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MILITARY SPECIFICATION

FILTER-SEPARATORS, LIQUID FUEL: AND FILTER-COALESCER ELEMENTS, FLUID PRESSURE: INSPECTION REQUIREMENTS AND TEST PROCEDURES FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers inspection requirements and test procedures for filter-separators, filter-separator conversion kits, and filter-coalescer elements used in fuel supply system.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein:

SPECIFICATIONS

FEDERAL

VV-F-800	- Fuel Oil, Diesel.
VV-G-1690	- Gasoline, Automotive, Leaded or Unleaded.

MILITARY

MIL-G-3056	- Gasoline, Automotive, Combat.
MIL-G-5572	- Gasoline, Aviation, Grades 80/87, 100/130, 115/145.
MIL-T-5624	- Turbine Fuel, Aviation, Grades JP-4 and JP-5.

FSC 4330

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Mobility Equipment Research and Development Command, ATTN: DRDME-DS, Fort Belvoir, VA 22060 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MIL-F-16884	- Fuel Oil, Diesel, Marine.
MIL-I-25017	- Inhibitor, Corrosion, Fuel Soluble.
MIL-P-25576	- Propellant, Kerosene.
MIL-I-27686	- Inhibitor, Fuel System Icing.
MIL-F-52308	- Filter Element, Fluid Pressure.
MIL-D-81227	- Detector Kit, Water, Automotive-Aviation Fuel.
MIL-D-81248	- Detector Pad, Free Water.
MIL-S-81282	- Standard, Free Water Detector.
MIL-T-83133	- Turbine Fuel, Aviation, Kerosene Type, Grade JP-8.

STANDARDS

FEDERAL

FED-STD-791	- Lubricant, Liquid Fuel and Related Products, Methods of Testing.

MILITARY

MIL-STD-810	- Environmental Test Methods.
MIL-STD-831	- Test Reports, Preparation of.

(Copies of specifications and standards required by the contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

D1298	- Test for Density, Specific Gravity, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
D1331	- Surface and Interfacial Tension of Solutions of Surface-Active Agents.
D1655	- Aviation Turbine Fuels.
D2276	- Particulate Contaminant in Aviation Turbine Fuels.
D2550	- Water Separation Characterisitcs of Aviation Turbine Fuels.
D2624	- Electrical Conductivity of Aviation Fuels Containing a Static Dissipator Additive.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

3. REQUIREMENTS

3.1 Petroleum fuels and inhibitors. Unless otherwise specified (see 6.2), materials in filter-separators, filter-separator conversion kits, and filter coalescer elements shall not be adversely affected by and shall have no effect upon fuels or inhibitors conforming to the following specifications:

VV-F-800	MIL-F-16884	MIL-T-83133
VV-G-1690		
MIL-G-3056	MIL-I-25017	
MIL-G-5572	MIL-P-25576	
MIL-T-5624	MIL-I-27686	

3.2 Contamination limits. The required effluent fuel samples shall conform to the following contamination limit requirements:

(a) Water. When analyzed in accordance with 4.6.1 the effluent fuel shall contain not more than 5 parts per million (ppm) by volume of undissolved water for a sustained totamitor reading of 1 minute.
(b) Solids. When analyzed in accordance with 4.6.3, the average weight of solids in the effluent fuel samples shall not exceed 0.5 milligram (mg) per liter, and the weight of solids in any single sample shall not exceed 1 mg per liter.
(c) Fibers. When analyzed in accordance with 4.6.4 the effluent fuel sample shall contain an average of not more than 10 fibers per liter and the number of fibers in any single sample shall not exceed 15 fibers per liter (see 6.3.4).

3.3 Performance. The filter-separator including all controls shall conform to the following performance requirements. The flow rate of the filter-separator shall be as specified in the end item specification.

3.3.1 Differential pressure. Differential pressure across the filter-separator with new elements installed and clean fuel (see 6.3.1) shall not exceed 10 pounds per square inch (psi) at any flow rate up to 115 percent of rated flow when measured across the inlet and outlet couplings (see 6.3.2). The differential pressure without the filter-coalescer elements and separator stages shall not exceed 5 psi.

3.3.2 Media migration. The media contamination limits specified in 3.2(c) shall not be exceeded at any rate of flow (see 6.3.5).

3.3.3 Water removal. The filter-separator shall remove water (see 4.4.2.4(b)) to the limits specified in 3.2(a) at fuel flow rates up to 115 percent of rated flow, with the influent fuel containing water up to 5 percent by volume for portable equipment and up to 10 percent by volume for fixed equipment. The discharge water shall contain not more than 0.5 percent fuel by volume.

3.3.4 Solids removal. The filter-separator shall remove red iron oxide (see 4.4.2.4(a) and AC dust (see 4.4.2.4(c)) and up to 3 percent by volume of water to the limits specified in 3.2(a) and 3.2(b) at fuel flow rates up to 100 percent of rated flow.

3.3.4.1 Solids removal capacity. The filter-separator shall remove a quantity of solids at least equal to 10 grams per gallon-per-minute of its rated flow capacity. The pressure differential across the media at rated flow (see 6.3.3) shall not exceed 20 psi before 30 minutes nor 40 psi before 70 minutes at a solids injection rate of 0.143 grams per gallon under the following conditions:

(a) Red iron oxide-fuel and 3 percent water mixture.
(b) Dry red iron oxide.
(c) AC test dust, inhibited fuel, and 1 percent by volume of water.

3.3.5 Inhibited fuel. The filter-separator shall remove AC dust and up to 1 percent by volume of water at fuel flow rates up to 100 percent of rated flow on inhibited fuel.

