
USACE / NAVFAC / AFCEA / NASA UFGS-123 11 13.00 20 (April 2006)

Preparing Activity: NAVFAC Replacing without change
 UFGS-15192N (August 2003)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 9 October 2006

Latest change indicated by CHG tags

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 11 13.00 20

FUEL OIL PIPING

04/06

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 DEFINITIONS
 - 1.3.1 Carrier Piping
 - 1.3.2 Secondary Containment System
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Welding Procedure
 - 1.5.2 Qualification of Welders
 - 1.5.3 List of Welder's Names and Symbols
 - 1.5.4 Defective Welds
 - 1.5.5 Previous Welder Qualifications
- 1.6 WELDING SAFETY
- 1.7 REGISTRATION

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
 - 2.1.1 Steel Pipe and Fittings
 - 2.1.1.1 Pipe
 - 2.1.1.2 Threaded and Socket-Welding Fittings
 - 2.1.1.3 Threaded Fittings
 - 2.1.1.4 Butt-Welding Fittings
 - 2.1.1.5 Flanges and Flange Fittings
 - 2.1.2 Copper Piping
 - 2.1.2.1 Pipe and Tubing
 - 2.1.2.2 Flanges and Flanged Fittings
 - 2.1.2.3 Solder Joint Fittings
 - 2.1.3 Fiberglass and Flexible Pipe
 - 2.1.3.1 Pipe
 - 2.1.3.2 Fiberglass Pipe Fittings
 - 2.1.3.3 Flexible Pipe Fittings

- 2.1.4 Vent Piping
- 2.1.5 Valves
 - 2.1.5.1 Bronze Gate Valves
 - 2.1.5.2 Steel Gate Valves
 - 2.1.5.3 Ball Valves
 - 2.1.5.4 Relief Valves
 - 2.1.5.5 Check Valves
 - 2.1.5.6 Plug Valves
- 2.1.6 Secondary Containment System for Piping
- 2.1.7 Piping Accessories
 - 2.1.7.1 Flexible Hose
 - 2.1.7.2 Unions
 - 2.1.7.3 Welding Filler Metal
 - 2.1.7.4 Brazing Filler Metal
 - 2.1.7.5 Hangers, Supports, and Shields
 - 2.1.7.6 Strainers
 - 2.1.7.7 Gaskets
 - 2.1.7.8 Bolting
 - 2.1.7.9 Sleeves in Masonry and Concrete Walls, Floors, Roofs
 - 2.1.7.10 Sleeves in Other Wall, Floor, and Roof Materials
 - 2.1.7.11 Floor, Walls, and Ceiling Plates
 - 2.1.7.12 Identification for Piping Aboveground
 - 2.1.7.13 Buried Utility Warning and Identification Tape
 - 2.1.7.14 Miscellaneous Metal
- 2.1.8 Meters
- 2.1.9 Instruments
 - 2.1.9.1 Tank Gages
 - 2.1.9.2 Thermometers
 - 2.1.9.3 Pressure Gages
- 2.1.10 Protective Coating Systems for Underground Steel Piping
 - 2.1.10.1 Underground Piping and Fittings
 - 2.1.10.2 Cathodic Protection
- 2.1.11 Protective Coating Materials for Aboveground Pipe and Tanks
 - 2.1.11.1 External Coatings
 - 2.1.11.2 Internal Coatings
- 2.2 FUEL OIL HEATERS AND PUMPING EQUIPMENT
 - 2.2.1 Storage Tank Heater
 - 2.2.2 Shell and Tube Heater
 - 2.2.3 Electric Heater
 - 2.2.4 Oil Pumps
- 2.3 FUEL OIL STORAGE TANKS AND ACCESSORIES
 - 2.3.1 Fuel Oil Storage Tanks
 - 2.3.2 Design, Construction, and Testing of Fuel Oil Tanks
 - 2.3.3 Connections to Fuel Oil Tanks
 - 2.3.4 Monitoring System to Detect Fuel Oil and Water Leaks

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Fuel Oil Piping System
 - 3.1.1.1 Underground Piping
 - 3.1.2 Pipe Sleeves and Plates
 - 3.1.3 Steel Piping
 - 3.1.4 Threaded Joints in Piping
 - 3.1.5 Copper Tubing
 - 3.1.5.1 Copper Tube Extracted Joint
 - 3.1.6 Non-Metallic Piping
 - 3.1.7 Welding
 - 3.1.7.1 Welding of Piping

- 3.1.7.2 Quality of Welds
- 3.1.7.3 Arc Welding and Gas Welding
- 3.1.8 Unions and Flanges
- 3.1.9 Valves
- 3.1.10 Thermometers
- 3.1.11 Fuel Oil Storage Tanks
- 3.2 FIELD QUALITY CONTROL
 - 3.2.1 Piping Test
 - 3.2.1.1 Pneumatic Test
 - 3.2.1.2 Hydrostatic Tests
 - 3.2.1.3 Flushing
 - 3.2.2 Secondary Containment Piping Test
 - 3.2.3 Protective Coating Systems
 - 3.2.4 Steel Fuel Oil Storage Tanks
 - 3.2.5 Cathodic Protection
 - 3.2.6 Leak Detection

-- End of Section Table of Contents --

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FUEL OIL PIPING 04/06

NOTE: This guide specification covers the requirements for new systems for diesel fuel and for No. 2, 4, 5, and 6 heating fuel systems for buildings and central heating systems not requiring field erected tanks.

