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USACE / NAVFAC / AFCEA / NASA            UFGS-23 11 16.00 20 (April 2006)  
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Preparing Activity:    NAVFAC            Replacing without change  
   UFGS-15191N (September 1999)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 18 July 2006

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### SECTION 23 11 16.00 20

#### FIBERGLASS REINFORCED PLASTIC (FRP) PIPING (FOR PETROLEUM) 04/06

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NOTE: This guide specification covers the requirements for design, installation, and testing of fiberglass reinforced plastic piping for petroleum products in underground locations.

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.

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NOTE: This guide specification is an acceptable alternate for aluminum or stainless steel in installations where noncorrosive pipe is required. Delete "(FOR UNDERGROUND PETROLEUM PRODUCTS)" from the title in project specifications.

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## PART 1 GENERAL

### 1.1 REFERENCES

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

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

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

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

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D (2002; Errata 2005) Specification for Pipeline Valves

ASTM INTERNATIONAL (ASTM)

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

ASTM C 920 (2005) Elastomeric Joint Sealants

ASTM C 94 (1994) Ready-Mixed Concrete

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

MSS SP-72 (1999) Ball Valves with Flanged or Butt-Welding Ends for General Service

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-18480 (Rev B; Notice 1) Coating Compound, Bituminous, Solvent, Coal-Tar Base

MIL-P-29206 (Rev A; Am 2; Notice 1) Pipe and Pipe Fittings, Glass Fiber Reinforced Plastic, for Liquid Petroleum Lines

MIL-V-18436 (Rev F) Valves, Check, Bronze, Cast Iron, and Steel Body

MIL-V-18634 (Rev B; Notice 2) Valves: Safety, Relief, and Safety-Relief

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-S-001543 (Rev A) Sealing Compound: Silicone Rubber Base (For Calking, Sealing, and Glazing in Buildings and Other Structures)

## 1.2 SUBMITTALS

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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.

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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-02 Shop Drawings

FRP piping system

### SD-03 Product Data

FRP pipe and fittings

Adhesive

Valves

### SD-06 Test Reports

Initial pneumatic tests

Second pneumatic tests

Hydrostatic test

Hydrostatic cycle test

Operational test

#### SD-07 Certificates

List of qualified installers

Final certification of FRP pipe system

Glass fiber reinforced plastic fuel systems

#### SD-11 Closeout Submittals

Daily reports

### 1.3 QUALITY ASSURANCE

#### 1.3.1 List of Qualified Installers

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NOTE: Contractor's responsibility for qualification, has been approved by NAVFAC HQ 021 in accordance with the requirements of NAVFAC P-68. The paragraph in the guide specification may be used without any other NAVFAC approval or request for waiver.  
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Submit [to the Contracting Officer] a manufacturer's certified list of contractor personnel qualified to install and join the FRP piping. Personnel not on the list will not be permitted to install and join FRP piping.

#### 1.3.2 Final Certification of FRP Pipe System

Upon completion of the project and before final acceptance, deliver [to the Contracting Officer] a statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in complete accordance with the contract plans and specifications and the FRP pipe manufacturer's prescribed procedures and techniques.

#### 1.3.3 Glass Fiber Reinforced Plastic Fuel Systems

Certify the systems and products required to conform to the testing requirements of MIL-P-29206 do and that all the products provided meet the specified requirements and were manufactured with the same materials and procedures as those tested.

#### 1.3.4 Daily Reports

Submit a daily written report at the construction site. The report shall note which employees were making FRP pipe joints. The original report shall be signed by the Contractor and presented [to the Contracting Officer] on the same day it is prepared. The report shall state whether or

not the condition and quality of the materials used and the installation of the system is satisfactory in all respects. If the installation is unsatisfactory, the reports shall state what corrective action has been taken, or shall contain the recommendations for corrective action.

## PART 2 PRODUCTS

### 2.1 MATERIALS

FRP piping system shall conform to the respective specifications and standards and to the requirements specified herein. Pipe, fittings, and joint adhesives shall be supplied by the same manufacturer. Threaded fittings or mechanical couplings will not be permitted.

#### 2.1.1 FRP Pipe and Fittings

MIL-P-29206. FRP pipe Type I, filament wound with filament wound fitting or Type II, centrifugally cast with centrifugally cast fitting.

#### 2.1.2 Flanged Connections

Flat or flat face-type flanges with raised integral sealing rings inside and outside of bolt hole circle.

##### 2.1.2.1 FRP Flanges

MIL-P-29206.

##### 2.1.2.2 Gaskets

3 mm 1/8 inch full face, Shore A hardness of 60, Buna-N rubber.

