PRF-81380, except as modified herein. Monitor shall have Type 304 or 316 stainless steel or Types 3003 or 6061-T6 aluminum alloys fabricated housing with flanged inlet and outlet, 2 gauge taps, an air release tap complete with automatic air eliminator, and a 19 mm 3/4 inch drain valve. Fuel quality monitor elements shall also conform to MIL-PRF-81380 for test procedures and performance requirements, except elements shall be of the slow-closing, water-absorbing type. Piston type direct-reading pressure differential gauge shall be provided wherein the piston moves downward in a glass cylinder along a 0 to 210 kPa 0 to 30 psi graduated scale; permanent set of the spring shall be clearly visible by the position of the piston when there is no differential pressure. One complete set of elements for each unit shall be provided along with a calibrated tag showing differential pressure versus fuel flow for clean and dirty elements. One complete spare set of elements for each unit shall be provided.

2.12.5 Filter-Separator Unit

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

2.12.5.1 Housing Vessel

Unit shall be fabricated from carbon steel or aluminium and be internally coated in accordance with Section 09973 INTERIOR COATING OF WELDED STEEL PETROLEUM FUEL TANKS. Unit shall be constructed and labeled in accordance with ASME BPVC SEC VIII D1. The housing shall be designed for a working pressure of 1030 kPa 150 psig. Unit shall be horizontal, end-opening type with coalescers and separators mounted side-by-side (coalescers at the bottom of the vessel and separators at the top). The head opening shall be equipped with a hinged or pivoting device to facilitate swinging the head to one side for servicing. The hinges or pivots shall support the head during servicing without distortion or misalignment. Swing-type bolts shall be used on main closures. Unit shall be provided with 75 mm 3 inch inside diameter lifting eyes spaced to support the entire weight of the unit. The housing shall be provided with a 19 mm 3/4 inch inlet compartment fuel drain plug. A hand hole access plate shall be provided in the inlet compartment. Gaskets and O-ring shall be Buna-N or Viton construction. Threaded base mounting adapters shall be provided for the coalescers. The separators shall be mounted on adapters with blunted "Vee" type knife edges.

2.12.5.2 Legs

Unit shall be provided with 4 each 75 x 75 x 6 mm 3 x 3 x 1/4 inch angle-shaped legs welded to the housing. Each leg shall be fitted with a 100 x 100 x 13 mm 4 x 4 x 1/2 inch base plate.

2.12.5.3 Inlet and Outlet Connections

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

2.12.5.4 Manual Drain Valve

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

2.12.5.5 Sight Gauge

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

2.12.5.6 Automatic Air Eliminator and Pressure Relief Valve

Unit shall be provided with an angle pattern pressure relief valve on top of the unit to assure the design working pressure of the unit is never exceeded. An automatic air eliminator shall be installed on top of the unit to vent trapped air from within the vessel. The air eliminator shall release at pressures up to 1030 kPa 150 psi with no fuel leakage. The air eliminator shall be provided with a nonreturn check valve feature, opening pressure of 7 kPa 1 pound, to prevent air from being drawn into the unit via the air eliminator.

2.12.5.7 Sampling Connections

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

2.12.5.8 Spider Assembly

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

2.12.5.9 Coalescer and Separator Cartridges

Unit shall be provided with coalescers and separators that have been qualified to the performance requirements of API/IP Spec 1581, Group II, Class B. Separators shall be 200 mesh stainless steel and be coated on both sides with teflon. Coalescers shall have a minimum capacity of 5.7

mL/s per mm 2.27 gpm per inch of length, and separators shall have a minimum capacity of 21.0 mL/s per mm 8.33 gpm per inch of length.

2.12.5.10 Differential Pressure Gauge

The unit housing shall be equipped with a direct-reading, piston type differential pressure gauge that measures the differential pressure across both coalescers and separators. The gauge shall consist of a spring-supported, corrosion resistant piston moving inside a glass cylinder. The cylinder shall have stainless steel end flanges with Viton O-ring seals. The high pressure inlet of the gauge shall have a 0.01 mm 10 micron pleated paper filter and the low pressure connection shall have a fine mesh stainless steel strainer. The gauge shall have an operating pressure of 2070 kPa 300 psi with a cylinder burst pressure of not less than 8270 kPa 1200 psi. Differential pressure range of the gauge through approximately 75 mm 3 inches of piston movement shall be 0-210 kPa 0-30 psi with an accuracy of plus or minus 3.5 kPa 0.5 psi, calibrated linearly with 7 kPa 1 psi scale graduations. High and low pressure connections shall be 6 mm 1/4 inch NPT female with a stainless steel bar stock valve at each connection. Construction of the gauge shall be such that a 3-valve manifold is not necessary. If only 1 bar stock valve is closed, the gauge shall not be damaged by up to 2070 kPa 300 psi differential pressure in either direction. The differential pressure gauge shall be attached to the filter separator by a gauge panel.

2.12.5.11 Filter-Separator Factory Tests

Factory tests shall be performed on a filter separator to demonstrate compliance with the testing and qualification procedures defined in API/IP Spec 1581 for Group II, Class B filter separators. The tests shall be performed in the presence of a Government representative if deemed necessary by the Contracting Officer. The tests shall be on a full-scale test system in accordance API/IP Spec 1581, except as modified herein. The test sample shall consist of a complete filter separator with coalescer and separator elements installed. Elements shall be representative of a production lot. The filter separator, coalescers, and separator screens shall be identified with the manufacturer's part number. Prior to performing Test Series 1, 2, and 3, the filter separator shall be subjected to a hydrostatic pressure of 1900 kPa 275 psig per the requirements of ASME BPVC SEC VIII D1. The average free water content in a test set shall not exceed 10 parts per million and any single sample shall not exceed 15 parts per million.

2.12.6 System Control Valves

Valves shall be single-seated, diaphragm actuated, pilot-controlled globe valves. Each shutoff valve shall be provided with a position indicator, a pilot circuit strainer, and pressure gauge quick-disconnect fittings located in the valve inlet, outlet, and cover. Service and adjustments to a valve shall be possible without removing the valve from the line. Portions of a valve coming in contact with fuel shall be compatible with the fuel and be of noncorrosive material. Valves shall have bodies, bonnets, and covers constructed of [stainless steel conforming to ASTM A 743/A 743M, type 304 or type 316; or aluminum alloy conforming to ASTM B 26/B 26M, types 3003, 6061-T6, or 356-T6] [cast steel conforming to ASTM A 216/A 216M, Grade WCB]. Each valve shall have stainless steel stem and trim. Valves shall be suitable for a working pressure of 1900 kPa 275 psig at 38 degrees C 100 degrees F with a weatherproof housing. Valves shall be provided with flanged end connections unless otherwise indicated. Seats,

body seals, and stem seals shall be Viton or Buna-N.