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

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

Use of electronic communication is encouraged.

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

NOTE: This guide specification shall not be used for AVGAS, jet fuel, and other volatile fuel systems. Use Section 33 56 16 UNDERGROUND PETROLEUM TANKS for underground fuel oil storage tanks.

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

1. Fuel tank installation, design and details
2. Fuel oil heating and pumping equipment design and details
3. Associated piping and accessory equipment layout

and details.

PART 1 GENERAL

1.1 REFERENCES

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

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

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

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|--------------|---|
| ANSI A13.1 | (1996; R 2002) Scheme for Identification of Piping Systems |
| ANSI B16.24 | (1991; Errata 1991) Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500 |
| ANSI B18.2.1 | (1996; Errata 2003) Square and Hex Bolts and Screws Inch Series |

AMERICAN PETROLEUM INSTITUTE (API)

- | | |
|-------------|---|
| API 600 | (2001) Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas Industries |
| API RP 1110 | (1997) Pressure Testing of Liquid Petroleum Pipelines |
| API RP 1615 | (1996; R 2001) Installation of Underground Petroleum Storage Systems |
| API Std 599 | (2002) Metal Plug Valves - Flanged, Threaded and Welding Ends |

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS Z49.1	(1999) Safety in Welding, Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME B1.1	(2001; R 2003) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.11	(2005) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2005) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.3	(1998) Malleable Iron Threaded Fittings
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 B18.2.2	(1987; R 2005) Square and Hex Nuts
ASME B31.1	(2004) Power Piping
ASME B31.3	(2004) Process Piping
ASME B31.4	(2002) Piping Transportation Systems for Liquid Hydrocarbons and Other Liquid
ASME B40.1	(1998) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2004) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2004) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASTM INTERNATIONAL (ASTM)

ASTM A 194/A 194M	(2005) Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service or Both
ASTM A 307	(2004) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 36/A 36M	(2005) Carbon Structural Steel
ASTM A 53/A 53M	(2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM B 88	(2003) Seamless Copper Water Tube
ASTM B 88M	(2003) Seamless Copper Water Tube (Metric)

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

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-58	(2002) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(2003) Flammable and Combustible Liquids Code
NFPA 31	(2001) Installation of Oil Burning Equipment
NFPA 70	(2005) National Electrical Code
NFPA 780	(2004) Installation of Lightning Protection Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA Seismic Restraint Mnl	(1998, 2nd Ed) Seismic Restraint Manual: Guidelines for Mechanical Systems
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THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	(2002; R 2004) Zinc-Rich Primers, (Type I - "Inorganic" and Type II - "Organic")
SSPC SP 10	(2000; R 2004) Near-White Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD-C-24176	(Rev B; Am 1) Cement, Epoxy, Metal Repair and Hull Smoothing (Metric)
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MIL-C-18480	(Rev B; Notice 1) Coating Compound, Bituminous, Solvent, Coal-Tar Base
MIL-C-19902	(Rev C; Notice 2) Caps, Vent, Fuel Storage Tank
MIL-C-4556	(Rev F; Notice 1) Coating Kit, Epoxy, for Interior of Steel Fuel Tanks
MIL-P-24441	(Rev C; Supp 1) Paint, Epoxy-Polyamide
MIL-PRF-907	(Rev E; Am 2) Antiseize Thread Compound, High Temperature
MIL-T-22361	(Basic; Am 1; Notice 1) Thread Compound; Antiseize, Zinc Dust-Petrolatum
MIL-T-27730	(Rev A; Notice 2) Tape, Antiseize, Tetrafluoroethylene, with Dispenser
MIL-V-18436	(Rev F) Valves, Check, Bronze, Cast Iron, and Steel Body

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-1689	(Rev B) Tape, Pressure-Sensitive Adhesive, (Plastic Film)
FS A-A-50561	(Basic) Pumps, Rotary, Power-Driven, Viscous Liquids
FS A-A-50568	(Basic) Gages, Liquid Level Measuring, Tank
FS GG-M-2802	Meter, Fluid Quantity Volumetric
FS L-C-530	(Rev C) Coating, Pipe, Thermoplastic Resin
FS L-T-1512	(Rev A) Tape, Pressure Sensitive Adhesive, Pipe Wrapping
FS WW-S-2739	(Basic) Strainers, Sediment: Pipeline, Water, Air, Gas, Oil, or Steam

UNDERWRITERS LABORATORIES (UL)

UL 142	(2002) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 842	(1997; Rev Oct 1999) Valves for Flammable Fluids
UL Gas&Oil Dir	(2003) Flammable and Combustible Liquids and Gases Equipment Directory

1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Carrier Piping

Piping which contains fuel oil, exclusively.

1.3.2 Secondary Containment System

System which contains carrier piping and prevents fuel leakage from carrier piping into surrounding soil and/or water. System may be either boxed-in trench or double-walled piping.

1.4 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

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

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

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Pipe and fittings

Valves

Flexible hose

Dielectric unions

Strainers

Meters

Instruments

Heaters

Pumps

Storage tanks

Secondary containment system for piping

Leak detection system

Copper tube extracted joint

[SD-06 Test Reports

Prefabricated joints for double-walled piping secondary containment.]

