UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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FILTER SEPARATOR, AVIATION FUELING SYSTEM

08/18

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USACE / NAVFAC / AFCEC / NASA	**UFGS-33 52 43.28 (August 2018)**

Preparing Activity: USACE	**Superseding**
	UFGS-33 52 43.28 (November 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION 33 52 43.28

FILTER SEPARATOR, AVIATION FUELING SYSTEM
08/18

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NOTE: This guide specification covers the requirements for filter separators and fuel quality monitors used in aircraft refueling systems constructed to the requirements of the DoD Type III/IV/V, and Cut and Cover Hydrant Refueling System Standards.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
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PART 1 GENERAL

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NOTE: NOTE: DoD Type III systems must conform to Standard Design AW 078-24-28 PRESSURIZED HYDRANT FUELING SYSTEM TYPE III. DoD Type IV/V systems must conform to Standard Design AW 078-24-29 PRESSURIZED HYDRANT DIRECT FUELING SYSTEM TYPE IV/V. Cut and Cover systems must conform to Standard Design AW 078-24-33 UNDERGROUND VERTICAL STORAGE TANKS CUT AND COVER. Field fabricated ASTs must conform to AW 078-24-27 ABOVEGROUND VERTICAL STEEL TANKS WITH FIXED ROOFS.Standards can be found on the Whole Building Design Guide at the following location https://www.wbdg.org/ffc/dod/non-cos-standards.

Subject Matter Expert (SME) is defined as Service Headquarters Subject Matter Experts: Air Force - The Air Force Fuels Facilities Subject Matter Expert (HQ AFCEC/COS), Army - Headquarters, U.S. Army Corps of Engineers, POL-MCX Facilities Proponent (CECW-EC) through the Army Petroleum Center (APC), Navy/Marine Corps - NAVFAC POL Facility Subject Matter Expert (NAVFAC EXWC, CI11).
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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 Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.
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The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B31.3	(2016) Process Piping
ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM C827/C827M	(2016) Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures

ENERGY INSTITUTE (EI)

EI 1541	(2016) Requirements for Internal Protective Coating Systems Used in Aviation Fuel Handling Systems

EI 1581	(2016) Specifications and Laboratory Qualification Procedures for Aviation Jet Fuel Filter/Separators
EI 1590	(2014) Specifications And Qualification Procedures For Aviation Fuel Microfilters

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-P-5315	(2013, Rev B) Butadiene - Acrylonitrile (NBR) Rubber For Fuel-Resistant Seals 60 To 70

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-HDBK-831	(2013; Rev A; Notice 1 2018) Preparation of Test Reports
MIL-PRF-4556	(1998; Rev F; Am 1 1999; CANC Notice 1 2011) Coating Kit, Epoxy, for Interior of Steel Fuel Tanks
MIL-STD-130	(2007; Rev N; Change 1 2012) Identification Marking of U.S. Military Property

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1923	(Rev A; Notice 3) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

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, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

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

Air Force, and NASA projects.

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

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

SD-02 Shop Drawings

Filter Separator; G[, [_____]].

Micronic Pre-Filter; G[, [_____]].

SD-03 Product Data

Filter Separator; G[, [_____]].

Micronic Pre-Filter; G[, [_____]].

SD-07 Certificates

Filter Separator.

Micronic Pre-Filter.

SD-10 Operation and Maintenance Data

Filter Separator; G[, [_____]].

Micronic Pre-Filter; G[, [_____]].

1.3 PREPRODUCTION TESTING

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NOTE: Contact the Naval Facilities Engineering Command (NAVFACENGCOM) or the Corps of Engineers (COE) for direction on selection. For COE projects, include in the MOU the specific Air Force representatives to be notified when factory filter separator test dates are submitted to the Contracting Officer.