3.3.6 Life. When specified (see 6.2), the filter-separator shall remove red iron oxide solid contaminant and water from 0.5 percent up to 3 percent by volume at rated flow, on unhibited fuel, over a period of up to 125 hours.

3.3.7 Environmental conditions.

3.3.7.1 Operating temperatures. Unless otherwise specified (see 6.2), the filter-separator and the filter-coalescer elements when installed in a filter-separator shall permit rated flow when operating in ambient temperatures ranging from minus 25° F. to plus 125° F.

3.3.7.2 Storage temperatures. Unless otherwise specified (see 6.2), the filter-separator and the filter-coalescer elements shall withstand storage in temperatures ranging from minus 50° F. to plus 160° F. after which they shall operate as specified in 3.3.7.1.

3.3.7.3 Fuel and salt water immersion. The filter-coalescer element after being emmersed in fuel for 100 hours, and after immersion in salt water for 72 hours, shall show no evidence of swelling, corrosion, separation of components, dissolving of adhesives, or deformation which could cause failure during operation.

3.3.8 Post environmental. Unless otherwise specified in the end item specification the filter-coalescer elements subjected to the environmental conditions in 3.3.7 shall operate without any failure when installed in a filter-separator and subjected to 0.5 percent water removal run at a fuel temperature between 70° F. and 90° F.

3.4 Filter-separator and components.

3.4.1 Filter-separator vessel. The filter-separator vessel shall be as specified in the end item specification. Unless otherwise specified (see 6.2), the vessel shall withstand a hydrostatic test pressure of 1-1/2 times the working pressure for a period of 5 minutes. The inlet compartment of the vessel shall withstand a hydrostatic test pressure of 50 percent of the hydrostatic pressure specified for the vessel but not less than 75 psi for a period of 10 minutes without any evidence of structural failure or permanent deformation.

3.4.2 Filter-coalescer element. The filter-coalescer element shall be the standard military element (NSN 4330-00-983-0998) conforming to MIL-F-52308. Each element shall remove solids and coalesce water in clear drops at a rated flow of 20 gallons per minute (gpm). The elements shall withstand a differential pressure of 75 psi without structural failure or permanent deformation. The flow rating of the filter-separator using the filter-coalescer elements is applicable only when using test fuel, JP-5.

3.4.3 Separator stages. The separator stages shall remove coalesced water droplets from the fuel consistent with the filter-separator flow rate. The separator stages shall be either replaceable elements, permanent type canisters, baskets, or other types when specified in the end item specification.

3.4.3.1 Replaceable separator elements. The replaceable separator elements shall have a life expectancy not less than that of the filter-coalescer element. The average air breakthrough pressure shall not vary more than plus or minus 1 inch of water. The average pressure shall be computed on a minimum of 12 separator elements.

3.4.3.2 Permanent separator stage. The permanent separator stage shall be either individual canisters or two single envelope type screens (baskets). The canisters and the baskets shall withstand a 1/2-inch static water head, measured in the normal direction of flow, without any evidence of leakage through the tetrafluorethylene-polymer-coated screen seams or end connections.

3.4.4 Manual water drain valve. A water drain valve shall be provided for manual drainage of water. This valve shall operate independent of the automatic drain valve but shall be of the same capacity.

3.4.5 Differential pressure dial gage. Unless otherwise spcified (see 6.2), a differential pressure dial gage shall be provided for direct reading of the differential pressure across the filter or the filter-coalescer elements. The accuracy of the gage shall be such that any error shall not exceed plus or minus 2 psi. Graduation of the scale shall be in accordance with the end item specification.

3.4.6 Automatic controls.

3.4.6.1 Water drain valve. When specified (see 6.2), an automatic drain valve shall be furnished. The water drain valve shall function automatically to discharge water before it reaches the bottom of the elements within the filter-separator. The rate of water discharge shall be not less than 10 percent of 115 percent of the rated flow at maximum operating pressure, or as specified in the end item specification. There shall be no leakage when the drain valve in not functioning to discharge water.

3.4.6.2 Fuel shutoff control. When specified (see 6.2), a fuel shutoff control shall be furnished. The fuel shutoff control shall function to stop the fuel flow when the capacity of the automatic water drain is exceeded. The fuel shutoff control shall stop the fuel flow before the water level reaches the bottom of the elements.

3.5 Test loop system. Arrangement of the test loop system shall be as shown in figure 1 and as specified herein.

3.5.1 Instruments. Instruments such as meters and gages used in the test loop system shall be of laboratory precision type and shall be calibrated at intervals spaced to assure laboratory accuracy.

3.5.2 Main pumping unit. The main circulating pump shall be one of the models described in table I or equal. If the alternate water injection system through the strainer (dispersing screen) is used, any pump that produces a steady nonpulsating flow and the required pressure may be used.

3.5.3 Fuel flowmeter. A meter shall be provided to indicate the specified fuel flow within an accuracy range of 1.0 percent at rated flow.

TABLE I. Main pumping units.

Make	Model	Capacity (gpm)	TDH	Motor H.P	RPM
Worthington	1-1/2 U Two Stage 2-7-1/4 inch impellers	50	400 ft.	15 H.P.	3510
Worthington	2 LLR9 Two Stage 2-7-3/8 inch impellers	100	400 ft.	25 H.P.	3550
Allis-Chalmers	FHB Single Stage 1-9-1/2 inch impellers	300	390 ft.	50 H.P.	3550
Allis-Chalmers	211-645-503 Single Stage 1-9-7/8 inch impellers	600	400 ft.	100 H.P.	3550

3.5.3.1 Water flowmeter. A meter shall be provided to indicate the flow rate of the water added to the fuel as a contaminant. The flowmeter accuracy range shall be within plus or minus 2 percent of the specified water flow rate.