SD-07 Certificates

Welding procedure

Qualification of welders

List of welder's names and symbols

Flexible hose

Dielectric unions

Tank surface preparation

Coating materials

Coating application procedure

SD-08 Manufacturer's Instructions

Secondary containment system for piping

Leak detection system

Copper tube extracted joint

Fiberglass and flexible pipe

SD-10 Operation and Maintenance Data

Heaters, Data Package 3

Pumps, Data Package 3

Leak detection system, Data Package 3

Submit in accordance with Section 01 78 23 OPERATION AND
MAINTENANCE DATA.

1.5 QUALITY ASSURANCE

1.5.1 Welding Procedure

Before performing welding, submit three copies of welding procedure specification for metals included in the work, together with proof of its qualifications as outlined in ASME B31.1.

1.5.2 Qualification of Welders

Before welder or operator performs welding, submit [to the Contracting Officer] three copies of the Welder's Performance Qualification Record in conformance with ASME B31.1 showing that the welder was tested under the approved procedure specification submitted by the Contractor.

1.5.3 List of Welder's Names and Symbols

Submit each welder's assigned number, letter, or symbol which shall be used to identify the work of the welder and shall be affixed immediately upon completion of the weld.

1.5.4 Defective Welds

Welders making defective welds after passing a qualification test shall be required to take a re-qualification test. Welders failing the re-qualification tests will not be permitted to work under this contract.

1.5.5 Previous Welder Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without re-qualification, subject to approval by the Contracting Officer provided that all the conditions specified in ASME B31.1 are met before a procedure can be used.

1.6 WELDING SAFETY

AWS Z49.1.

1.7 REGISTRATION

Contractor shall obtain required tank registration or permit/approval application forms from governing regulatory agencies. Furnish completed forms to the Contracting Officer and the installation environmental office within 10 days after contract award for their submission to the regulatory agency.

PART 2 PRODUCTS

NOTE: The SMACNA Seismic Restraint Manual referenced in the paragraph below shall be applied to locations subject to significant risk of seismic induced loads. The degree to which this manual is to be used for contract drawings and specifications shall be determined by the designer of record in coordination with the NAVFAC Engineering Field Division's Mechanical Design Branch.

Provide fuel oil system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1, [and NFPA 70] [NFPA 70 and SMACNA Seismic Restraint Mnl,] as modified and supplemented by the contract specifications and drawings.

2.1 MATERIALS AND EQUIPMENT

2.1.1 Steel Pipe and Fittings

2.1.1.1 Pipe

NOTE: Where pipe is to be threaded use Schedule 80 pipe.

ASTM A 53/A 53M, Schedule [40] [80], black steel, [electric-resistance welded] [or] [seamless].

2.1.1.2 Threaded and Socket-Welding Fittings

ASME B16.11, forged steel, Class [2000] [3000].

2.1.1.3 Threaded Fittings

ASME B16.3, black malleable iron, Class [150] [300].

2.1.1.4 Butt-Welding Fittings

ASME B16.9, Class [150] [300]. Backing rings shall conform to ASME B31.3 and be compatible with materials being welded.

2.1.1.5 Flanges and Flange Fittings

ASME B16.5, steel flanges or convoluted steel flanges which meet the criteria of ASME BPVC SEC VIII D1. Flange faces shall have integral grooves of rectangular cross section which afford containment for self-energizing gasket material.

2.1.2 Copper Piping

NOTE: Copper alloy piping materials shall not be used within a boiler plant structure.

2.1.2.1 Pipe and Tubing

ASTM B 88, Type [K] [or] [L], [hard-drawn] [annealed].

2.1.2.2 Flanges and Flanged Fittings

ANSI B16.24, Class [150] [300].

2.1.2.3 Solder Joint Fittings

ASME B16.22 wrought copper.

2.1.3 Fiberglass and Flexible Pipe

2.1.3.1 Pipe

Fiberglass and flexible pipe shall be approved by the Underwriters Laboratories for the service intended and listed in UL Gas&Oil Dir. Use of fiberglass or flexible piping is limited to buried service only and at pressures not exceeding that marked on the pipe.

2.1.3.2 Fiberglass Pipe Fittings

Fiberglass pipe fitting shall be the same manufacturer as the pipe with adhesives compatible with the product. Threading of fiberglass pipe or mechanical pipe coupling will not be permitted.

2.1.3.3 Flexible Pipe Fittings

Bronze mechanical coupling shall be supplied by the same manufacturer as the pipe.

2.1.4 Vent Piping

ASTM A 53/A 53M standard weight, zinc-coated steel with zinc-coated malleable iron fittings ASME B16.3.

2.1.5 Valves

2.1.5.1 Bronze Gate Valves

MSS SP-80 Class 125, 50 mm 2 inches and smaller, wedge disk, nonrising stem.

2.1.5.2 Steel Gate Valves

API 600, oil service, Class 150.

2.1.5.3 Ball Valves

MSS SP-72 for flanged or butt-welding ends and MSS SP-110 for threaded, socket-welding, solder joint, grooved and flared ends.

2.1.5.4 Relief Valves

UL 842, steel or bronze bodies, corrosion-resistant valve seats, and positive closing to prevent leakage.

2.1.5.5 Check Valves

MIL-V-18436, Group [A] [C], Type [I] [II] [III] [____], Trim [3] [4] [5] [____], Class 150 [____].

2.1.5.6 Plug Valves

[Bronze] [Cast-Steel] [API Std 599], PTFE seat, non-lubricated full port, [taper plug] [square head], UL listed.

2.1.6 Secondary Containment System for Piping

NOTE: Specify secondary containment for piping when
required by state, regional, or local laws,
regulations, statutes, etc.