2.12.6.1 Truck Fill Stand Shutoff Valve

**NOTE: Indicate the fuel flow and corresponding
downstream pressures to be maintained at the valve.
Coordinate this paragraph with paragraph Control
Stations.**

Valve shall be for [single-] [two-] stage fuel flow. Valve shall hydraulically maintain the downstream pressure to the valve indicated during flowing conditions. Valve shall be in complete coordination with the corresponding control station (i.e. deadman controls [, grounding unit] [, and truck overfill unit]). Control of the shutoff valve shall be as defined under paragraph Control Station. Valve shall fail closed in the event of a failure of the valve's diaphragm or a malfunction with any of the control station equipment. Solenoids mounted on the valve shall be rated for Class I, Division I, Group D hazardous locations. The solenoid shall accommodate the specific control conditions of the system in which the valve is to be installed. Functions of the valve shall be externally adjustable.

2.12.6.2 Pressure Control Valve

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

Valve shall be capable of maintaining the downstream flow rate at the indicated pressure. Valve setpoint shall be adjustable within a minimum range of plus or minus 20 percent of the indicated setpoint. Functions shall be externally adjustable. Valve shall be provided with a stainless steel orifice plate integrally mounted at the inlet port of the valve. Stainless steel control piping shall be provided to allow sensing differential pressure across the orifice plate. Valve shall be provided with opening speed controllers which are adjustable from 2 to 30 seconds without affecting the closing of the valve. Speed controllers shall be field adjustable and factory set for 15 seconds.

2.12.6.3 Float-Operated Control Valve

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

2.12.6.4 Relief Valve

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

indicator which has flanged end connections. The sight flow indicator shall consist of a housing containing a rotating propeller that is visible through a glass observation port.

2.12.6.5 Filter Separator Control Valve and Float Assembly

Valve shall be float-operated and normally opened. Valve shall be capable of maintaining the downstream flow rate at the indicated pressure. Functions shall be externally adjustable. Valve shall be provided with a stainless steel orifice plate integrally mounted at the inlet port of the valve. Stainless steel control piping shall be provided to allow sensing differential pressure across the orifice plate. Valve shall be provided with a float-operated pilot control assembly. The float and float assembly shall be stainless steel. The movement span of the float shall be field adjustable. The assembly shall be fitted into the filter separator housing sump. The float assembly shall control both the filter separator control valve and the automatic water drain valve. Float shall ride on the fuel-water interface inside the filter separator sump and have 3 stages of operation. The stages of operation include:

- (a) Stage I: With the float down, the filter separator control valve shall be open and the automatic water drain valve closed.
- (b) Stage II: With the float at the intermediate level, the filter separator control valve shall remain open while the automatic water drain valve opens.
- (c) Stage III: With the float at a high level, the filter separator control valve shall close while the automatic water drain valve remains open.

2.12.6.6 Filter Separator Automatic Water Drain Valve

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

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

2.12.7 Control Stations

NOTE: Indicate the location and approximate configuration of each station. Mount all the control equipment on a single equipment rack next to the corresponding load/unload station.

Each tank truck and tank car unloading station shall be provided with a pump control start/stop station, an emergency "stop" pushbutton station, and a grounding unit. Each truck fill stand shall be provided with a pump control start/stop station, an emergency "stop" pushbutton station, a grounding unit, deadman control, and a truck overfill unit. Electrical

supply and electrical control equipment shall be suitable for Class I, Division 1, Group D locations, be intrinsically safe, be weather resistant and be in accordance with UL 913, NEMA 250, and NFPA 70. Mounting hardware shall be corrosion resistant.

2.12.7.1 Pump Control Start/Stop Station

Station shall include a start pushbutton, a stop pushbutton, and red and green indicating lights. The sequence of operation for the station shall be as indicated on the drawings. During activation, the start pushbutton shall maintain contact until deactivated by the stop pushbutton. The stop pushbutton shall maintain contact until deactivated by the start pushbutton.

2.12.7.2 Emergency "Stop" Pushbutton Station

Activation of the emergency pushbutton station shall shutdown power to the entire fueling system and send an alarm signal to the fire department as indicated. Station housing shall contain an emergency pushbutton. Pushbutton shall be a single unit with a bright red jumbo mushroom operator with 1-NC and 1-NO contact. During activation, the pushbutton shall maintain contact until deactivated by a key release. A caution sign shall be mounted beside the emergency shutdown station, with red 50 mm 2 inch letters stating "EMERGENCY SHUTDOWN". The sign shall have a white background and be of noncorrosive construction.

2.12.7.3 Grounding Unit

NOTE: Delete the second set of brackets if the tank trucks to be loaded/unloaded have a plug-in connection for such a system. Indicate on the drawings the type of connection required. Delete the first set of brackets if a grounding cable and clamp connection will be sufficient.

[Unit shall provide continual verification that the frame of the tank truck is grounded (electrically bonded). At truck fill stands, the unit shall immediately close the corresponding truck fill stand shutoff valve if the ground is broken or if the monitoring circuitry fails. Unit shall include red and green status lamps and lockable bypass switch. The type of tank truck connection required shall be as indicated. Unit shall be provided a self winding reel and 9 m 30 feet of cable.] [The grounding reel station shall be in accordance with CID A-A-50696, Type II.]

2.12.7.4 Deadman Control

Deadman controls shall include a deadman handle and necessary hose or control wiring. Handle shall be constructed of aluminum with a smoothly polished finish. Handle shall contain a manually activated ON/OFF trigger. Each deadman control shall be provided with a self winding reel and 9 m 30 feet of fuel sensing hose or retractable cable. Fuel sensing hose shall be dual type with Buna-N or Viton tube, vertically braided textile body with fuel resistant neoprene cover with stainless steel fittings. Fuel flow through a truck fill stand shall not be capable unless the deadman handle is depressed.

2.12.7.5 Truck Overfill Unit

NOTE: Delete this paragraph if the tank trucks to be loaded do not have a plug-in connection for such a system. Indicate on the drawings the type of connection required and the overfill conditions.

Unit shall provide for truck overfill protection by continuously and automatically monitoring the liquid-level within the tank of a tank truck. Unit shall be the self-checking type. Unit shall immediately close the corresponding truck fill stand shutoff valve if an overfill (high liquid-level) condition exists. Overfill conditions shall be as indicated. Unit shall be provided with red and green indicator lamps. The type of tank truck connection required shall be as indicated. Unit shall be provided a self winding reel and 9 m 30 feet of cable. Unit connection may be combined with the grounding unit if applicable.