3.5.4 Solids contaminant feeder. A continuous solid contaminant feeder with an accuracy range within plus or minus 1 percent of the specified feed rate shall be provided to feed the solids contaminant into the test loop system.

3.5.5 Test filter-separator. Unless otherwise specified (see 6.2), a four-element 50 gpm filter-separator that has successfully passed all tests specified in this specification shall be provided for the testing of filter-coalescer elements. Only two elements are used in each test leaving two inlets open. These two inlets shall be blocked off prior to starting the test. Canisters shall be installed on all four inlets to maintain even velocity throughout the vessel.

3.5.5.1 Cleanup filter-separator. The cleanup filter-separator shall be of a type that has successfully passed all tests specified in this specification and shall be capable of processing fuel at not less than 115 percent of the system flow rating.

3.5.6 Clay filter. A commercial clay filter assembly shall be used to remove residual fuel system additives as required. The clay filter shall be by-passed or removed from the test loop during testing (see figure 1).

3.5.7 Differential and other pressure gages. Pressure gages shall be provided for installation in the test loop system. One differential pressure gage shall indicate the pressure drop across the test filter-separator. Three additional pressure gages shall indicate pressure readings at various locations in the test loop as shown in figure 1. The accuracy of the gages shall be that any error shall not exceed plus or minus 2 psi.

3.5.8 Turbidmeter. The test loop shall be provided with a fuel quality monitor installed on the effluent side of the test filter-separator. The monitor shall be a Keene Corporation (formerly Bowser-Briggs), model 861-B (totamitor) or equal (example: Keene Corporation Model 861-B Turbidimeter, see 6.4). A Fisher-Porter Company, model 2202 BL electric chart recorder, or a Rustrak Instrument Company, Inc., miniaturized automatic chart recorder, model 88 may be used at the discretion of the testing activity.

3.5.9 Water filter. A water filter shall be provided for filtering the water, used as a contaminant, to the cleanliness specified in 4.4.2.4(b).

3.5.10 Heat exchanger. When required, one or more heat exchangers shall be installed in the test loop, as shown in figure 1, to control test fuel temperature.

3.5.11 Sampling devices. Probe-type sampling devices, facing upstream, shall be provided and installed in the test loop, as shown in figure 1, within 10 pipe diameters of the outlet or inlet as applicable.

3.5.12 Fuel tanks. Fuel tanks shall be commercially acceptable storage tanks. Except for the inhibited fuel test, fuel volume shall be not less than 10 times the rated flow in gallons per minute of the filter-separator under test.

3.5.13 Test system piping. The flow system piping between the pump and the effluent sampling point shall provide for a minimum fluid velocity of 6 feet per second (fps) at the rated flow of the test unit. Solids shall be injected as close as praticable to the test filter-separator, and shall not be passed through the main circulating pump. Water contaminant injection piping shall be either connected to the suction side of the main circulating pump or to the main pump discharge line. If the water is not connected to the suction side of the pump, a water disperser screen shall be installed between the water injection point and the solids injection point. This disperser shall consist of a standard 100-mesh screen of corrosion-resistant metal and shall have an area of 0.11 plus or minus 0.02 square inches per gallon-per-minute rated flow of the test filter-separator. The screenhousing shall be such that the screen can be