Provide [boxed-in trench] [double-walled piping] secondary containment system for underground piping to completely contain the carrier piping from the tank, including swing joints, to [within 150 mm 6 inches of interior point of connection] [150 mm 6 inches aboveground]. Secondary containment shall allow for complete inspection of carrier pipe connections, during carrier pipe hydrostatic testing, before the secondary containment system is sealed. When steel pipe is provided as the secondary containment, provide protection as specified in paragraph entitled "Protective Coating Systems for Underground Steel Piping." The secondary containment system for underground piping shall be:

- a. Compatible with No. [____] fuel oil.
- b. Non-corrosive, di-electric, non-degradable and resistant to attack from microbial growth.
- c. Designed and made of materials which have sufficient strength to withstand the maximum underground burial loads. [Double-walled outer piping shall be able to withstand H2O loading and a minimum 34 kPa 5 pounds per square inch air pressure test. Prefabricated joints shall be 100 percent air tested at factory.]

2.1.7 Piping Accessories

2.1.7.1 Flexible Hose

Flexible metal hose, corrugated type with braided wire sheath covering, close-pitch annular corrugations, rated for a working pressure of at least 862 kPa (gage), 200 mm 125 psig, 8 inch minimum live length, [flanged] [screwed] end connections, UL listed for flammable liquid service. Metal for hose and braided wire sheath shall be stainless steel, any type of ASTM 300-series.

2.1.7.2 Unions

ASME B16.39, Class [150] [250] pound.

- a. Dielectric Unions: Union comprised of steel female pipe thread end and copper solder-joint end conforming to dimensional, strength, and pressure requirements of ASME B16.39, Class 1. Steel parts shall be galvanized or plated. Union shall have a

water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint. When dry, it shall be able to withstand a 600-volt breakdown test.

2.1.7.3 Welding Filler Metal

ASME B31.4 and compatible with the materials to be welded.

2.1.7.4 Brazing Filler Metal

AWS A5.8, silver base alloy, with melting point not less than 593 degrees C 1100 degrees F.

2.1.7.5 Hangers, Supports, and Shields

Design, selection, fabrication, installation, and spacing shall conform to MSS SP-58 and MSS SP-69. Hangers, supports, rods, anchors, nuts, bolts, and washers shall be hot-dip galvanized. Hangers and supports shall be of the adjustable type.

2.1.7.6 Strainers

FS WW-S-2739 [single] [duplex] basket type, with inlet and outlet on the same center line. Cast steel or fabricated steel body, [40 by 40] [[_____] by [_____] mesh ASTM 300-series stainless steel baskets. Open area of one basket shall be 2 1/2-times inlet or outlet piping area. Furnish one spare basket.

2.1.7.7 Gaskets

Provide one piece, factory cut, 1.60 mm 1/16 inch thick, gaskets resistant to the effects of fuel oil and manufactured of fire-resistant materials. Provide full-face gaskets for flat-face flanged joints, and ring gaskets for raised-face flanged joints. Dimensions for gaskets shall be in accordance with ASME B16.21.

2.1.7.8 Bolting

Material for bolts and studs ASTM A 307, Grade-B and for nuts ASTM A 194/A 194M, Grade-2. Dimensions of bolts, studs and nuts ANSI B18.2.1 and ASME B18.2.2 with threads conforming to ASME B1.1 coarse type, with Class 2A fit for bolts and studs, and Class 2B for nuts.

2.1.7.9 Sleeves in Masonry and Concrete Walls, Floors, Roofs

Provide ASTM A 53/A 53M, Schedule 40 or Standard Weight, zinc-coated steel pipe sleeves.

2.1.7.10 Sleeves in Other Wall, Floor, and Roof Materials

Provide minimum 26 gage zinc-coated steel sheet sleeves in partitions and other than masonry and concrete walls, floors, and roof.

2.1.7.11 Floor, Walls, and Ceiling Plates

Plates shall be painted cast-iron, malleable iron, or steel.

2.1.7.12 Identification for Piping Aboveground

Labels for pipes 20 mm 3/4 inch diameter and larger shall bear printed legends to identify contents of pipes and arrows to show direction of flow.

Labels shall have color coded background to signify levels of hazard in accordance with ANSI A13.1. Legends and type and size of characters shall also conform to ANSI A13.1. Make labels of plastic sheet FS A-A-1689 with pressure sensitivity suitable for intended applications, or they may be premolded of plastic to fit over pipe. For pipes smaller than 20 mm 3/4 inch diameter, provide brass identification tags 40 mm 1 1/2 inches in diameter with legends in depressed black filled characters.

2.1.7.13 Buried Utility Warning and Identification Tape

Detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 80 mm 3 inches minimum width, yellow in color with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read "CAUTION BURIED FUEL OIL PIPING BELOW" or similar wording. Provide permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with printed side up at a depth of 300 mm 12 inches below top surface of earth or top surface of subgrade under pavements.

2.1.7.14 Miscellaneous Metal

ASTM A 36/A 36M, standard mill finished structural shapes, hot-dip galvanized after fabrication.

2.1.8 Meters

FS GG-M-2802, Style A [piston] [or] [disk], size as indicated, for [_____] liter per second gpm maximum flow of Grade No. [_____] fuel oil at [_____] to [_____] degrees C F and [_____] kPa (gage) psig maximum pressure. Meter shall be arranged for mounting [in pipe line] [on pedestal] [and shall have overrange protection]. Casing shall be [aluminum] [bronze] [cast-iron]. Pressure drop through meter shall not exceed [_____] kPa psi. Provide [combination register-totalizer] [and] [water escape hole].