****

Prior to construction of filter separators (FSI-1 THROUGH FSI-[_____], FSR-[_____], THROUGH FSR-[_____]) for the project, preproduction tests must have been conducted in the presence of [Det 3, WR-ALC/AFTH Technical

Assistance Team Air Force Petroleum Office Wright-Patterson AFB, OH] [NAVAIR/NAFAC] [Army Petroleum Center] representative. Notify the Contracting Officer [_____] days prior to conductance of factory tests in order to schedule witnessing by representative.

1.3.1 Inspection and Testing

The inspection and testing of the preproduction filter separator must be conducted on a full-scale test system in accordance with EI 1581 and as specified herein. The test sample must consist of a complete filter separator with elements installed. Elements must be representative of a production lot. The filter separator, coalescers, and separator screens must be identified with the manufacturer's part number.

1.3.2 Deviations from EI 1581

No deviations are allowed.

1.3.3 Data Required Prior to Tests

Submit installation data to enable Government representative to verify that the equipment has been installed and operated correctly. Submit certification from the manufacturer that the test vessel has passed a hydrostatic pressure test, and that the design conforms to EI 1581, Category M, Type S. The test vessel represents the original model from the manufacturer. Re-certification would be required for a change to the model and or as required by EI 1581. Submit assembled drawings of the test vessel and accessories for approval.

1.3.4 Submittal of Test Documents

****

NOTE: Contact NAVFACENGCOM or COE for direction on selection. For NAVFACENGCOM Projects, the designer must consult with the engineer in charge (EIC) to determine the review input of the appropriate service. For COE projects, coordinate with appropriate service to determine which service agency will review test documents and ensure that MOU and submittal register contain these requirements.

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Subject Matter Expert (SME) is defined as Service Headquarters Subject Matter Experts. SME for this project is [Air Force - The Air Force Fuels Facilities Subject Matter Expert (HQ AFCEC/COS)[[Army - Headquarters, U.S. Army Corps of Engineers, POL-MCX Facilities Proponent (CECW-EC) through the Army Petroleum Center (APC)] [Navy/Marine Corps - NAVFAC POL Facility Subject Matter Expert (NAVFAC EXWC, CI11)]]].

The test report must be submitted to the SME. Prepare report in accordance with MIL-HDBK-831. In addition to results, the report must 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. Submit color photographs of the sample elements before and after tests. Submit one new coalescer element and one new separator element.

1.3.5 Required Preproduction Tests

a. Examination. A visual examination of the filter separator housing and each element must be performed to ensure compliance with the drawings and verify workmanship requirements.

b. Hydrostatic Pressure Tests. The filter separator must be subjected to a hydrostatic pressure test in accordance with EI 1581, Section 3.2.2.11.1.

c. Full Scale Performance Test. EI 1581 The filter/separator with a full set of coalescer and separator elements must be tested in accordance with EI 1581 section 4.4 at [38] [_____] L/s [600] [_____] gpm (FSI-1 through FSI-[_____] ; [FSR-1 and FSR-2]) [and[75] [_____] L/s [1200] [_____] gpm (FSR-1 and FSR-2)].

d. Coalescer Structural Test. A coalescer structural test must be conducted in accordance with EI 1581 Section 4.5.

e. Disassembly Inspection. Upon completion of the tests specified above, the filter separator must be disassembled and inspected to determine the condition of the coalescer and separator elements. Defects in the element such as swelling of the elements, or damaged gaskets must be noted. Swelling of or damage to the elements or other parts must be cause for rejection.

1.4 DESIGN CONDITIONS

Design conditions must be as specified in Section 33 52 43.11 AVIATION FUEL MECHANICAL EQUIPMENT and as modified herein.

1.5 WORKMANSHIP

Each filter separator, including all parts and accessories, must be free from blemishes, defects, burrs and sharp edges. The vessel must exhibit accuracy of dimensions, accurate radii of fillets and complete marking of parts and assemblies.

1.6 CLEANING

Components of the filter separators must be cleaned to remove dirt; excess soldering; brazing, and welding flux; welding slag; loose, spattered, or excess solder; metal chips; and other foreign materials before, during and after assembly.

PART 2 PRODUCTS

2.1 WELDING

Welding must be in accordance with ASME B31.3.