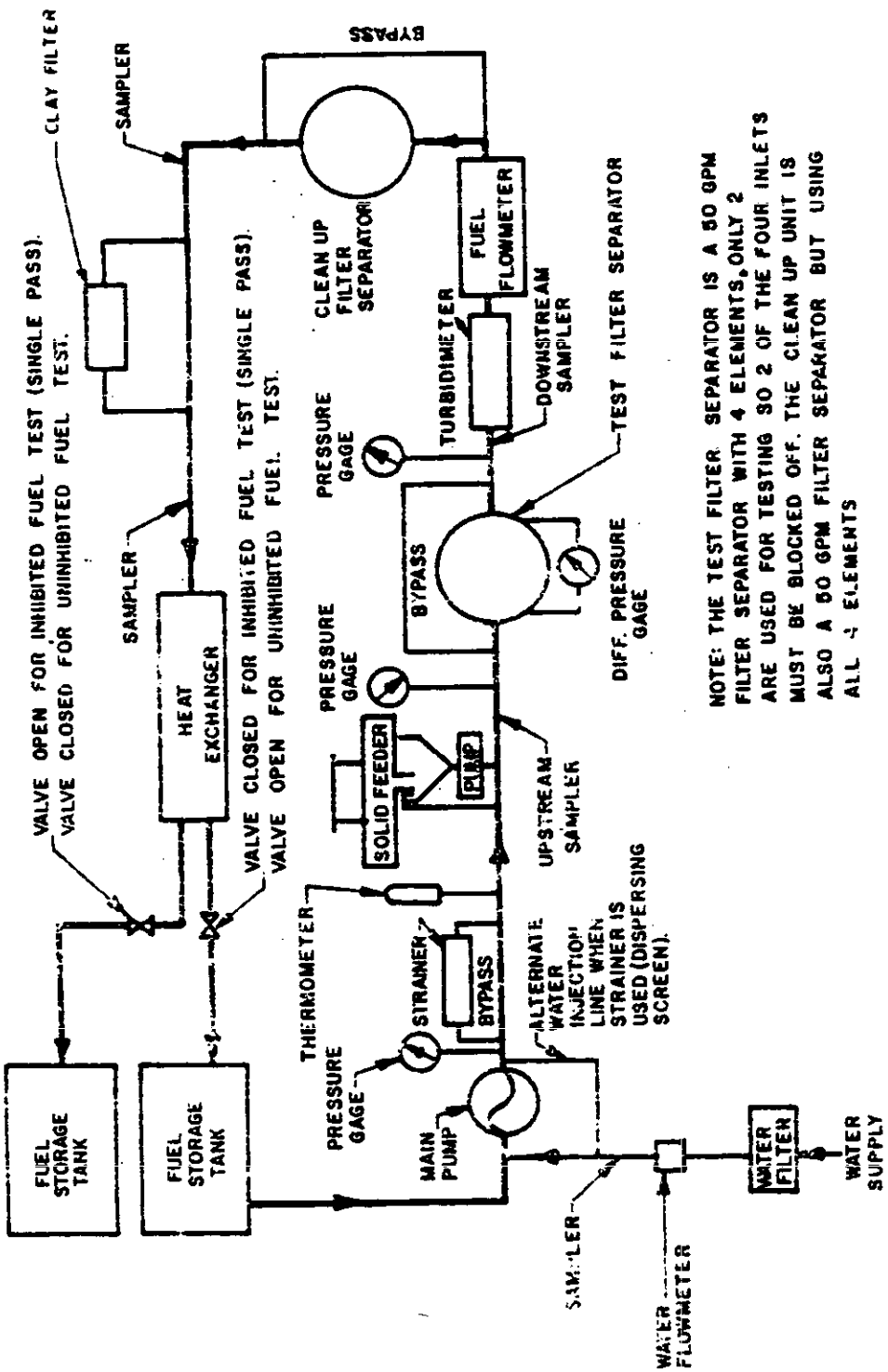

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FIGURE 1. Arrangement of test loop system.

removed for inspection and cleaning. This unit shall be equipped with a differential pressure measuring device with a scale rate of 0 to 30 psi or higher and an accuracy range of 1 psi. The screen shall be inspected (and cleaned if necessary) prior to every short-term run involving water or solid contaminant injection and every 8 hours of operation during the 125-hour life test. Rapid buildup of screen differential pressure during test is an indication of excessive system contamination which must be corrected before proceeding with the subsequent test or test period.

3.5.14 Test system pressure. The test system pressure shall be not less than 20 psi when measured at the sampler just downstream of the test filter-separator during the tests specified herein under all flow conditions.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproval by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspection. Inspection shall be classified as specified in the end item specifications.

4.3 Qualification or preproduction inspection. Examination and tests shall be in accordance with the end item specifications (see 6.5).

4.4 Quality conformance inspection.

4.4.1 Sampling, examination, and tests. Sampling for examination and tests shall be as specified in the end item specification (see 6.6).

4.4.2 Test conditions.

4.4.2.1 Uninhibitted fuel. Grade JP-5 fuel conforming to MIL-T-5624 shall be used in all tests. When a new batch of test fuel is received, it shall be analyzed for conformance to the applicable requirements of table I of MIL-T-5624, listed below:

Aromatics	Freezing point
Olefins	Viscosity
Sulfur	Copper strip corrosion
Distillation temperature	Existent gum
Flash point	Particulate matter
Specific gravity	

After the initial analysis, the JP-5 will be considered to be within the limits of MIL-T-5624 provided that the Interfacial Tension (IFT), Water Separometer

Index Modified (WSIM), and Specific Gravity (SG), meet the values specified herein after the fuel has been circulated through the clay filter as specified in 4.4.2.1(a).

(a) The uninhibited fuel shall be circulated through a filter unit filled with fuller's earth or replaceable clay cartridges to absorb any residual fuel system additives. The test filter-separator shall be bypassed. The fuel shall be circulated at a flow rate not to exceed 50 percent of the rated capacity of the filter unit. The fuel shall be circulated until the IFT is above 40 dynes/cm as measured between the test fuel and test water and the WSIM of the test fuel is not less than 85. The SG of the test fuel shall be a minimum of 0.788 and a maximum of 0.845. Samples of test fuel for analysis, shall be obtained from the fuel storage tanks or upstream from the test filter-separator.

(b) Each batch of uninhibited test fuel (minimum of 400 gallons) used for quality conformance testing, shall be analyzed for conformance to the values specified in 4.4.2.1(a) at the beginning of each week in which quality conformance testing is scheduled. Should a set of elements fail during a test, (except for obvious structural failures) additional samples of the test fuel shall be analyzed for IFT and SG to determine if the fuel still meets the requirements specified herein. If the fuel does not meet the specified values, the test fuel shall be recirculated through the clay filter until it meets these values (IFT, WSIM, SG), and the failed elements retested or a new set from the same lot installed in the test filter-separator and subjected to the quality conformance tests. If the test fuel does not meet the specified values after recirculation through the clay filter, it shall be replaced with a new batch of fuel that meets the specified values prior to resumption of quality conformance testing.

(c) Prior to the start of qualification or quality conformance testing, the uninhibited test fuel shall be circulated through the fuel quality monito (turbidimeter), cleanup filter-separator, and back to the storage tank. The fuel shall be circulated until the fuel quality monitor indicates that any residual free water in the test fuel has been reduced to zero or some irreducible minimum value that remains stable. The test fuel shall then be circulated through the test filter-separator (test elements installed) and the minimum value (not less than zero) shall be recorded on the test data sheet. This value shall be subtracted from all subsequent fuel quality monitor readings after testing starts to obtain the net free water reading. The fuel shall not contain more than 0.5 Mg/Liter of solids prior to initiation of testing.