2.1.9 Instruments

2.1.9.1 Tank Gages

FS A-A-50568, buoyant force type with direct reading dial.

2.1.9.2 Thermometers

Thermometers shall be bi-metal dial type with stainless steel case, stem, and fixed thread connection; 125 mm 5 inch diameter dial with glass face gasketed within the case; accuracy within one percent of scale range. Provide scale range suitable for the intended service.

2.1.9.3 Pressure Gages

ASME B40.1, single style with 115 mm 4 1/2 inch diameter dial for fuel, brass or aluminum case, bronze tube; accuracy within [2] [_____] percent of scale range. Provide scale range suitable for the intended service.

2.1.10 Protective Coating Systems for Underground Steel Piping

2.1.10.1 Underground Piping and Fittings

Provide protective coating system on both steel carrier piping when direct buried, in secondary containment or in a trench and on steel secondary containment piping.

- a. Piping: New steel pipe shall receive protective coating system of factory-applied adhesive undercoat and continuously extruded polyethylene coating conforming to **FS L-C-530**, minimum thickness of plastic resin shall be **0.91 mm 36 mils** for pipe sizes **150 mm 6 inches** and larger, and **0.58 mm 23 mils** for pipe sizes under **150 mm 6 inches**.
- 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 tape. Surfaces to be tape wrapped shall be clean, dry and grease free. Tape conforming to **FS L-T-1512** and of the type specified below shall be applied over a primer compatible with the tape and the extruded polyethylene coating.

NOTE: Polyethylene heat shrink sleeves can be used for welded joints and pipe with factory applied polyethylene coating in lieu of protective tape; however not recommended for systems with numerous bends.

(1) Fittings, Couplings, and Regular Surfaces: Tape shall be initially stretched sufficiently to conform to the surface to which it is applied, using one layer lapped at least **25 mm one inch**. Tape shall overlap the extruded polyethylene coated piping **80 mm 3 inches** at all joints. A second layer, lapped at least **25 mm one inch**, with a tension as it comes off the roll shall be applied and pressed to conform to the shape of the component. Tape shall conform to **FS L-T-1512**, Type II, **0.51 mm 20 mils** nominal thickness. Do not wrap joints until completion of pressure testing.

(2) 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 **80 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. Tape shall conform to **FS L-T-1512**, Type II, **0.51 mm 20 mils** nominal thickness.

(3) Existing Piping Affected by the Contractor's Operation: Wrap to **80 mm 3 inches** beyond the point of connection.

- c. Flanges, Valves, and Irregular Surfaces: These items shall receive coal tar base coating conforming to **MIL-C-18480** applied to a minimum dry film thickness of **0.76 mm 30 mils**.

2.1.10.2 Cathodic Protection

NOTE: Cathodic protection is required for all parts of an underground storage tank system that are made of steel (except for FRP coated steel tanks) and that are in contact with the ground. Cathodic protection shall be designed by a licensed corrosion engineer or cathodic/corrosion protection specialist certified by the National Association of Corrosion Engineers (NACE) in accordance with the current edition of MIL-HDBK-1004/10, "Electrical Engineering Cathodic Protection."

Underground coated steel piping shall have cathodic protection with test stations as specified in Section [26 42 13.00 20 CATHODIC PROTECTION BY GALVANIC ANODES] [26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT].

2.1.11 Protective Coating Materials for Aboveground Pipe and Tanks

Coatings shall be the products of one manufacturer and coating application procedure shall be in accordance with manufacturer's instruction. Tank surface preparation shall be abrasive blast clean steel surfaces in accordance with SSPC SP 10 to a surface profile of 0.013 to 0.051 mm 1/2 to 2 mils.

2.1.11.1 External Coatings

Protect aboveground piping and steel tanks against atmospheric corrosion with a coat of organic, lead and chromate free, zinc-rich primer conforming to SSPC Paint 20, Type II applied to a minimum dry film thickness of 0.102 mm 4 mils and finish with two coats of epoxy-polyamide topcoat conforming to MIL-P-24441. Apply a gray first topcoat conforming to MIL-P-24441/2, Formula 151 applied to a minimum dry film thickness of 0.076 mm 3 mils and finish with a white second topcoat conforming to MIL-P-24441/3, Formula 152 applied to a minimum dry film thickness of 0.076 mm 3 mils resulting in a total system minimum dry film thickness of 0.28 mm 11 mils.

2.1.11.2 Internal Coatings

Internally coat tanks larger than 76 cubic meters 20,000 gallons. Prior to coating tank interior, seal unsealed lap seams with epoxy cement conforming to DOD-C-24176, Type II. Fill voids that are inaccessible to brush applied coatings with epoxy cement prior to coating application. Provide a [three coat epoxy-polyamide system conforming to MIL-P-24441] [two coat epoxy resin system conforming to MIL-C-4556]. Coat tank bottom and up 457 mm 18 inches on all sides.

- a. [MIL-P-24441 System: Provide MIL-P-24441/1, Formula 150 primer, MIL-P-24441/2, Formula 151 intermediate coat and MIL-P-24441/3, Formula 152 topcoat. Apply each coat to a minimum dry film thickness of 0.076 mm 3 mils resulting in a total system minimum dry film thickness of 0.25 mm 10 mils.]

NOTE: Specify Composition I coating for use in areas with regulations controlling the emission of

solvents into the atmosphere.