2.12.7.6 Remote Emergency "Stop" Pushbutton Station

Activation of the emergency pushbutton station shall shutdown power to the entire fueling system and send an alarm signal to the fire department as indicated. Station housing shall be a watertight, galvanized steel enclosure with a replaceable break glass front with hammer and an open bottom. The galvanized enclosure shall be painted red. Mounting hardware shall be corrosion resistant. An emergency pushbutton shall be mounted inside the station housing and shall be accessible through the break glass and front. Pushbutton shall be a single unit with a jumbo mushroom operator, 1-NC and 1-NO contact. Station shall be suitable for Class I, Division 1, Group D locations, be intrinsically safe, be weather resistant, and be in accordance with UL 913, NEMA 250, and NFPA 70. During activation, the pushbutton shall maintain contact until deactivated by a key release. A caution sign shall be mounted beside the emergency shutdown station, with red 50 mm 2 inch letters stating "EMERGENCY SHUTDOWN". the sign shall have white background and be of noncorrosive construction.

2.13 MONITORING SYSTEM

2.13.1 Aboveground Vaulted Tanks

NOTE: Delete this paragraph if interstitial monitoring is not required by the Using Agency. Interstitial monitoring for aboveground tanks is not required by EPA.

The interstitial space of each vaulted tank shall be continuously and automatically monitored to detect breaches in the integrity of the primary tank and the exterior vaulted shell. The interstitial space shall be monitored by an electronic capacitance type liquid sensor capable of distinguishing the difference between hydrocarbons and water. Sensors shall be intrinsically safe for use in Class 1, Division 1, Group D environment as defined by NFPA 70. Sensors shall be easily removed from the tank. Sensors shall be compatible with the electronic monitoring panel.

2.13.2 Belowground Storage Tank System

NOTE: Liquid sensors are the preferred devices for leak detection. Liquid-filled interstitial space monitoring will only be specified for FRP tanks.

The interstitial space of each belowground tank shall be continuously and automatically monitored to detect breaches in the integrity of the inner and/or outer tank shells. The interstitial space shall be monitored by [an electronic capacitance type liquid sensor] [a positive pressure system] [a liquid-filled interstitial space monitoring system]. [The liquid sensor shall be capable of distinguishing the difference between hydrocarbons and water. Sensors shall be intrinsically safe for use in a class 1, division 1, group D environment as defined by NFPA 70. Sensors shall be easily removal from the tank.] [For a liquid-filled interstitial space monitoring system, the liquid solution (brine) shall be a corrosion inhibitor and be freeze protected. Liquid-filled systems shall be capable of detecting and discriminating between a high and a low brine level condition.] Sensors shall be compatible with the electronic monitoring panel.

2.13.3 Belowground Piping System

NOTE: Slope secondary containment piping to containment sumps and dispenser sumps. Install liquid sensors in the sumps in order to provide piping leak protection.

Belowground piping systems shall be continuously and automatically monitored by electronic capacitance type liquid sensors as indicated. Sensors shall be capable of distinguishing the difference between hydrocarbons and water. Sensors shall be intrinsically safe for use in a class 1, division 1, group D environment as defined by NFPA 70. Sensors shall have a probability of detection of 95 percent and a probability of false alarm of 5 percent. Sensors shall be compatible with the electronic monitoring panel.

2.13.4 Electronic Monitoring Panel

NOTE: Panels located outdoors will require NEMA 4 enclosures. Panels located indoors will only require a standard industrial enclosure.

panel shall be [tank-mounted] [remotely-mounted where indicated] and shall be capable of providing an audible and visual alarm in the event of a detected leak. Audible alarms shall be a buzzer sounding at 70 decibels or greater. Each visual alarm shall indicate the type and location of the alarm condition. Visual alarms shall be capable of delineating between individual alarm conditions. Panel shall provide a means of delineating between individual alarm conditions. Panel shall be housed in a [NEMA 4 rated enclosure in accordance with NEMA 250] [standard industrial enclosure]. Panel shall have a hinged door to swing left or right (doors shall not swing up or down). Panel using computer memory shall be capable of maintaining current programmable information in the event of a power

failure. Panel shall be provided with a manual acknowledge switch which shall be capable of deactivating the audible alarm. The acknowledge switch shall not be capable of deactivating subsequent audible alarms unless depressed manually again for each occurrence. Under no circumstance shall this acknowledgement switch extinguish the visual alarms until the alarm condition has been corrected. Switches shall be an integral component located on the front panel and be either a key switch or push button.

2.14 PIPING COMPONENTS

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

2.14.1 Product Piping

Piping routinely carrying fuel shall be [steel] [FRP] [stainless steel] [aluminum] as defined herein.

2.14.2 Secondary Containment Piping

Belowground piping carrying fuel shall be secondarily contained, unless otherwise indicated. Piping system shall be of double-wall construction with the internal pipe being the product pipe and the exterior pipe being an fiberglass reinforced plastic containment pipe as defined herein. Piping system shall be a factory manufactured piping system designed in accordance with ASME B31.3 and NFPA 30. The containment piping shall allow for complete inspection of the product piping before the containment piping is sealed. Containment piping shall be chemically compatible with the type of fuel to be handled. Containment piping shall be non-corrosive, dielectric, non-biodegradable, and resistant to attack from microbial growth. Containment piping shall be capable of withstanding a minimum 35 kPa 5 psi air pressure. Containment piping shall be evenly separated from the primary pipe using pipe supports which are designed based on pipe size, pipe and fuel weight, and operating conditions. The supports shall be constructed of [the same material as the primary pipe] [FRP] and shall be designed so that no point loading occurs on the primary or exterior pipe. Supports shall be permanently attached to the product pipe either by tack welding or by an adhesive. The exterior piping and supports shall allow for normal draining as well as the installation of any necessary leak detection equipment or cables. Supports shall be designed and installed to allow for pipe movement of both the product piping and the exterior piping without causing damage to either. Containment piping shall be capable of withstanding H-20 highway loading as defined by AASHTO HB-17.

2.14.3 Vent and Vapor Recovery Piping

Piping shall be single wall steel as defined herein.

2.14.4 Steel Pipe

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

2.14.4.1 Connections for Steel Pipe

Connections for pipe or fittings smaller than 65 mm 2-1/2 inches shall be forged, socket weld type, 2000 W.O.G. conforming to ASTM A 182/A 182M and ASME B16.11. Connections for pipe or fittings 65 mm 2-1/2 inches and larger shall be butt weld type conforming to ASTM A 234/A 234M, Grade WPB and ASME B16.9 of the same wall thickness as the adjoining pipe. Piping in inaccessible locations, such as product piping inside of containment piping, shall be welded.