4.4.2.2 Inhibited fuel. Unless otherwise specified (see 6.2), the uninhibited JP-5 jet fuel specified in 4.4.2.1 shall be inhibited with 16 pounds per 1000 barrels of HiTec E-515 conforming to MIL-I-25017, and 0.15 percent icing inhibitor (FSII), conforming to MIL-I-27686. The inhibitors shall be blended in the test fuel as follows:

(a) All filtration equipment shall be bypassed and HiTec E-515 shall be injected. Icing inhibitor conforming to MIL-I-27686 shall then be injected into the system. The two inhibitors shall not be premixed or injected simultaneously. The inhibitors shall be injected into the main pump suction line or through the contaminant injection equipment or at tank opening (using two-tank system). The inhibitors may be prediluted (individually) with the test fuel if necessary to achieve the required injection rate.

(b) The inibitor shall be introduced into the fuel system at a rate equal to the ratio of the final fuel blend desired. For example, if a 6000 gallon quantity of fuel requires 0.38 pounds of inhibitor per 1000 gallons of fuel (16 pounds per 1000 barrels), and if the fuel is circulated at 250 gpm, the inhibitor shall be introduced at 0.095 pounds per minute.

(c) Following the inhibitor introduction the fuel shall be circulated until two system turnovers have been completed, bypassing all filtration equipment.

(d) For filter-coalescer elements (FNS 4330-00-983-0998) conforming to MIL-F-52308 the test shall be conducted using a minimum of two elements and two separators in a single housing. Single element and single separator tests may be substituted; however, two successful tests are required to satisfy the requirements. For other type filter-separators and elements, filter-coalescer-separator element combinations shall be devised and installed in a housing scaled in the same proportion as the filtration area, housing design, and flow velocity in the application full scale filter-separator. The fuel flow rate through the small scale unit shall also be proportionally reduced during testing. This test shall be conducted with the test loop system in the single pass mode (see figure 1).

4.4.2.2.1 Electrical conductivity additive. When specified (see 6.2), ASA-3 conforming to ASTM D1655 shall be added to the test fuel for the test specified in 4.4.2.2. The ASA-3 shall be added before the inhibitors and in the amount required to establish a fuel conductivity within a range of 200-600 picosiemens per meter (pS/m).

4.4.2.3 Fuel temperature. Unless otherwise specified (see 6.2), the fuel temperature shall be between 70° F. and 90° F. during the testing specified herein, and shall be maintained within plus or minus 5° F from the starting temperature.

4.4.2.4 Test contaminants. The following contaminants shall be used:

(a) Red iron oxide (fe_2O_3), obtainable from Fisher Scientific Company, 204 Fisher Building, Pittsburg, PA 15219, identified as Fisher red iron Oxide no. I-116.

(b) Unless otherwise specified by the end item specification, fresh water shall contain less than 1.0 mg/liter of solids and shall have a surface tension of not less than 65 dynes/cm at 75° F. The acidity-alkalinity value (pH) shall be between 5 and 8. These values shall be determined and the results recorded on the applicable

data sheet at the beginning of each week when quality conformance testing is scheduled, or prior to the start of qualification testing.

(c) Siliceous dust, (AC dust) obtainable from the AC Spark Plug Division, 1300 North Dort Highway, Flint, MI 48506, identified as AC Spark Plug Company test dust, coarse grade package no. 1543637.

4.4.2.5 Test data. Test data sheets no. 1 through 6 (see appendix A) shall be used for each test as stated in the applicable individual tests. In addition, test data shall be provided on the test fuel as specified in 4.4.2.1.

4.4.2.5.1 Prequalification test report. Prior to Government qualification testing the contractor shall submit a test report in accordance with MIL-STD-831.

4.4.2.6 Test sampling schedule and procedures. Test sampling schedule and procedures shall be in accordance with table II. All test samples shall conform to the contamination limit requirements specified in 3.2.

4.4.2.7 Fuel flow rate. All full scale tests shall be performed at 100 percent of the flow rating of the filter-separator, except the pressure drop calibration (see 3.3.1) and water removal (see 3.3.3).

4.4.3 Tests. Unless otherwise specified (see 6.2), all tests shall be in accordance with table II and as specified herein.

4.4.3.1 Filter-coalescer element, inside-to-outside flow. The filter-coalescer element (inside-to-outside flow) shall be subjected to the following test:

(a) Equipment. An open tank of fuel, a pump, a flowmeter, pressure gage, piping or flexible hose, valves, fixtures for retaining the element, a metered supply of tap water, and a water drain are required for this test. The retaining fixture shall mechanically support the element in the same manner as the vessel for which the element is intended, and shall direct the flow in the normal direction through the element. A schematic arrangement of the filter-coalescer test equipment is shown in figure 2.

(b) Procedure. The test shall be conducted as follows:

(1) Submerge mounted element in the fuel.
(2) Start fuel flow and gradually increase flow rate, expelling all air, until rated flow is reached.
(3) Inject water at 10 percent of rated flow until water drops are formed on the element.
(4) Rotate the element, and observe the water drops and fuel. The formation of clusters of water drops, graping, or cloudy streams shall constitute failure of this test.

TABLE II. Test sampling and procedures.