2.2 MATERIALS AND EQUIPMENT

2.2.1 Housing

a. [Carbon steel with internal epoxy coating][AL5083-0 or 6061 aluminum alloy][Type 304 or 316 stainless steel].

b. Float Assembly. Stainless steel.

c. Manual Drain Valve. Stainless steel.

d. Sight Glass. Armored clear Pyrex with nickel-copper alloy ball checks.

e. Differential Gauge. Corrosion resistant piston with stainless steel valves.

f. Separators. 75 um 200 mesh stainless steel wire cloth, polytetrafluorethylene (PTFE) coated on both sides, or synthetic mesh cloth.

2.3 FILTER SEPARATOR CONSTRUCTION

****

NOTE: As required by the SME. Coated carbon steel must not be used for filter separator vessels on Navy/Marine Corps projects. Specify internally coated carbon steel vessel construction for Air Force projects.

Indicate the operating height of the unit on the drawings. Note that the unit's support system (legs) may have to be structurally designed to meet project requirements.

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2.3.1 Housing Vessel

Each filter separator housing must be fabricated from [carbon steel and must be internally coated with an epoxy coating in accordance with MIL-PRF-4556 [and EI 1541]][AL5083-0 or 6061 aluminum alloy][Type 304 or 316 stainless steel].[Coat the exterior with alkalyd resin primer (universal metal primer).] Each unit must be constructed and labeled in accordance with ASME BPVC SEC VIII D1. The housing must be designed for a working pressure of 1725 kPa275 psig. Each unit must 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)][vertical, top-opening type with coalescers and separators mounted side-by-side (coalescers at the inlet of the vessel and separators at the outlet)]. The head opening must be equipped with a hinged or pivoting device to facilitate swinging the head to one side for servicing. The hinges or pivots must support the head during servicing without distortion or misalignment. Swing-type bolts must be used on all main closures. Unit must be provided with 75 mm3-inch inside diameter lifting eyes spaced to support a weight of 2-1/2 times the gross weight of the filter separator. The configuration of the pressure vessel must be as shown on the drawings. The housing must be provided with a 19 mm 3/4-inch inlet compartment fuel drain plug. A hand hole access plate must be provided in the inlet compartment. The head must be sealed to the body by means of an O-ring, meeting requirements of SAE AMS-P-5315, mounted in a circular groove at the point of closure. Threaded base mounting adapters must be provided for the coalescers. The separators must be mounted on adapters with blunted Vee-type knife edges. Height of Vee section to be 1.5 mm0.06 inches, plus or minus 10 percent. Weld ridges must not prevent liquid from draining. The filter separator vessel must be able to withstand a force of 10 kN 2400 pounds and a moment of 3250 J 2400 foot-pounds at the flanges.

2.3.2 Legs

Four 75 x 75 x 6 mm 3 x 3 x 1/4 inch angle-shaped legs must be welded to the housing. Each leg must be fitted with a 100 x 100 x 13 mm 4 x 4 x 1/2-inch base plate drilled through with a 19 mm 3/4-inch hole.

2.3.3 Inlet and Outlet Connections

The inlet and outlet connections must be 150 mm 6 inch nominal pipe size and must be located parallel to each other as shown on the drawings. Inlet connection must be provided with raised face flanges, faced and drilled in compliance with ASME B16.5, Class 150. Outlet connection flange face must match Filter Separator Control Valve (FSCV).

2.3.4 Manual Drain Valve

As specified in paragraph ACCESSORIES.

2.3.5 Sight Gauge

As specified in paragraph ACCESSORIES.

2.3.6 Differential Pressure Gauge

****
NOTE: Coordinate selection of this feature with the SME.
****

As specified in paragraph ACCESSORIES.

2.3.7 Automatic Air Eliminator and Pressure Relief Valves

As specified in paragraph ACCESSORIES.

2.3.8 Sampling Connections

As specified in paragraph ACCESSORIES.