2.14.4.2 Welding Electrodes

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

2.14.4.3 Threaded Connections

NOTE: Threaded connections should only be allowed at dispenser and submersible pump connections due to the high leak potential. Specifically indicate each threaded connection.

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

2.14.5 Fiberglass Reinforced Plastic (FRP) Pipe

NOTE: Include the reference to ASTM D 5677 if aviation fuels are to be handled. When fuels other than aviation fuels are to be handled include the UL reference. FRP piping will only be used for buried service.

2.14.5.1 Pipe

Pipe shall be compatible with the fuel to be handled and be [in accordance with ASTM D 5677] [listed in UL FCLGED]. Pipe shall be compatible with the fluid being transported. Use of FPR piping is limited to buried service only and at pressures not exceeding that marked on the pipe.

2.14.5.2 Fittings

Fittings and joining materials shall be [in accordance with ASTM D 5677] [listed in UL FCLGED]. Threaded fittings shall not be used for product piping in inaccessible locations. Fittings for secondary exterior pipe of double-wall piping system shall accommodate the primary inner pipe and any additional equipment required, such as leak detection cables. Fittings and joining materials shall be compatible with the fuel to be handled.

2.14.6 Stainless Steel Pipe

Stainless steel pipe 150 mm 6 inches or smaller shall be in accordance with

ASTM A 312/A 312M Schedule 40, Type TP304L, seamless only. Longitudinally welded 150 mm 6 inch pipe also can be provided if made in accordance with the procedures in ASTM A 358/A 358M with wall thickness of 6.4 mm 0.25 inch.

Stainless steel pipe larger than 150 mm 6 inches shall be in accordance with ASTM A 312/A 312M Schedule 10S, Grade 304L, seamless only or ASTM A 358/A 358M Grade 304L, Class 1 or 3, welded with wall thickness no less than 6 mm 1/4 inch for pipe 300 mm 12 inches and smaller, and 8 mm 0.312 inch for pipe larger than 300 mm 12 inches.

2.14.6.1 Connections

Connections for pipe smaller than 65 mm 2-1/2 inches shall be forged, socket weld type, Type 304 or 304L, 2000 W.O.G. conforming to ASTM A 182/A 182M and ASME B16.11. Connections for pipe 65 mm 2-1/2 inches and larger shall be butt weld type conforming to ASTM A 403/A 403M, Class WP, Type 304L, seamless or welded, and ASME B16.9 of the same wall thickness as the adjoining pipe. Piping in inaccessible locations, such as product piping inside of containment piping, shall be welded.

2.14.6.2 Welding Process and Electrodes

The welding process for stainless steel piping shall be a gas tungsten arc or gas metal arc process in accordance with ASME B31.3. Welding electrodes shall be E308L conforming to AWS A5.4.

2.14.7 Aluminum Pipe

NOTE: Aluminum piping has poor structural integrity, corrodes readily, and is difficult to weld. Use of aluminum piping must be approved by the using agency. Aluminum pipe should only be required for the transfer of aviation fuels.

Aluminum piping shall be in accordance with ASTM B 241/B 241M or ASTM B 345/B 345M, alloy 6061-T6, Schedule 40 for pipe sizes 50 mm 2 inches through 300 mm 12 inches; Schedule 80 for pipe sizes 50 mm 2 inches and smaller.

2.14.7.1 Connections for Aluminum Pipe

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

2.14.7.2 Aluminum Welding Process and Electrodes

The welding process for aluminum piping shall be a gas tungsten arc or gas metal arc process in accordance with ASME B31.3. Welding electrodes shall be ER5356 conforming to AWS A5.10/A5.10M.

2.14.8 Valves

NOTE: Require stainless steel or aluminum

construction only if aviation fuels are to be handled.

Portions of a valve coming in contact with fuel shall be compatible with the fuel to be handled. Valves shall have bodies, bonnets, and covers constructed of [stainless steel conforming to ASTM A 743/A 743M, Type 304 or 316; or aluminum alloy conforming to ASTM B 26/B 26M, Type 3003, 6061-T6, or 356-T6] [cast steel conforming to ASTM A 216/A 216M, Grade WCB]. Each valve shall have stainless steel stem and trim. Valves shall be suitable for a working pressure of 1900 kPa 275 psig at 38 degrees C 100 degrees F with a weatherproof housing and be provided with flanged end connections unless indicated otherwise. Seats, body seals, and stem seals shall be Viton or Buna-N.

2.14.8.1 Gate

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

2.14.8.2 Swing Type Check

Valve shall be swing type conforming to API Spec 6D regular type. Check valves shall be the tilting disc, non-slam type. Discs and seating rings shall be renewable without removing from the line. The disc shall be guided and controlled to contact the entire seating surface.

2.14.8.3 Wafer Type Check

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

2.14.8.4 Ball

Valves 50 mm 2 inches and larger shall conform to API Spec 6D. Valves smaller than 50 mm 2 inches shall have one piece bodies and have a minimum bore not less than 55 percent of the internal cross sectional area of a pipe of the same nominal diameter. The ball shall be stainless steel. Valve shall be fire tested and qualified in accordance with API Spec 6FA or API Std 607. Valve shall be non-lubricated and operate from fully open to fully closed with 90 degree rotation of the ball.

2.14.8.5 Plug

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

2.14.8.6 Globe

Valve shall conform to ASME B16.34.

2.14.8.7 Pressure/Vacuum Vent Relief

Valve pressure and vacuum capacities shall be in accordance with NFPA 30. Valve shall be factory set for [5.2] [_____] kPa [12] [_____] ounces/square inch pressure and [215] [_____] Pa [0.5] [_____] ounce/square inch vacuum. Pressure and vacuum relief shall be provided by a single valve. Valve shall be constructed of cast steel or aluminum with flanged or threaded end connections. Trim shall be stainless steel. Inner valve pallet assemblies shall have a knife-edged drip ring around the periphery of the pallet to preclude condensation collection at the seats. Pallet seat inserts shall be of a material compatible with the fuel specified to be stored.

2.14.9 Accessories

2.14.9.1 Foot Valve

NOTE: Foot valves are typically only used on small belowground tank applications which use a suction type pumping system (i.e., the pump is not located within the tank). The function of the valve is to to hold prime in the line following a pump shutdown. Foot valves are located at the termination of the suction line within a belowground storage tank.