#### 2.1.3 Bolting

Stainless steel bolts, nuts, and washers.

#### 2.1.4 Valves

Flanged hand operated line valves, air vent valves, and drain valves are required where indicated. Valves in noncorrosive aviation fuel systems shall have aluminum (Alloys 3003 or 6061) or stainless steel (Type 304 or 316) bodies and not contain zinc, zinc-coated, copper, or copper-bearing materials in contact with the fuel. Other valves shall have carbon bodies and bonnets. Cast-iron or bronze-bodied valves shall not be furnished or installed in liquid petroleum service.

##### 2.1.4.1 Gate Valves

API Spec 6D, minimum Class 150, steel body, except as specified otherwise, flexible wedge disc type, conduit disc type or double-disc type with rising stem, outside screw, and yoke.

##### 2.1.4.2 Ball Valves

MSS SP-72, Class 150, except as specified otherwise, nonlubricated double-seated type capable of handling two-way shutoff, [full bore] [or] [nominal bore]. Provide valves larger than 50 mm 2 inches with a drilled, tapped, and plugged opening to drain the valve body.

#### 2.1.4.3 Check Valves

MIL-V-18436, Type IV, Class 150, nonslamming type, except as specified otherwise.

#### 2.1.4.4 Relief Valves

MIL-V-18634, Type III, Class 10, Style D, except as specified otherwise.

#### 2.1.4.5 Vent and Drain Valves

Stainless steel or aluminum construction.

#### 2.1.5 Valve Boxes

For each buried valve provided cast-iron, ductile-iron, or plastic box of a suitable size. Provide cast-iron, ductile-iron, or plastic cover for the box with "FUEL OIL" cast on the cover. Plastic boxes shall be constructed of ABS plastic or inorganic fiber-reinforced black polyolefin plastic. Coat cast-iron and ductile-iron boxes with bituminous paint conforming to MIL-C-18480.

### PART 3 EXECUTION

#### 3.1 FRP PIPING FIELD ASSEMBLY

Shall be in accordance with the manufacturer's written instructions and installation procedures as approved by the Contracting Officer. Submit design and installation drawings that indicate and detail recommended installation procedures including provisions for expansion, anchors, thrust blocks, supports, vent, and drain connections.

##### 3.1.1 Inspection

Prior to preparation and assembly, the Contractor shall inspect pipe for physical damage and make repairs in accordance with the manufacturer's written instructions, except over wrapping the damaged or faulty area with any type patch or other material will not be permitted.

##### 3.1.2 Preparation

Sand surfaces to be bonded, including those formed or shaved at the factory, not more than 2 hours prior to assembly. Clean and remove sanding dust to obtain surfaces suitable for bonding. Sanded surfaces which come in contact with hands, equipment, or dirt must be re-sanded. Dry and re-sand damp or wet bonding surfaces as required by the manufacturer. During rain or cold weather, prepare joint and assemble under a protective cover with heat applied. Pipe cut to length in the field shall have ends square within 1.60 mm 1/16 inch for all diameters through 300 mm 12 inch pipe. Form spigot ends using tools recommended by the manufacturer. Align and fit prepared joints prior to application of adhesive.

##### 3.1.3 Adhesive Mixing and Application

MIL-P-29206, adhesive materials, mixing, and application shall be in accordance with manufacturer's instructions including limitations on adhesive shelf life and pot life.

#### 3.1.4 Assembly and Alignment

Assemble FRP pipe and fittings according to manufacturer's instructions. Proper alignment must be maintained during assembly so that twisting or straightening is not required after joining. Misalignment shall not exceed 1.60 mm 1/16 inch or one degree prior to application of adhesive.

#### 3.1.5 Curing

Cure FRP pipe joints and fitting joints according to the manufacturer's instructions. Heating devices shall be as recommended by the FRP pipe manufacturer. Do not move, vibrate, or otherwise disturb joints during curing of adhesive.

#### 3.1.6 Connections to Metal Pipe

Use flanged connections between FRP pipe and metal pipe with the metal pipe anchored within 1.50 meters 5 feet of the connection. Do not transmit expansion and load forces of metal piping to the FRP pipe. Do not bury metal-to-FRP connections. Install washers under bolt heads and nuts on flanges, and torque bolts in accordance with manufacturer's requirements.

#### 3.1.7 Air Vents and Low Point Drains

Install hand operated air vent valves at all high points in the piping. Install hand operated low point drain valves at low points in the piping.

#### 3.1.8 Pitch

Pitch horizontal buried fuel piping, unless otherwise indicated, with a downward grade of not less than 25 mm in 15 meters one inch in 50 feet in the direction of low point drains.