- b. [MIL-C-4556 System: Composition [G, General] [L Limited] use.
Apply each coat to a minimum dry film thickness of 0.076 mm 3 mils
resulting in a total system minimum dry film thickness of 0.18 mm
7 mils.]

2.2 FUEL OIL HEATERS AND PUMPING EQUIPMENT

2.2.1 Storage Tank Heater

NOTE: Provide heaters for all fuel systems for No.
6 oil. The designer shall determine the
requirements for heating the other fuel oils from
the fuel oil supplier's specifications.

NOTE: For all aboveground heated tanks the design
shall include an economic analysis for the incentive
to insulate the storage tank.

Vertical type installed through a [_____] mm inch diameter manhole in top
of tank. Weld pipe connections to manhole cover. Entire assembly shall be
removable as a unit. Heater shall have the capacity to heat [_____] liter
per second gpm of No. [_____] fuel oil from [_____] degrees C F to [_____]
degrees C F when supplied with [[_____] kPa (gage) psig steam] [[_____]
liter per second gpm of [_____] degree C F hot water]. Coil shall have
steel tubes and be designed for working pressure of [_____] kPa (gage) psig.
Coil shall extend to within 150 mm 6 inches of tank bottom and shall
surround oil suction line. Heater shall be provided with [bottom] [side]
suction, inlet and outlet, drains, vent, thermometer and pressure gage.

2.2.2 Shell and Tube Heater

The shell, containing oil, shall be steel with steel or cast iron heads and
20 mm 3/4-inch o.d. by 16 BWG steel tubes with removable bundles rated for
1034 kPa (gage) 150 psig working pressure. Construct unit in accordance
with ASME BPVC SEC VIII D1 and design for [_____] kPa (gage) psig. Heater
shall have necessary heating medium connections such as inlet and outlet,
drain, vent, thermometer, and pressure gage. Heater shall have the
capacity to heat [_____] liter per second gpm of No. [_____] fuel oil from
[_____] degrees C F to [_____] degrees C F when supplied with [[_____] kPa
(gage) psig steam] [[_____] liter per second gpm of [_____] degrees C F
hot water].

2.2.3 Electric Heater

Construct heater with steel shell and steel flanges and design for [_____]
kPa (gage) psig. Heater shall have sufficient capacity to heat [_____]
liter per second gpm of No. [_____] fuel oil from [_____] degrees C F to
[_____] degrees C F while operating on [_____] volts, [_____] phase,
[_____] Hz electric service. Control electric heater by a magnetic starter
with a manually operated "on-off" switch in series with a thermostatic
control with an adjustable range.

2.2.4 Oil Pumps

NOTE: Maximum suction lift for internal gear pumps
shall not exceed 34 kPa 10 inches Hg.

FS A-A-50561 suitable for No. [_____] oil at a viscosity of [_____] Pa.S SSU.
Pumps shall deliver [_____] liter per second gpmat a developed head of
[_____] kPa feet and a suction lift not less than [_____] kPa feet. Mount
pump and direct connected electric motor or steam turbine on extended base
plate. Provide a drip pan with each pump. Provide all metal flexible
coupling between pump and drive. Provide pressure relief valve on
discharge lines, piped to return line. Provide duplex strainer on suction
side. Motor starters on oil pumps shall be lockable.

2.3 FUEL OIL STORAGE TANKS AND ACCESSORIES

2.3.1 Fuel Oil Storage Tanks

NOTE: For steel aboveground tanks with a capacity
of more than 19 cubic meters 5000 gallons, provide a
manhole in accordance with UL 142.

NOTE: For aboveground tanks with a capacity larger
than 2501 liters 660 gallons, provide a dike to
contain entire contents of tank or largest single
tank in a bulk storage tank installation, with
sufficient freeboard to allow for precipitation or a
drainage system leading to an inplant catch basin or
holding pond.

NOTE: State Environmental Control Regulations are
becoming increasingly more restrictive when it comes
to installing new underground fuel tank systems.
Some states are now requiring leak detection
monitoring systems and secondary containment for
piping. Currently, NAVFAC policy requires
double-walled tanks with interstitial monitoring
capability. The designer shall check to ensure that
the tank and piping system being provided will meet
the current state, regional and local laws,
regulations, statutes, etc. Refer to Section 33 56
16, "Underground Petroleum Tanks" for underground
tanks.

Construct fuel oil tanks of steel to comply with NFPA 30, NFPA 31, and
UL 142. [Each fuel oil tank shall have a [_____] mm inch diameter manhole
on top, with the same diameter extension neck, and bolted cover with
gastight gasket. Tank shall include an interior bolted ladder.] Provide
openings for fill, vent, pump suction, oil return, oil level gage [, and
oil heater]. Size vent pipes according to NFPA 30, NFPA 31, and UL 142 but
not less than 32 mm 1 1/4 inch nominal inside diameter. Vent pipe shall

connect to tapping at high end of tank and shall not extend more than 25 mm one inch into tank. For underground tanks, refer to Section 33 56 16 UNDERGROUND PETROLEUM TANKS.

2.3.2 Design, Construction, and Testing of Fuel Oil Tanks

Aboveground steel fuel oil tanks, UL 142, welded construction, UL listed.