2.3.9 Spider Assembly

Each filter separator must contain a spider assembly to hold the coalescers and separators in position, to support them firmly against vibration. The method of stabilization must assure an electrical bond between the spider and the vessel.

2.3.10 Coalescer and Separator Cartridges

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NOTE: The Designer indicates appropriate identification (FSR or FSI). Filter separators must be flow-rated in 19 L/s 300 gpm increments.
****

Each filter separator must be provided with coalescers and separators that have been qualified to the performance requirements of EI 1581, Category M, Type S. Filter separators must use coalescers 150 mm 6-inch in diameter and 1090 mm 43-inch long for a flow-rate of[19 L/s 300 gpm] [38

L/s 600 gpm] [57 L/s 900 gpm] [_____].

2.3.11 Control Valve Accessories

Provide each filter separator with a control valve (FSCV), manual water drain valve, and float control valve (FC) with manual tester as specified in Section33 52 43.14 AVIATION FUEL CONTROL VALVES and must be of the same manufacturer.

2.3.11.1 Float Control Pilot and Tester

Each housing sump must be fitted with a float control pilot and tester specified in Section 33 52 43.14 AVIATION FUEL CONTROL VALVES and must be of the same manufacturer as the control valves. The drain port "D" must be tubed to the drain piping to the product recovery tank.

2.3.12 Identification of Product

Equipment, assemblies, and parts must be marked for identification in accordance with MIL-STD-130. The main equipment nameplate must be mounted on the housing, and in addition to the usual MIL-STD-130 requirements, must include the following markings in letters 0.09 mm 3/32 inch high or larger:

Filter Separator, Liquid Fuel			
Design Flow-Rate			
Design Pressure			
Elements			
First Stage		Mfg. Part No. *	
Second Stage		Mfg. Part No. *	
	Contract No. *		
	Manufacturer *		
	Specification*		
*Applicable information shall be entered by the Contractor.			
*Applicable information shall be stenciled by LFM personnel.			

2.3.13 Assembly

Each filter separator must come assembled with all accessories and must be ready for use. The functions of all components must be tested prior to shipment and no assembly or field adjustment of valves or components must be required.

2.4 MICRONIC PRE-FILTER CONSTRUCTION

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NOTE: As required by the SME.
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2.4.1 Product Submittals

a. If product has been previously tested and approved by the Government, submit certification of qualification under EI 1590. Include the description of qualification, which contains element types and quantities, and provide details of the configurations of vessels tested. Also, include the name of the Government Agency and the date of approval.

b. Submit scaled drawings showing dimensions, tolerances, connection sizes of the vessel and accessories. Submit shop drawings for elements. Shop drawings must include number and arrangement of elements. Submit technical literature on the vessel, elements, and accessories, which is the manufacturer's published literature.

c. Refer to Section 01 78 23.33 OPERATION AND MAINTENANCE MANUALS FOR AVIATION FUEL SYSTEMS for specifics on the required operation and maintenance information.

2.4.2 Housing Vessel

Each pre-filter housing must be fabricated from carbon steel and must be internally coated with an epoxy coating in accord with MIL-PRF-4556. Coat the exterior with alkalyd resin primer (universal metal primer). Each unit must be constructed and labeled in accordance with ASME BPVC SEC VIII D1. The housing must be designed for a working pressure of 1725 kPa 275 psig. Each unit must be horizontal, end-opening type with filters mounted side-by-side. The head opening must be equipped with a hinged or pivoting device to facilitate swinging the head to one side for servicing. The hinges or pivots must support the head during servicing without distortion or misalignment. Swing-type bolts must be used on all main closures. Unit must be provided with 75 mm 3-inch inside diameter lifting eyes spaced to support a weight of 2-1/2 times the gross weight of the filter separator. The configuration of the pressure vessel must be as shown on the drawings. The housing must be provided with a 19 mm 3/4-inch inlet compartment fuel drain plug. A hand hole access plate must be provided in the inlet compartment. The head must be sealed to the body by means of an O-ring, meeting requirements of SAE AMS-P-5315, mounted in a circular groove at the point of closure. The filter cartridges must be mounted on adapters with blunted Vee-type knife edges. Height of Vee section to be 1.5 mm 0.06 inches, plus or minus 10 percent.