Foot valve shall be compatible with the fuel to be handled and with the working pressure of the system. Foot valve shall be the double-poppet design. Foot valve shall be provided with a minimum 20 mesh screen on the intake. Foot valve seats shall be the replaceable type. Foot valve shall be capable of passing through a 75 mm 3 inch pipe or tank flange.

2.14.9.2 Flanges

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

2.14.9.3 Flange Gaskets

Flange gaskets shall be 2 mm 1/16 inch thick, NBR, and be in accordance with ASME B16.21. Full-face gaskets shall be provided for flat-face flanged pipe joints. Ring gaskets shall be provided for raised-face flanged pipe joints.

2.14.9.4 Steel Coupling

Coupling shall be in accordance with API Spec 5L, seamless, extra heavy, wrought steel with recessed ends.

2.14.9.5 Welded Nipple

Nipple shall be in accordance with ASTM A 733 or ASTM B 687 and of the same material as the product piping.

2.14.9.6 Threaded Union

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

2.14.9.7 Joint Compound

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

2.14.9.8 Flexible Connector

Connectors shall conform to requirements of UL 567 and be the flexible metal hose, corrugated type with braided wire sheath covering. Connectors shall have close-pitch annular corrugations and be rated for a working pressure of at least 1900 kPa 275 psig at 38 degrees C 100 degrees F. Connectors shall have a minimum 300 mm 12 inch live length with flanged end connections. Metal for hose and braided wire sheath shall be stainless steel in accordance with ASTM A 167.

2.14.9.9 Strainer

NOTE: Reference ASTM F 1199 when the operating conditions are at 1035 kPa (150 psig) and 66 degrees C (150 degrees F) or less; otherwise reference ASTM F 1200. Stainless steel strainers are only required on systems which handle aviation fuels.

Strainer shall be in accordance with ASTM F 1199 or ASTM F 1200, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, and be the same size as the pipeline. Strainer body shall be fabricated of [cast steel or brass] [Type 304 or 316 stainless steel] with the bottom drilled and tapped. The body shall have arrows clearly cast on the sides indicating the direction of flow. Strainer shall be equipped with a removable cover and sediment screen. Strainer screen shall be wire screen constructed of [brass sheet,] [monel,] [corrosion-resistant steel,] [Type 316 stainless steel,] with small perforations numbering not less than 60 per square centimeter 400 per square inch to provide a net free area through the basket of at least 3.3 times that of the entering pipe. Flow shall be into the screen and out through the perforations.

2.14.9.10 Pipe Hangers and Supports

NOTE: Coordinate with subparagraph PIPE HANGERS AND SUPPORTS in PART 3.

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

- a. Pipe Protection Shields. Shields shall conform to MSS SP-58 and MSS SP-69, Type 40, except material shall be Type 316 stainless steel. Shields shall be provided at each slide type pipe hanger and support.
- b. Low Friction Supports. Supports shall have self-lubricating anti-friction bearing elements composed of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates, prebonded to appropriate backing steel members. The coefficient of static friction between bearing elements shall be 0.06 from initial installation for both vertical and horizontal loads and deformation shall not exceed 0.05 mm 0.002 inch under allowable static loads. Bonds between material and steel shall be heat cured, high temperature epoxy. Design pipe hangers and support elements for the loads applied. Anti-friction material shall be a minimum of 2.3 mm 0.09 inch thick. Steel supports shall be hot-dipped galvanized. Units shall be factory designed and manufactured.

2.14.9.11 Exterior Coatings for Belowground Steel Piping

NOTE: Heat shrink sleeves can be used in lieu of the protective tape; however, the sleeves are not recommended for systems with numerous bends. Delete the last sentence of subparagraph b accordingly.

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

- a. Pipe: Pipe shall receive protective coating system of factory-applied adhesive undercoat and continually extruded polyethylene coating conforming to NACE RP0185, Type A. The protective coating shall have a minimum thickness of 0.76 mm (30 mils). 30 mils.
- b. Fittings and Other Surfaces: Fittings, couplings, regular surfaces, damaged areas of extruded polyethylene coating and existing piping affected by the Contractor's operations shall be protected by the application of polyethylene tape which conforms to NACE RP0169, 0.76 mm 30 mils nominal thickness. Surfaces to be tape wrapped shall be clean, dry, grease free, and primed with a compatible primer prior to application of tape. Primer shall be as recommended by the tape manufacturer and approved by the pipe coating manufacturer. Heat shrink sleeves may be provided in lieu of tape and shall overlap the pipe coating not less than 150 mm 6 inches.
- c. Irregular Surfaces: Irregular surfaces shall be protected with a cold-applied liquid primer and heated coal-tar tape in accordance with AWWA C203.

2.14.9.12 Exterior Coating for Aboveground Steel Piping

NOTE: Coordinate the color of the coating with the using agency.

Aboveground steel piping shall be painted as specified in Section 09900 PAINTS AND COATINGS. Paint shall be rated for use on hot metal surfaces up to 230 degrees C 450 degrees F and for surfaces exposed to the weather. Color of the finish coat shall be [aluminum] [light gray] [_____].

2.14.9.13 Pressure Gauge

NOTE: Indicate the scale range for each pressure gauge.

Gauge shall conform to ASME B40.100. Gauge shall be single style pressure gauge for fuel with 115 mm 4-1/2 inch dial, have brass or aluminum case, bronze tube, stainless steel ball valve, pressure snubbers, and scale range for the intended service.

PART 3 EXECUTION

3.1 INSTALLATION

Storage tanks shall be handled with extreme care to prevent damage during placement and shall be installed in accordance with the manufacturer's installation instructions and NFPA 30 or NFPA 30A, as applicable. The exterior surface of each tank shall be inspected for obvious visual damage prior to and proceeding the placement of each storage tank. Surface damage to a storage tank shall be corrected according manufacturer's requirements before proceeding with the system installation.

3.1.1 Belowground Storage Tank

Installation of belowground storage tanks shall be in accordance with API RP 1615 except as modified herein. Tank shall be placed on a 3 mm per 30 mm 1/8 inch per foot slope with the fill point at the low end and the vent connection at the high end. Tank shall be located so that the fuel discharge pipes slope up uniformly toward the fuel outlet. Containment sumps shall be installed prior to any backfill being added above the storage tanks.

3.1.1.1 Steel Tank Handling

Storing, handling, and placing of coated steel tanks shall be done with care and in a manner that will minimize damage to the coating and will not reduce its protective value. A coated tank shall be placed in position carefully and with a minimum of handling. Coating damage shall be repaired and tested as previously specified before backfilling.