2.3.3 Connections to Fuel Oil Tanks

Provide the following connections:

- a. Goose-neck vent caps or caps conforming to MIL-C-19902.
- b. Fill lines with removable single strainer and locking fill boxes.
- c. A sounding connection, to permit entry of the gaging rod, with a locking cap. Provide graduated gaging rod and calibration chart.
- d. Pump suction lines with internal vertical pipes [and foot valve] extending to within 100 mm 4 inches of tank bottom.
- e. Fuel oil supply, return, fill and vent piping utilizing swing joint elbows to allow for ample tank movement and pipe expansion. Drain piping into tank when pump is shut-off.
- f. Flexible hose connections for vibration isolation of oil burning equipment.
- g. On steel tanks weld a 300 by 300 by 6 mm 12 by 12 by 1/4 inch steel striker plate under gage and fill lines.
- h. Nylon dielectric bushings on pipe connections to steel tanks.
- i. Ball float valves on vent lines to restrict flow into tank when the tank reaches 90 percent full.
- j. Automatic high level alarm with setting of approximately 95 percent and 98 percent of tank capacity. Audible alarm shall sound locally at tank, [and alarm signal shall be transmitted to remote locations as indicated].

2.3.4 Monitoring System to Detect Fuel Oil and Water Leaks

NOTE: Federal Register Part II Environmental Protection Agency 40 CFR Parts 280 and 281 requires a method of release detection for pressurized underground fuel piping which is either direct buried or in secondary containment.

Provide an electrical or electronic control center in accordance with Section 33 56 16 UNDERGROUND PETROLEUM TANKS. Automatic line leak detection system for pressurized piping shall detect leaks of 3.20 milliliter per second 3 gallons per hour at 69 kPa 10 pounds per square inch line pressure within 1 hour.

[Vapor monitoring for direct buried piping shall include vapor sensors

located in monitoring wells as indicated. The vapor sensor shall monitor the unsaturated zone of the monitoring well for hydrocarbons. The sensor shall be UL listed and classified for NFPA 70 Class 1, Division 1, Group C and D hazardous location].

[Groundwater monitoring for direct buried piping shall include liquid sensors located in monitoring wells as indicated. The liquid sensor shall monitor the liquid hydrocarbons floating in the ground water surface directly at the air/water interface. The sensor shall measure at least 3 mm 0.125 inches of oil on water. The sensor shall be UL listed and classified for NFPA 70 Class 1, Division 1, Group C and D hazardous location.]

[Interstitial monitoring system in secondary containment shall include sensor probes located in the low point sump of the secondary containment system as indicated. The collection sumps shall include the following:

- a. A lid designed to prevent surface water from draining down into the sump.
- b. A vent which will allow any collection of vapors to escape.
- c. Sufficient strength to keep out the surrounding backfill material.

Probes shall measure at least 3 mm 0.125 inches of oil on water. Probes shall meet NFPA 70, Class 1, Division 1, Group D hazardous location requirements.]

[Interstitial monitoring system for the secondary containment shall include sensing cables located in the annulus of double-wall pipes or floor of trench. Sensing cable shall detect the presence of fuel at any point along its length. System shall meet NFPA 70 Class 1, Division 1, Group D hazardous location requirements.]

PART 3 EXECUTION

3.1 INSTALLATION

Contractor shall provide installation of fuel oil piping system in accordance with applicable Federal, State, regional or local regulations.

3.1.1 Fuel Oil Piping System

Install piping in out-of-the-way locations, in a manner that will minimize cutting of beams, girders, columns, or load-bearing members. Installation of oil piping and equipment in buildings shall conform to NFPA 30 and NFPA 31, except as indicated or specified herein. Underground piping shall also conform to API RP 1615.

3.1.1.1 Underground Piping

- a. Arrange piping to minimize piping across tanks.
- b. Piping shall be free from traps and shall drain toward tank.
- c. Provide swing joints at points where underground piping connects to the tank.

[d. Install underground fuel lines in a single trench with a bed of

well-compacted non-corrosive material such as cleaned, washed sand at least 150 mm 6 inches deep.]

- [e. Trenches shall be wide enough to permit at least 150 mm 6 inches of backfill between underground fuel lines and the sides and floor of the trench. Provide cover of at least 150 mm 6 inches.]

3.1.2 Pipe Sleeves and Plates

Provide sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Extend sleeves in floor slabs 80 mm 3 inches above the finished floor. Provide not less than 6 mm 1/4 inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and calk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal. Secure plates to pipes at sleeves.

3.1.3 Steel Piping

Steel piping 50 mm 2 inches and smaller shall be threaded or socket-welded.

Steel piping 65 mm 2 1/2 inches and larger shall be butt-welded. Flanges may be used for valves and equipment installation. Piping joints shall conform to ASME B31.3. Direct buried piping connections shall be welded.

3.1.4 Threaded Joints in Piping

Provide lubricant or polytetrafluoroethylene tape conforming to MIL-T-27730 on male threads of screwed joints. Red or white lead and zinc compound conforming to MIL-T-22361 may be used. Lubricate threaded pipe joints, as well as bolts and studs used on high temperature pipe joints up to 566 degrees C 1050 degrees F, with anti-seize compound in accordance with MIL-PRF-907. Piping shall be free from fins and burrs. Ream or file out pipe ends to size of bore and remove chips. Attach screwed flanges by screwing the pipe through the flange, and reface pipe and flange accurately.

3.1.5 Copper Tubing

Cut with square ends and remove burrs and fins. Replace tubing cut, dented, or otherwise damaged with new tubing. Clean outside surface of tubing ends and inside recess of fittings to bright metal with wire brush or abrasive, then apply flux to outside surface of tubing ends and on the recess inside of fittings. Insert tubing to the full depth of fitting, then braze. Remove stems and washers of solder-joint type valves before brazing. Brazing procedure qualification and preparation and procedures for joints shall be in accordance with ASME B31.3.