Test	Test para.	When samples are taken	Size sample Ml	Purpose	No. of Samples	Analysis para.	Sampling	Type sample
1	2	3	4	5	6	7	8	9
Pressure drop media gration	4.4.3.6	At start	500 (water)	For IFT	1	4.6.8	Water filter effluent	Bottle
		At start	4,000	IFT WSIM	1	4.6.8 4.6.5	Storage tank	Glass con-tainers
		5, 10, and each 10 min utes there-after	1,000	Solids	7	4.6.3	Test F-S effluent	In-line sampler
		5, 10, and each 10 min-utes there-after	1,000	Fibers	7	4.6.4	Test F-S effluent	In-line sampler
Red iron oxide	4.4.3.7	5, 10, and each 10 min-utes until 40 psi then at 5 psi differential pressure thereafter	1,000	Solids	8 mini mum	4.6.3	Test F-S effluent	In-line sampler
Water removal (see note)	4.4.3.8	At start	500 (water)	pH, solids, and sur-face ten-sion	1	4.6.10 4.6.9	Water filter effluent	Bottle In-line sampler
		Last 15 minutes of second hour	18,925	Fuel in water	1	4.6.11	Test F-S effluent	5-gallon carboy

TABLE II. Test sampling and procedures (cont).

Test	Test para.	When samples are taken	Size sample Ml	Purpose	No. of Samples	Analysis para.	Sampling	Type sample
1	2	3	4	5	6	7	8	9
Red iron oxide and water (see note)	4.4.3.9	5, 10, and each 10 minutes thereafter until 40 psi	1,000	Solids	8 minimum	4.6.3	Test F-S effluent	In-line sampler
		At end	500 (water)	Suface tension and pH	1	4.6.9 4.6.10	Test F-S sump	Bottle
		Last 15 minutes	18,925	Fuel in water	1	4.6.11	Test F-S sump	5-gallon carboy
Inhibited fuel (see note)	4.4.3.10	At start of water test	500 (water)	For IFT	1	4.6.8	Water filter effluent	Bottle
		At end of water test	500 (water)	For IFT	1	4.6.8	Test F-S sump	Bottle
		Two before adding inhibitor	5,000	Hitec E-515 FSII WSIM	6	4.6.7 4.6.6 4.6.5	Storage tank	Any glass container
		Two at start (after adding inhibitor)	5,000	IFT and ECA		4.6.8 4.6.12		
		Two at end	4,000					
		5, 10, and 10 minutes thereafter after first hour	1,000	Solids	8	4.6.3	Test F-S effluent	In-line sampler

TABLE II. Test sampling and procedures (cont).

Test	Test para.	When samples are taken	Size sample	Purpose	No. of Samples	Analysis para.	Sampling	Type sample
1	2	3	4	5	6	7	8	9
		At end of AC dust and water test	500 (water)	Surface tension and pH	1	4.6.9 4.6.10	Test F-S sump	Bottle
		Last 15 minutes	18,925	Fuel in water	1	4.6.11	Test F-S sump	5-gallon carboy
Life	4.4.3.11	Last 15 minutes of life	18,925	Fuel in water	1	4.6.11	Test F-S sump	5-gallon carboy
(see note)		Every 15 minutes of each water added period	1,000	Solids	68	4.6.3	Test F-S effluent	In-line sampler
		At 1 minute, 15 minutes; 8 hours; and 1 at beginning and end of every 8 hours thereafter, and during the last 5 minutes.	1,000	Fibers	32	4.6.4	Test F-S effluent	In-line sampler

Note: 1. Turbidimeter readings shall be recorded at start (prior to water injection) and every 10 minutes thereafter. Total free water shall be the difference between the readings at the start and subsequent readings.

2. See Appendix B for in-line sampling apparatus for solids.

TABLE III. Examination and tests.

Examination and Tests	Requirements Paragraph	Test Method Paragraph	Qualification or Preproduction	Initial Production Inspection	Quality Conformance	
					Individual	Sampling Plan
Examination of Product	As required by end item spec.	N/A	X	X	X	X End Item Spec.
Hydrostatic Test Pressure	3.4.1	4.4.3.5	X (If vessel is being supplied)	X	X	-
Filter-Coalescer Element	3.4.2 and End Item Spec.	4.4.3.1 4.4.3.2	X	X	-	X End Item Spec.
Replaceable Separator Elements	3.4.3.1	4.4.3.3	X	X	X	-
Permanent Separator Stages	3.4.3.2	4.4.3.4	X	X	X	-
Differential Pressure and Media Migration	3.3.1 3.3.2	4.4.3.6	X	X	-	-
Red Iron Oxide (Dry)	3.3.4 3.3.4.1(b)	4.4.3.7	X	X	-	X
Fuel Shutoff Control	3.4.6.2	4.4.3.8.1	X	X	-	-
Water Removal	3.3.3	4.4.3.8	X	X	-	X
Red Iron Oxide and Water	3.3.4 3.3.4.1(a)	4.4.3.9	X	X	-	X
Inhibited Fuel	3.3.4, 3.3.4.1(c) 3.3.5	4.4.3.10	X	-	-	-
Life (125 hours)	3.3.6	4.4.3.11	X	-	-	-

TABLE III. Examination and tests (cont)

Examination and Tests	Requirements Paragraph	Test Method Pargraph	Qualification or Preproduction	Initial Production Inspection	Quality Conformance	
					Individual	Sampling Plan
Environmental (Elements)	3.3.7 through 3.3.7.3	4.4.3.13.2, 4.4.3.14.2, 4.4.3.15, 4.4.3.16	X	-	-	-
Environmental (Vessel)	3.3.7 through 3.3.7.3	4.4.3.12.1 4.4.3.12.2 4.4.3.13.1, 4.4.3.14.1	X	-	-	-
Post Environmental	3.3.8	4.4.3.17	X	-	-	-

NOTE: X = Applicable.