3.1.1.2 Steel Tank Installation Procedures

[Tank shall be set on a minimum of 150 mm 6 inches of backfill material.]
[Tank shall be anchored to a reinforced concrete anchor pad as indicated through the use of manufacturer's supplied holddown straps. Tank shall be separated from an anchor pad by a minimum of 300 mm 12 inches of backfill material. Metal straps, turnbuckles, anchors, and accessories shall be coated to resist corrosion.] Holiday testing of protective coatings for steel tanks shall be successfully completed prior to any backfilling, strapping, or piping connections to the tank. Backfill material shall be uniformly placed around the entire tank and extend to grade level. Tank

anodes shall be inspected to ensure integrity during backfill operations.

3.1.1.3 FRP Tank Handling

Tank shall be handled with extreme care to prevent damage during installation and transportation to the site. Any damaged tank shall be replaced or repaired and tested under direct supervision and advice of the tank manufacturer, using the manufacturer's written procedures.

3.1.1.4 FRP Tank Installation Procedures

[Tank shall be set on a minimum of 150 mm 6 inches of backfill material.]
[Tank shall be anchored to a reinforced concrete anchor pad as indicated through the use of manufacturer's supplied holddown straps. Tank shall be separated from an anchor pad by a minimum of 300 mm 12 inches of backfill material.]

3.1.2 Equipment

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

3.1.3 Piping

**NOTE: FRP piping should never be used under
concrete slabs (excluding concrete walkways) or
aboveground.**

Piping shall be inspected, tested, and approved before burying, covering, or concealing. Piping shall be installed straight and true to bear evenly on supports. Piping shall be free of traps, shall not be embedded in concrete pavement, and shall drain toward the corresponding storage tank. Any pipe, fittings, or appurtenances found defective after installation shall be replaced. Piping connections to equipment shall be as indicated or as required by the equipment manufacturer. Pipe and accessories shall be handled carefully to assure a sound, undamaged condition. The interior of the pipe shall be thoroughly cleaned of foreign matter and shall be kept clean during installation. The pipe shall not be laid in water or stored outside unprotected when weather conditions are unsuitable. When work is not in progress, open ends of pipe and fittings shall be securely closed so that water, earth, or other substances cannot enter the pipe or fittings. Cutting pipe, when necessary, shall be done without damage to the pipe. Pipe shall be reamed to true internal diameter after cutting to remove burrs. Changes in pipe sizes shall be made through tapered reducing pipe fittings. Stainless steel pipe shall in no case be welded directly to carbon steel pipe. Cutting of FRP pipe shall be performed with a hacksaw or circular saw. Fuel supply piping from a storage tank shall extend to within 150 mm 6 inches of the tank's bottom.

3.1.3.1 Aboveground Piping

Pipe sections shall be installed as indicated and be complete prior to performing any piping tests. FRP shall not be used aboveground.

3.1.3.2 Belowground Piping

Nonmetallic pipe shall be installed in accordance with pipe manufacturer's instructions. Belowground piping shall be laid with a minimum pitch of 25 mm per 6 m 1 inch per 25 feet. Horizontal sections of pipe shall be installed with a minimum of 450 mm 18 inches of backfill between the top of the pipe and the ground surface. The full length of each section of belowground pipe shall rest solidly on the pipe bed. Joints in secondary piping shall not be made until inner pipe is successfully pressure tested.

3.1.3.3 Pipe Hangers and Supports

NOTE: Provide seismic details, if a Government designer (either Corps office or A/E) is the Engineer of Record, and show on the drawings. Delete the bracketed phrase if no seismic details are provided. Sections 13080 and 15070A, properly edited, must be included in the contract documents.

Seismic requirements shall be in accordance with Sections 13080, SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT [as shown on the drawings]. Additional hangers and supports shall be installed for concentrated loads in piping between hangers and supports, such as for valves. Miscellaneous steel shapes as required shall be installed in accordance with ASTM A 36/A 36M. Pipe supports shall be installed in accordance with MSS SP-58 and MSS SP-69. Pipe spacing shall be as follows:

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

3.1.3.4 Pipe Sleeve

Piping passing through concrete or masonry construction shall be fitted with sleeves. Sleeve shall be of sufficient length to pass through the entire thickness of the associated structural member and be large enough to provide a minimum clear distance of 13 mm 1/2 inch between the pipe and sleeve. Sleeves through concrete shall be 0.91 mm 20 gauge steel, fiberglass, or other material as approved by the Contracting Officer. Sleeves shall be accurately located on center with the piping and securely fastened in place. The space between a sleeve and a pipe shall be caulked and sealed as specified in Section 07920 JOINT SEALANTS. In fire walls and

fire floors, both ends of a pipe sleeve shall be caulked with UL listed fill, void, or cavity material.

3.1.3.5 Pipe Anchor

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

3.1.3.6 Exterior Coating for Belowground Steel Pipe

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

- a. Regular Surfaces, Fittings, and Couplings: Tape shall be initially stretched sufficiently to conform to the surface to which it is applied, using one layer lapped at least 25 mm 1 inch. Tape shall overlap the extruded polyethylene coated piping 75 mm 3 inches at all joints. A second layer, lapped at least 25 mm 1 inch with a tension as it comes off the roll shall be applied and pressed to conform to the shape of the component.
- b. Damaged Areas of Extruded Polyethylene Coating: Residual material from coating shall be pressed into the break or trimmed off. Tape shall be applied spirally and one-half lapped as it is applied. Tape shall extend 75 mm 3 inches beyond the damaged area. A double wrap of one full width of tape shall be applied at right angles to the pipe axis in a manner to seal each end of the spiral wrapping.
- c. Existing Piping Affected by the Contractor's Operation: Pipe shall be wrapped to 75 mm 3 inches beyond the point of connection.

3.1.4 Buried Utility Tape

Bury tape with the printed side up at a depth of 300 mm 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.5 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory, shall be painted and have identification markings applied as specified in Section 09900 PAINTS AND COATINGS. Stainless steel and aluminum surfaces shall not be painted. Prior to any painting, surfaces shall be cleaned to remove dust, dirt, rust, oil, and grease.

3.1.6 Framed Instructions

Framed instructions shall include equipment layout, wiring and control diagrams, piping, valves, control sequences, and typed condensed operation instructions. The condensed operation instructions shall include

preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The framed instructions shall be framed under glass or laminated plastic and be posted where directed by the Contracting Officer. The framed instructions shall be posted before acceptance testing of the system.