2.4.3 Legs

Four 75 x 75 x 6 mm 3 x 3 x 1/4 inch angle-shaped legs must be welded to the housing. Each leg must be fitted with a 100 x 100 x 13 mm 4 x 4 x 1/2-inch base plate drilled through with a 19 mm 3/4-inch hole.

2.4.4 Inlet and Outlet Connections

The inlet and outlet connections must be 200 mm 8 inch nominal pipe size and must be located parallel to each other as shown on the drawings. Connections must be provided with raised face flanges, faced and drilled in compliance with ASME B16.5, Class 150.

2.4.5 Manual Drain Valve

As specified in paragraph ACCESSORIES.

2.4.6 Differential Pressure Gauge

As specified in paragraph ACCESSORIES.

2.4.7 Automatic Air Eliminator and Pressure Relief Valves

As specified in paragraph ACCESSORIES.

2.4.8 Sampling Connections

As specified in paragraph ACCESSORIES.

2.4.9 Spider Assembly

The prefilter must contain a spider assembly to hold the filter cartridges in position, to support them firmly against vibration. The method of stabilization must assure an electrical bond between the spider and the vessel.

2.4.10 Filter Cartridges

The prefilter must be provided with 5 um5 micron pleated media filter cartridges. Filter cartridges must have a minimum efficiency of 98 percent and a minimum collapse strength 520 kPa 75 psig.

2.4.11 Identification of Product

Equipment, assemblies, and parts must be marked for identification in accordance with MIL-STD-130. The main equipment nameplate must be mounted on the housing, and in addition to the usual MIL-STD-130 requirements, must include the following markings in letters 2 mm 3/32 inch high or larger:

Micronic Prefilter, Liquid Fuel			
Design Flow-Rate			
Design Pressure			
Elements			
First Stage		Mfg. Part No. *	
Second Stage		Mfg. Part No. *	
	Contract No. *		
	Manufacturer *		
	Specification*		

*Applicable information shall be entered by the Contractor.
*Applicable information shall be stenciled by LFM personnel.

2.4.12 Assembly

The prefilter must come assembled with all accessories and must be ready for use. The functions of all components must be tested prior to shipment and no assembly or field adjustment of valves or components must be required.

2.5 ACCESSORIES

2.5.1 Manual Drain Valve

Each filter separator must be equipped with a 25 mm 1-inch stainless steel manual ball valve water and fuel drain. The valve must be capable of draining all water, fuel and sediment from the filter separator by gravity. The valve must be installed below the sump of the housing as shown on the drawings.

2.5.2 Sight Gauge

A[13 mm 1/2-inch armored, clear borosilicate (Pyrex)][or][magnetic level type] liquid level gauge must be provided for observing the water accumulation in the sump. The gauge must be equipped with stainless steel ball checks in both the upper and lower fittings, an upper and lower shutoff valve, and a bottom blowoff cock.[The gauge will contain a colored density sensitive ball.] Liquid level gauges must be rated for a maximum pressure of 1035 kPa 150 psi.

2.5.3 Differential Pressure Gauge

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NOTE: Coordinate selection of this feature with the SME.
****

The housing must be equipped with a direct-reading, piston type differential pressure gauge that measures the differential pressure across both coalescers and separators. The gauge must consist of a spring-supported, corrosion resistant piston moving inside a glass cylinder, with high pressure applied on top of the piston and low pressure applied below it. The gauge must have a peak-hold reading that locks the piston to indicate the maximum differential pressure that is measured until the piston is released by turning a knob, a push button test valve to relieve pressure under the piston, and a pressure relief feature set at 2070 kPa 300 psi to protect the gauge if isolation valves have been left closed. Under a differential pressure of 205 kPa 30 psi, leakage past the piston must not exceed 120 drops per minute. The cylinder and flanges must be stainless steel with fluoroelastomer (FCM), commonly referred to as Viton, O-ring seals. The high pressure inlet of the gauge must have a 10 um10-micron pleated paper filter and the low pressure connection must have a fine mesh stainless steel strainer. The gauge must have an operating pressure of 2070 kPa 300 psi. Differential pressure range of the gauge through approximately 75 mm 3 inches of piston movement must be 0-205 kPa 0-30 psi with an accuracy of ± 3 kPa0.5 psi, calibrated linearly with 5 kPa 1 PSI scale graduations. High and low pressure connections must be 6 mm