### 3.2 FRP PIPE INSTALLATION

#### 3.2.1 FRP Pipe Assembly

Visually inspect the inside of each length of pipe to ensure that it is clear and clean prior to installation. Not more than 12 meters 40 foot lengths of FRP pipe can be assembled over or beside the trench. Assemble greater lengths in the trench. Assemble outside the trench on timbers with the pipe blocked to hold alignment. Lower pipe into the trench in accordance with the manufacturer's recommendations. Lowering operation shall not move or disturb FRP pipe where joints are being assembled and cured. Block and support FRP pipe assembled in the trench with bedding to hold alignment.

#### 3.2.2 Thrust Blocks

Cast thrust blocks after successful completion of hydrostatic testing. Encase each elbow, tee, and change in size or direction of the FRP pipe in a concrete thrust block with dimensions sized to handle thrusts from design temperatures and pressures in accordance with FRP pipe manufacturer's recommendations and local soil conditions. In any case, thrust block shall provide a minimum of 0.30 square meter 3 square feet of thrust bearing surface against undisturbed soil, able to withstand both tensile and compressive loads, and with a minimum pipe-to-bearing surface single dimension of 255 mm 10 inches, and 0.255 cubic meter 9 cubic foot minimum volume. Provide in-line thrust or anchor blocks as indicated on straight

runs and outside of manholes and wall penetrations. Size in accordance with FRP pipe manufacturer's recommendations to handle thrusts from design temperatures and pressures. In any case, provide 0.42 square meter 4.5 square foot minimum bearing surface in each FRP pipe direction cast against undisturbed soil, 0.37 cubic meter 13 cubic foot minimum volume. Concrete shall conform to [Section 03 30 00.00 20 CAST-IN-PLACE CONCRETE] [ASTM C 94, [25] [30] MPa [3000] [4000] psi].

### 3.2.3 Bending of Fiberglass Reinforced Plastic Pipe

Limit bending of pipe to follow ditch contours to long trench curvatures and do not permit abrupt changes in pipeline direction. Bending radii shall not be less than shown in the manufacturer's installation instructions. Do not make bends until all joints in the section of pipe to be bent are cured.

### 3.2.4 Open Ends of the Pipe System

Close the open ends of the pipe system at the end of each day's work or when work is not in progress and keep closed until work is resumed.

## 3.3 MANHOLES AND WALL PENETRATIONS

Where an FRP pipe penetrates manhole, concrete, masonry, or metal walls, provide a Schedule 40 steel pipe sleeve 50 mm 2 inches larger than the pipe in accordance with ASTM A 53. Each steel pipe sleeve shall be given a coat of bituminous paint conforming to MIL-C-18480. Calk opening between sleeve and pipe with sealing compounds conforming to ASTM C 920, Type S or M, Grade NS, Class 25, use M or FS TT-S-001543, Type Non-Sag, Class A. Install in-line thrust or anchor blocks at least 1.50 meters 5 feet outside of manhole or wall penetration in accordance with paragraph entitled "Thrust Blocks."

## 3.4 LINE VALVES

Install line valves with stems vertically up. Provide individual supports and anchors for line valves. Sealed valve box or pit shall prevent soil and moisture contact with valve.

## 3.5 FLUSHING

Prior to hydrostatic testing, flush the FRP pipe system with water until piping is free of dirt and foreign matter.

## 3.6 FIELD INSPECTION AND TESTS

Furnish everything required for performing inspections and tests. Correct defects and repeat the respective inspections and tests.

### 3.6.1 Test Gages

Use pressure test gages certified as being accurate to within one percent of their full scale. Use gages with maximum scale between 1 1/2 and 2 times the test pressure.

### 3.6.2 Field Inspections

Prior to initial operation, inspect piping system for conformance to drawings, specifications, and manufacturer's submittals; submit daily

written reports, as specified under "Contractor's Responsibility."

### 3.6.3 Field Tests

#### 3.6.3.1 Initial Pneumatic Tests

Pneumatically test all FRP pipe and fittings and all FRP pipe to metal fittings at a pressure of 103 kPa (gage) 15 psig for at least 4 hours during which time brush each joint with a soap solution and examine for leaks. Maintain 103 kPa (gage) 15 psig pressure throughout test period. The piping may be tested in sections, but test the entire installation at 103 kPa (gage) 15 psig prior to the hydrostatic test. Contractor shall furnish all necessary air compressors, gages, and other equipment necessary for carrying out the tests. No taps in the line are permitted. Isolate equipment such as pumps and filter-separators from the FRP piping system during the test. Prior to starting any pneumatic testing of buried FRP pipe, portions of the pipe between all joints must be backfilled in place as described in Section 31 00 00 EARTHWORK to at least 610 mm 24 inches over the top of the pipe as a safety measure.