3.2 TESTS

3.2.1 Aboveground Storage Tank Tightness Tests

**NOTE: Delete the bracketed information if neither
skid-mounted or secondarily contained (open-top)
type tanks are specified.**

A tightness test shall be performed on each aboveground storage tank. The tests shall be performed prior to making piping connections. Tests shall be capable of detecting a 0.1 mL/s 0.1 gph leak rate from any portion of the tank while accounting for effects of thermal expansion or contraction. Gauges used in the tightness tests shall have a scale with a maximum limit of 69 kPa 10 psig. Each storage tank shall be pressurized with air to 35 kPa 5 psig and monitored for a drop in pressure over a 2-hour period during which there shall be no drop in pressure in the tank greater than that allowed for pressure variations due to thermal effects. [This pressure shall be maintained and soapsuds or equivalent material applied to the exterior of the tank. While applying the soapsuds, the entire tank shall be visually inspected, including the bottom surfaces, for leaks (bubble formations). Leaks discovered during either the 2-hour waiting period or the soapsuds tests shall be repaired in accordance with manufacturer's instructions.] The pneumatic test shall be performed again in the event a leak is discovered.

3.2.2 Belowground Storage Tank Tightness Tests

**NOTE: Pneumatic tests are the performed type of
tightness tests. Brine level tests will only be
specified for FRP tanks. Delete the inapplicable
tests.**

A tightness test shall be performed on each belowground storage tank. The test shall be performed following the placement of a tank into the ground and prior to backfill. Tests shall be capable of detecting a 0.1 mL/s 0.1 gph leak rate from any portion of a tank while accounting for effects of thermal expansion or contraction. Test shall either be [a pneumatic test] [a brine level test].

3.2.2.1 Pneumatic Test

Pneumatically pressurize each storage tank's primary chamber to 35 kPa 5 psig and monitor for a drop in pressure over a 2-hour period during which there shall be no drop in pressure in the tank greater than that allowed for thermal expansion and contraction. Following the 2-hour period, the pressure from the primary chamber shall then be bled over into the interstitial space. This pressure shall be maintained and soapsuds or equivalent material applied to the exterior of the tank. While applying

the soapsuds, the entire tank shall be visually inspected, including the bottom surfaces, for leaks (bubble formations). Leaks discovered in either the primary chamber or the interstitial space shall be repaired in accordance with manufacturer's instructions. The entire pneumatic test shall be performed again in the event a leak is discovered. Gauges used in pneumatic tests shall have a scale with a maximum limit of 69 kPa 10 psig.

3.2.2.2 Brine Level Test

The interstitial space of each tank shall be completely filled with a brine solution. A riser pipe shall be connected to the interstitial space which shall allow the solution to rise up within the riser at least 300 mm 12 inches. After filling the interstitial space, the tank shall set approximately 3 hours. Following the 3-hour period the Contractor shall measure and record the level of solution within the riser. After a subsequent 4-hour period, the Contractor shall again measure and record the level of solution within the riser. If the level of solution within the interstitial decreases anytime during the test, the tank is considered leaking and therefore fails the test. If a tank is considered to leak, the tank shall be repaired according to manufacturer's recommendations and a tightness test performed again.

3.2.3 Manufacturer's Tank Tests

Following the tank tightness test, each storage tank shall be leak tested in accordance with the manufacturer's written test procedure if the manufacturer's test procedure is different from the tightness tests already performed. Any test failure shall require corrective action and retest.

3.2.4 Belowground Steel Tank Exterior Coating Tests

3.2.4.1 Holiday Tests

Exterior surfaces, including the bottom surfaces, of each belowground steel storage tank shall have a holiday test performed using an electric holiday detector with an impressed current in accordance with NACE RP0274. The required voltage for the holiday test of STI P3 coatings shall be based on the coating thickness and ASTM G 62 Method A. The required voltage for the holiday test of FRP coatings shall be based on the coating thickness, ASTM G 62 Method B, and NACE RP0274. The holiday detector shall be equipped with an audible signal. Holidays in the protective covering shall be repaired and retested.

3.2.4.2 Thickness Tests

For belowground steel tanks using a FRP coating system, the thickness of the coating shall be tested by non-destructive means in at least 100 evenly spaced locations around the tank. Areas with insufficient thickness shall be repaired with materials identical to those used originally, and after drying, shall be tested again for thickness. The entire tank shall be tested including the bottom surfaces.

3.2.5 Exterior Coating for Belowground Steel Piping

The coating system shall be visually inspected for holes, voids, cracks, and other damage during installation. Damage to the protective coating incurred during transit and handling shall be repaired before installation.

Before lowering into the trench, each pipe section shall be tested by an electric holiday detector with impressed current in accordance with NACE

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

3.2.6 Radiographic Tests for Aviation Fuel Piping

**NOTE: Delete this paragraph if aviation fuels will
not be handled.**

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

3.2.7 Piping Pneumatic and Hydrostatic Tests

Testing shall comply with the applicable requirements of ASME B31.3, NFPA 30, and the requirements specified herein. Care shall be taken not to exceed pressure rating of various fittings. Hydrostatic testing shall be performed using fuel as the liquid. Water shall not be introduced into the system for testing. To facilitate the pneumatic and hydrostatic tests, various sections of the piping system may be isolated and tested separately. Where such sections terminate at flanged valve points, the line shall be closed by means of blind flanges in lieu of relying on the valve. Tapped flanges shall be provided to allow a direct connection between the piping and the air compressor and/or pressurizing pump. Tapped flanges shall also be used for gauge connections. Taps in the permanent line will not be permitted. Gauges shall be subject to testing and approval. In the event leaks are detected, the pipe shall be repaired and the test repeated. Following satisfactory completion of each pneumatic and hydrostatic test, the pressure shall be relieved and the pipe immediately sealed. Provision shall be made to prevent displacement of the piping during testing. Personnel shall be kept clear of the piping during pneumatic testing. Equipment such as pumps, tanks, and meters shall be isolated from the piping system during the testing.

3.2.7.1 Pneumatic Procedures for Product and Vent\Vapor Piping

Piping to be installed underground shall not receive field applied covering at the joints or be covered by backfill until the piping has passed the pneumatic test described herein. A pneumatic test pressure shall be applied in increments. A preliminary 170 kPa 25 psig test shall be applied. The pressure shall be maintained while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, the entire run of piping, including the bottom surfaces, shall be visually inspected for leaks (bubble formations). Leaks discovered shall be repaired in accordance with manufacturer's instructions and retested. Following the preliminary test, the piping shall be tested at a pressure of 340 kPa 50 psig for not less than 2 hours, during which time there shall be no drop in pressure in the pipe greater than that allowed for thermal expansion and contraction. The pressure source shall be disconnected during the final test period. Any leaks revealed by the test shall be repaired and the test repeated.