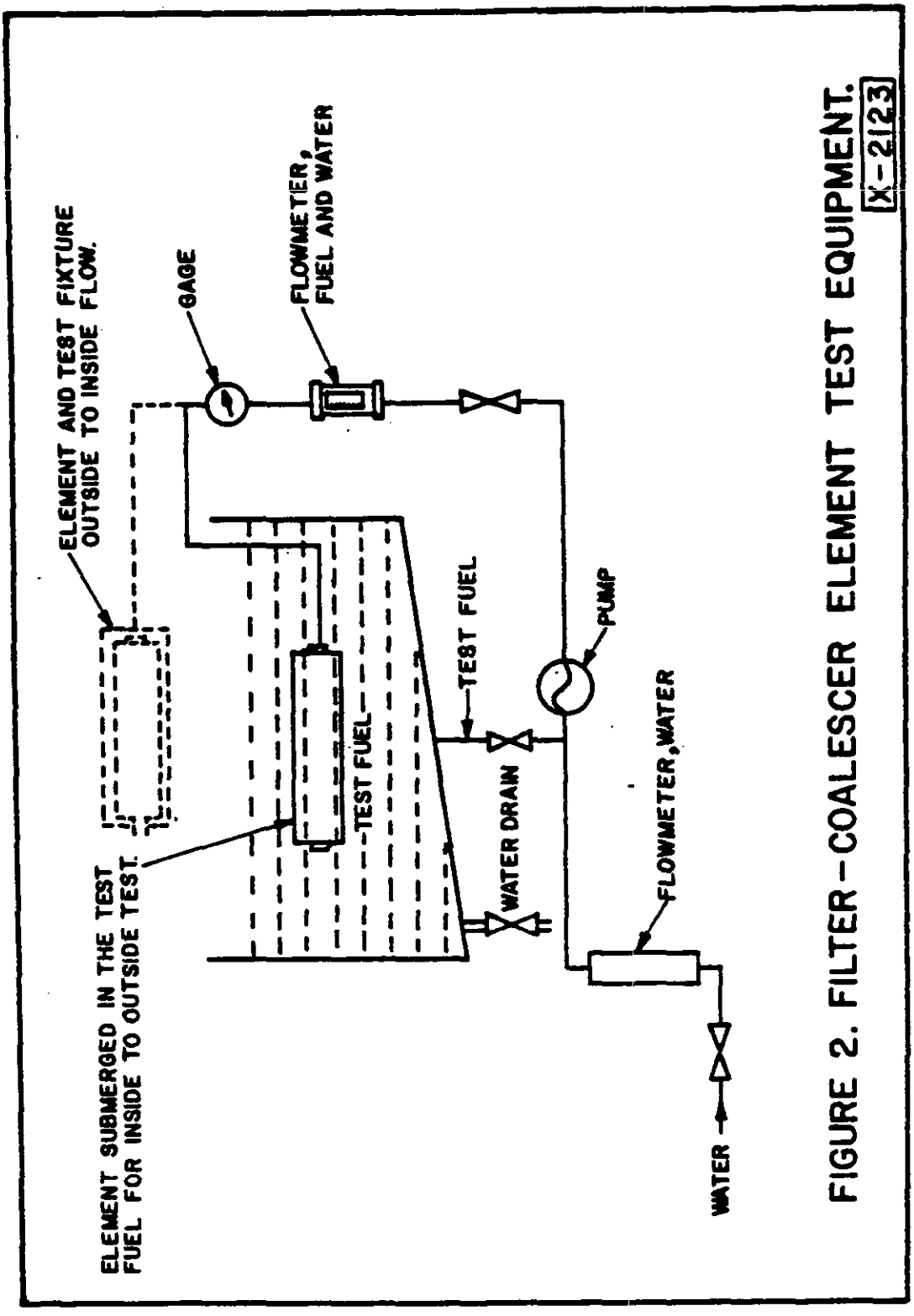

FIGURE 2. FILTER-COALESCER ELEMENT TEST EQUIPMENT. X-2123

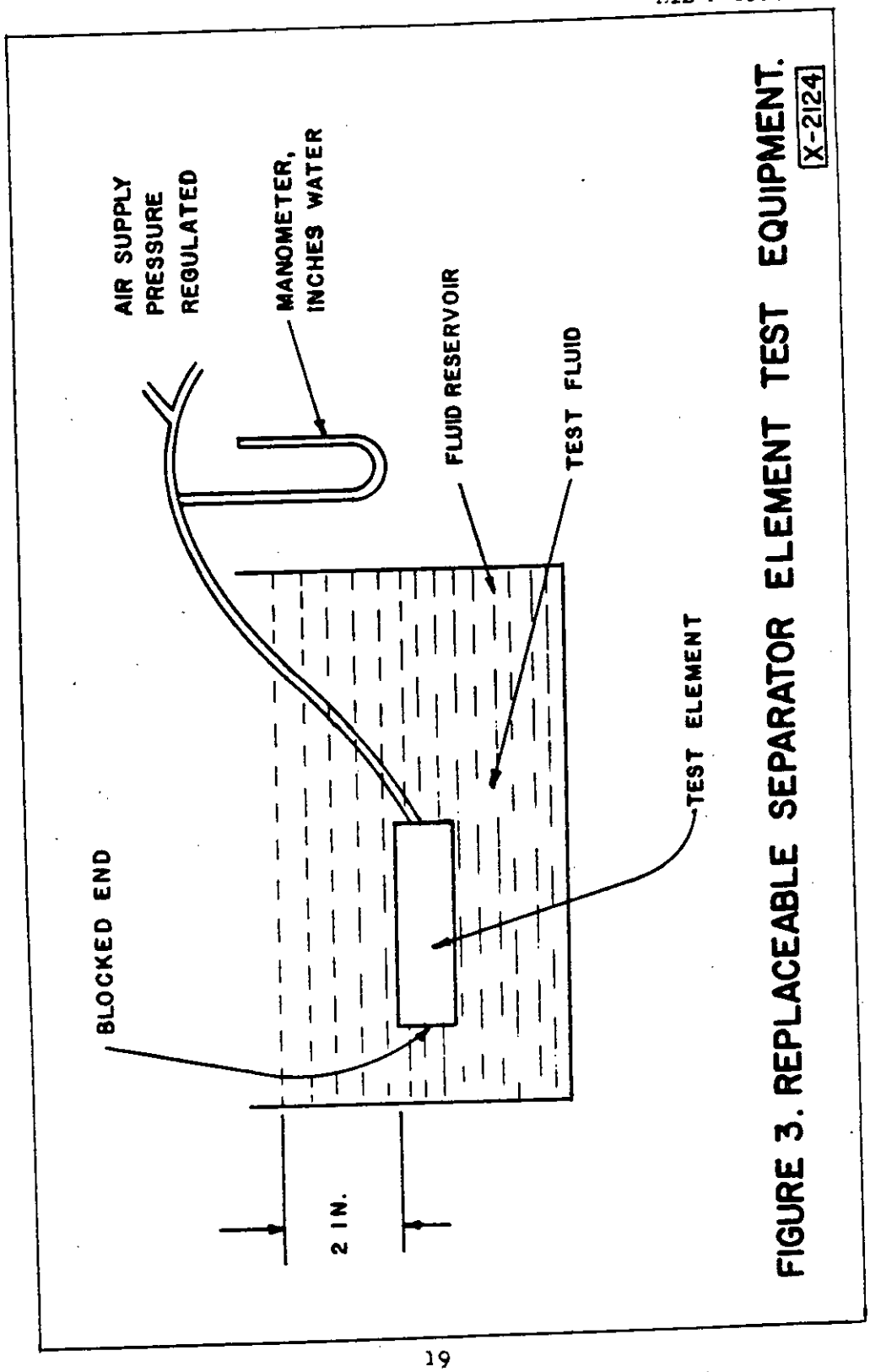

FIGURE 3. REPLACEABLE SEPARATOR ELEMENT TEST EQUIPMENT. X-2124

4.4.3.2 Filter-coalescer element outside-to-inside flow. The filter-coalescer elements (outside-to-inside flow) shall be subjected to the following test:

(a) The equipment required shall be as specified in 4.4.3.1(a) and as shown on figure 2.

(b) Procedure. The test shall be conducted as follows:

(1) Support the fixture and element with the outlet just below the surface of the fuel.

(2) Start the fuel flow and gradually increase the flow rate, expelling all air, until rated flow is reached.

(3) Inject water at 10 percent of rated flow until water drops are visible in the fuel. Note clarity of fuel and water. To determine the clarity, a small sample of the fuel discharge from the case shall be collected in a transparent bottle or beaker and observed for condition of the fluid. Evidence of unclear water or no definitive division between the water and fuel shall constitute failure of this test.

4.4.3.3 Replaceable separator element. The replaceable separator element shall be subjected to the following tests:

(a) Equipment. An open tank, a compressed air supply with control valving, water manometer, element mounting fixture, suitable tubing and flexible hose, and the elements to be tested, shall be arranged as shown on figure 3. The test fluid may be any liquid acceptable to the Government that is nondestructive to the element and can be removed by drying with available equipment.

(b) Procedure. The test shall be conducted as follows:

(1) Fill the tank with clean test fluid, and measure and record the surface tension.

(2) Submerge the element in the tank in a horizontal position so that the upper surface is 2 inches below the liquid surface.