#### 3.6.3.2 Second Pneumatic Tests

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**NOTE: The second pneumatic test applies only to piping supplying fuel to an aircraft or truck direct fueling station. This provides additional leak free assurance before fuel is added to pipelines.**

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Increase pneumatic pressure on all FRP pipe and fittings for aviation fuel dispensing systems to 345 kPa (gage) 50 psig. Hold pressure for at least 4 hours without a drop in pressure. An allowance of 35 kPa 5 psi may be made for gage error and thermal expansion and contraction. To reduce effects of solar load, begin testing near sundown or provide shade for exposed piping. During 4 hour pressure holding period, valve off system and disconnect method of system pressurization. Rely only on gage pressure for leak detection and provide signs warning personnel to stay clear of trenches during testing.

#### 3.6.3.3 Hydrostatic Test

Hydrostatically pressure test all FRP pipe and fittings and all FRP pipe to metal fittings using potable water to 1 1/2 times the maximum operating pressure or 1551 kPa (gage) 225 psig whichever is greater for a period of 4 hours prior to placement of sand bedding and backfill, except as required by paragraph entitled "Initial Pneumatic Test." The operating pressure shall be the sum of the static head pressure, pressure required to overcome friction losses, and any required back pressure. Provide controls and protective equipment so that the level of pressure rise above operating pressure due to surges and other variations from normal operation shall not exceed the test pressure at any point in the piping system. Limit pressure rise to 11.50 kPa per second 100 psi per minute at beginning of test and pressure drop to 11.50 kPa per second 100 psi per minute at conclusion of test. Air or vapor at all high points in the system must be replaced by the test fluid before testing. Pressure must hold for a minimum of 4 hours with a 27.50 kPa 4 psi maximum drop. After 4 hours at test pressure and with pressure still applied, visually inspect all pipe, fittings, and joints for indications of weeping or leaking. Repair any weeping or leaking condition discovered in accordance with paragraph entitled "Field

Repairs of Pipe and Joints." During 4 hour pressure holding period, valve off system and disconnect method of pressurization.

#### 3.6.3.4 Hydrostatic Cycle Test

Pressure cycle test system at 1896 kPa (gage) 275 psig or 1 1/2 times the maximum operating pressure, whichever is greater, for 10 cycles. Each cycle shall consist of a one-minute period at 1896 kPa (gage) 275 psig or 1 1/2 times the maximum operating pressure and a 4 minute period when the pressure is dropped at least 40 percent. Examine system for leaks and porosity, repair in accordance with paragraph entitled "Field Repairs of Pipe and Joints," and repeat test until system is proven tight. After successful completion of hydrostatic test series, cast concrete thrust blocks around FRP pipe in accordance with paragraph entitled "Thrust Blocks." After casting thrust blocks, backfill and compact bedding around center portions of FRP pipe with thrust blocks and joints clear for observation. FRP pipe must be held in place during operational tests after thrust blocks are installed. The expansion of FRP pipe must be absorbed by the FRP pipe itself. No expansion will be absorbed by changes in direction of the pipe or by expansion joints in buried systems.

#### 3.6.3.5 Operational Test

Thoroughly dry system of all water and fill with fuel. Verify operation of [surge absorbers and] system relief valves. Operate complete system as in service with fuel at design flow rates for 48 hours with fuel flowing through the system for 8 hours and flow stopped for 8 hours. Examine system for leaks and porosity. Repair leaks, replace porous pipe, and repeat test until system is proven tight. After successful completion of the test series, backfill trench.

#### 3.6.3.6 Additional Flushing

Flush or re-circulate aviation fuel dispensing system with design specification fuel until station fuel lab tests indicate fuel quality at dispensing point meets cleanliness use limits of:

Particulate matter	2.11 mg/liter 8.0 mg/gal
Free water	20 ppm

#### 3.6.4 Field Repairs of Pipe and Joints

The Contractor shall be responsible for the repair of all leaks or other deficiencies caused by faulty workmanship or materials. Make repairs to leaking pipe or joints, whatever the cause, by removing and replacing the faulty section or a short length containing the fault. Over wrapping the fault with any type of patch or other material will not be permitted. If a joint is damaged during the laying operation, it can be cut off and a coupling bonded to the cutoff end and laid in the line as a normal pipe. If damage occurs to a pipe after it has been laid, the damaged section shall be cut out and replaced with a new pipe section in accordance with the manufacturer's instruction.

-- End of Section --