3.2.7.2 Pneumatic Procedures for Exterior Containment Piping

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

3.2.7.3 Hydrostatic Procedures for Product Piping

Upon completion of pneumatic testing and after backfilling, each piping system shall be hydrostatically tested with fuel at not more than 1900 kPa 275 psig in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gauge pressure for 4 hours. The Contractor shall furnish electricity, instruments, connecting devices, and personnel for the test. Fuel will be furnished by the Government. Defects in work performed shall be corrected at the Contractor's expense, and the test repeated until the work is proven to be in compliance with the testing procedures. Any release of fuel (no matter the size) during testing shall be immediately contained, the pressure on the piping relieved, and the piping drained of fuel. The Contracting Officer shall be notified immediately of a fuel release, the exact location, an estimated quantity of release, and a discussion of the containment measures taken.

3.2.8 System Performance Tests

After all components of the system have been properly adjusted, the system shall be tested to demonstrate that the system meets the performance requirements for which it was designed. The maximum rated capacity of the system shall be tested by using several tank trucks simultaneously, if applicable. The use of tank trucks shall be coordinated with the Contracting Officer prior to testing. If any portion of the system or any piece of equipment fails to pass the tests, the Contractor shall make the necessary repairs or adjustments and the test shall be repeated until satisfactory performance is obtained from the Contracting Officer. The tests shall demonstrate the following:

- a. The capability of each fuel pump to deliver the indicated flow of fuel.
- b. The alarm and control panels are operational and perform as designed.
- c. Each fuel meter is operating accurately.
- d. Vent piping is clear of debris and each pressure/vacuum relief vent is operating properly.
- [e. Vapor recovery systems perform as designed.]
- [f. Dispensing units are operational and perform as designed.]
- [g. Truck loading and unloading arm assemblies perform as designed. Each preset type meter, counter and truck fill stand shutoff valve operates as designed.]
- [h. The capability of each emergency stop pushbutton station to shutdown the entire fueling operation.]

3.2.9 High Liquid Level Alarm Test

Each storage tank shall be initially overfilled with the appropriate product in order to verify the high liquid level alarms in the remote alarm panel function as designed. The initial overfill shall also verify that the storage tank overfill protection device functions as designed. Tank overfill shall stop immediately once the overfill device operates. The Contractor shall not overfill any storage more than 98 percent level even if the leak detection and liquid level electronic panel and the overfill device do not function as designed. Any problems with the electronic panel or the overfill device shall be corrected and retested. The system shall be drained below the high liquid levels following all tests.

3.3 FLUSHING, CLEANING AND ADJUSTING

Following installation and equipment testing but prior to system performance testing, the following flushing, cleaning, and adjustments shall be performed.

3.3.1 Preparations for Flushing

3.3.1.1 Initial System Cleaning

The interior of each fuel storage tank shall be visually inspected and cleaned free of debris before filling. In the event of entry into a storage tank, the Contractor shall ensure a safe atmosphere exists. Contractor shall remove all preservatives and foreign matter from valves, line strainers, pumps, and other equipment coming in contact with fuel. No fuel will be delivered to the system until the Contractor has satisfactorily completed this initial system cleaning.

3.3.1.2 Protection of Equipment

Temporary 40 mesh cone type strainers shall be installed in the suction line ahead of each fueling pump as well as ahead of each filter/separator. The strainers shall be constructed of the same material as the piping and shall be compatible with the fuel to be handled. The temporary strainers

shall remain in place for a minimum of [2] [_____] days after system startup, after which time the Contractor shall remove the strainers and prepare the piping as intended for final system operation.

3.3.2 System Flushing

3.3.2.1 Initial Fuel Supply

Following the preparations for flushing, each storage tank shall be filled to a 25 percent capacity with the proper fuel according to the fueling system's final operational requirements. Following the initial fuel supply, each storage tank's fuel temperature and liquid level shall be measured and recorded. The liquid level shall be measured using a manual tank gauge.

3.3.2.2 Vehicle Dispensing Unit Flushing

Fuel shall be pumped at the system's maximum design flow rate from a storage tank through the fuel supply piping, to the corresponding dispensing unit, and then into an empty fuel truck or tank as supplied by the Contracting Officer. Periodic samples for inspection by the Contracting Officer shall be taken during the flushing procedure. A minimum of [380] [_____] L [100] [_____] gallons shall be flushed through each dispensing unit's nozzle. The flushing procedure shall be continued until the fuel being delivered is acceptable to the Contracting Officer. Each dispensing unit shall be flushed in the exact same manner.

3.3.2.3 Truck Fill Stand Flushing

Fuel shall be pumped at the system's maximum design flow rate from a storage tank through the fuel supply piping, to the corresponding truck fill stand, and then into an empty tank truck. Periodic samples for inspection by the Contracting Officer shall be taken from the drawoff connection of each truck fill riser while the corresponding tank truck is filling. When a tank truck has been filled, the operation shall be discontinued until the tank truck has returned the fuel to the storage tank from which it was taken. The empty tank truck shall then be returned to the truck fill stand and the flushing operation resumed. This procedure shall be repeated until the fuel being delivered is acceptable to the Contracting Officer. Each truck fill stand shall be flushed in the exact same manner. During the flushing process, the strainer preceding the fueling meter shall be frequently cleaned.

3.3.2.4 Disposal of Initial Fuel Supply

In the event the fuel contained in the piping system at the conclusion of the flushing operation is not considered by the Contracting Officer to be of satisfactory quality for the desired use, the Contractor shall be responsible for pumping out the entire fuel supply from the storage tanks and the piping system. The filter/separator and piping system shall be completely drained to the storage tank. Disposition of the fuel removed from the system shall be the responsibility of the Government.

3.3.3 Cleaning Equipment

Upon completion of flushing operations, permanent strainers shall be removed, cleaned, and reinstalled. If the pressure differential across the filter/separator elements exceeds that recommended by the manufacturer, the elements shall be replaced with the spare set furnished with the unit.

3.3.4 Initial System Adjustments

Following the flushing and cleaning operations, each system component shall be initially adjusted, if necessary, to meet the system's final operational requirements. The Government will deliver enough fuel to the storage tanks to enable the Contractor to make final adjustments to equipment and controls. Flow rates and pressures shall be adjusted as required to meet the indicated requirements. The sequence of control for each component shall be adjusted to meet the indicated system requirements. Following the initial system adjustments, the equipment tests shall be performed in order to determine any necessary final system adjustments.

3.4 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of [_____] hours of normal working time and shall start after the system is functionally completed but prior to final system acceptance. The field instructions shall cover all of the items contained in the operation and maintenance manuals as well as demonstrations of routine maintenance operations.

-- End of Section --