1/4 inch NPT female with a stainless steel bar stock valve at each connection. Construction of the gauge must be such that a 3-valve manifold is not necessary. If only one bar stock valve is closed, the gauge must not be damaged by up to 2070 kPa 300 psi differential pressure in either direction. The differential pressure gauge must be attached to the filter separator by a gauge panel.[Differential pressure gauge must control the filter separator control valve (FSCV) to automatically shut down flow when 140 kPa 20 psi differential pressure is exceeded.] A pressure gauge must be attached to the differential pressure gauge to indicate the high pressure and have a range of 2070 kPa 300 psi.

2.5.4 Automatic Air Eliminator and Pressure Relief Valves

A 25 mm 1-inch angle pattern pressure relief valve must be provided on top of each vessel. An automatic air eliminator must be installed on the highest point of the vessel and must have check valve feature. The air eliminator must release at pressures up to 1035 kPa 150 psi with no fuel leakage allowed.

2.5.5 Sampling Connections

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

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment and components in position, true to line, level and plumb and measured from established benchmarks or reference points. Follow manufacturer's recommended practices for equipment installation. Provide required clearance between equipment components. Equipment apparatus, and accessories requiring normal servicing or maintenance to be accessible.

3.1.1 Anchoring

Anchor equipment in place. Check alignment of anchor bolts before installing equipment and cleanout associated sleeves. Do not cut bolts because of misalignment. Notify Contracting Officer of errors and obtain the Contracting Officer's acceptance before proceeding with corrections. Cut anchor bolts of excess length to the appropriate length without damage to threads. Where anchor bolts or like devices have not been installed, provide appropriate self-drilling type anchors for construction condition. Expansion bolt anchors provided must be in accordance with CID A-A-1923, Type 4, Class One, 13 mm 1/2 inch size.

3.1.2 Grouting

Equipment, which is anchored to a pad, must be grouted in place where applicable. Before setting equipment in place and before placing grout, clean surfaces to be in contact with grout, including fasteners and sleeves. Remove standing water, debris, oil, rust, coatings and other materials which impair bond. Clean contaminated concrete by grinding or other acceptable means. Provide necessary formwork for placing and

retaining grout. Grout to be nonmetallic, nonshrink, fluid precision grout of a hydraulic cementitious system with graded and processed silica aggregate, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents; free of aluminum power agents, oxidizing agents and inorganic accelerators, including chlorides; proportioned, premixed and packaged at factory with only the addition of water required at the project site. Grouting to meeting requirements of ASTM C827/C827M. Perform grouting in accord with ACI, equipment manufacturer's, and grout manufacturer's published specifications and recommendations.

3.1.3 Leveling and Aligning

Level and align equipment in accordance with respective manufacturer's published data. Do not use anchor bolts, jack-nuts or wedges to support, level or align equipment. Install only flat shims for leveling equipment. Place shims to fully support equipment. Wedging is not permitted. Shims to be fabricated flat carbon steel units of surface configuration and area not less than equipment bearing surface. Shims to provide for full equipment support. Shims to have smooth surfaces and edges, free from burrs and slivers. Flame or electrode cut edges not acceptable.

3.1.4 Painting

Equipment painting must be as specified in Section 33 52 43.13 AVIATION FUEL PIPING. Equipment labeling must be as specified in Section 33 52 43.11 AVIATION FUEL MECHANICAL EQUIPMENT.

-- End of Section --