3.1.5.1 Copper Tube Extracted Joint

Extracted mechanical tee joint may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to assure a free flow joint. Braze extracted joints using a copper phosphorous classification brazing filler metal. Soldered joints are not permitted.

Joints shall meet all system design and test requirements specified herein, be approved by the manufacturer for the specific service and be installed in strict accordance with the manufacturers written procedures and instructions.

3.1.6 Non-Metallic Piping

Non-metallic piping shall be installed in accordance with pipe manufacturer's instruction.

3.1.7 Welding

3.1.7.1 Welding of Piping

Welding of joints in piping, butt welds, fillet welds, bends, loops, offsets, and cleaning of pipe shall be in accordance with [ASME B31.1](#). Welds shall be visually examined and meet acceptance standards specified in Chapter VI of [ASME B31.1](#).

3.1.7.2 Quality of Welds

Quality of welds, correction of defects, stress relieving, and preheating shall be in accordance with [ASME B31.1](#).

3.1.7.3 Arc Welding and Gas Welding

In accordance with [ASME BPVC SEC IX](#).

3.1.8 Unions and Flanges

Place unions and flanges where necessary to permit easy disconnection of piping and apparatus. Each connection having a threaded end valve shall have a union.

3.1.9 Valves

Install valves in positions accessible for operation and repair.

3.1.10 Thermometers

Provide thermometers and thermal sensing elements of control valves with separable sockets. Install separable sockets in pipe lines in such a manner to sense the temperature of flowing fluid and minimize obstruction to flow.

3.1.11 Fuel Oil Storage Tanks

Install storage tanks, vents and other connections in accordance with [NFPA 30](#), [NFPA 31](#), recommendations and published instructions of the manufacturer, and as indicated. Provide grounding of tanks directly through ground rods or through bonding to grounded network in accordance with [NFPA 780](#). Fasten aboveground fuel oil tanks on a firm reinforced concrete foundation. Provide fireproofed steel supports between tank and foundation. Concrete shall have a compressive strength of [_____] MPa psi, [20] [_____] mm [3/4] [_____] inch maximum aggregate size and [80 to 100] [3 to 4] [[_____] to [_____] mm inch slump. Materials for sand, gravel, and concrete shall meet requirements specified in Section [03 30 00.00 20 CAST-IN-PLACE CONCRETE] [Short Form 03 30 00.00 20 CAST-IN-PLACE CONCRETE].

3.2 FIELD QUALITY CONTROL

Prior to application of test pressure, remove or valve off piping components which may be damaged by test and install a calibrated test gage in the system. Maintain test pressure for at least one hour. In the event of leakage, locate and repair leak by rewelding and repeat test. Materials and equipment shall be subject to inspection at the installation site by the Contracting Officer.

3.2.1 Piping Test

Before final acceptance of the work, test each system as in service to demonstrate compliance with contract requirements. Furnish electricity, instruments, connecting devices, and personnel for the tests. Correct defects in work provided by the Contractor and repeat tests until work is in compliance with contract requirements. Government will furnish fuel for piping testing and flushing provided by the Contractor. Contractor shall be responsible for test fuel losses greater than 10 percent.

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

3.2.1.1 Pneumatic Test

Pneumatically test each piping system to 172 kPa (gage) 25 psig, examine joints with soap solution. Gradually increase to 345 kPa (gage) 50 psig and hold for 1 hour. The pneumatic test is more hazardous than a hydrostatic test, therefore, special safety measures, including the wearing of face masks, shall be taken during testing under pressure. Only authorized personnel shall be permitted in the area during pneumatic and hydrostatic testing.

3.2.1.2 Hydrostatic Tests

Upon completion of pneumatic testing, hydrostatically test each piping system at 1.5 times maximum system operating pressure but in no case more than 1896 kPa (gage) 275 psig in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gage pressure for 4 hours.

3.2.1.3 Flushing

Thoroughly flush piping before placing in operation. Flush piping, including branch piping, at a minimum velocity of 2.40 meters 8 feet per second.

3.2.2 Secondary Containment Piping Test

The secondary containment piping system shall undergo a 34 kPa 5 psi minimum air-pressure/soap test upon completion of installation to confirm the secondary containment integrity. This testing shall be in compliance with the manufacturer's published installation instructions.

3.2.3 Protective Coating Systems

Inspect protective coating systems, with a holiday tester just prior to placement in ground. Holidays revealed shall be promptly repaired. Steel piping coating system shall be given a holiday test with a voltage of 100 to 200 times the mm mil thickness of the coating.

3.2.4 Steel Fuel Oil Storage Tanks

Test tanks for leaks by applying internal air pressure and using soapsuds, linseed oil or equivalent material on external welds. For horizontal tanks, test pressure shall be not less than 34 5 nor more than 48 kPa (gage) 7 psig. For vertical tanks, test pressure shall be not less than 10 kPa (gage) 1 1/2 psig nor more than that pressure which first causes visible deformation of the tank. During testing, tank shall be provided with a suitable pressure relief device.

3.2.5 Cathodic Protection

Test to prove continuity of electrical connections prior to backfill.

3.2.6 Leak Detection

Test the leak detection monitoring system in accordance with the manufacturer's testing procedure.

-- End of Section --