(3) Admit very low air pressure to the inside of the element, equal to a head of 6 inches of water, and let stand for 2 minutes. Rotate the element and observe for air bubbles escaping from the element.

Note: When the element is first submerged and very low air pressure started, there might be a few air bubbles due to air trapped between the medium and its container.

(4) If no bubbles occur in (3) above, gradually increase medium.

(c) Observation. The average break-through pressure shall be established on not less than the results of 12 samples tested. Evidence of a sudden break-through of air bubbles in (3) above, or water pressure not within plus or minus 1 inch of the average break-through pressure shall constitute failure of this test.

4.4.3.4 Permanent separator stages.

4.4.3.4.1 Permanent separator stage examination. When constructed from tetrafluoroethylene-polymer-coated screen, the permanent separator stage shall be visually examined to assure that coatings are completely fused (centered) and uniform, free from mud-cracks, craters, pinhole, sags, rims, heavy edges, wrinkles, beads, tears, blisters, incomplete coverage, and other surface imperfections. Mud-cracks and pinholes to the basic metal or any other discontinuity shall constitute failure of this test if visible at a magnification of 32X.

4.4.3.4.2 Permanent separator stage tests. One of the following two tests shall be performed as applicable.

4.4.3.4.2.1 Permanent canisters inside-to-outside flow. Each canister shall be mounted on a fixture having the capability of rotating the canister horizontally 360 degrees in a level plane. Fill water inside the coated screen to a depth of 1/2 inch. Rotate the canister 360 degrees and examine for leakage. Nonconformance to 3.4.3.2 shall constitute failure of this test.

4.4.3.4.2.2 Permanent baskets, outside-to-inside flow. The permanet basket separator shall be mounted in a fixture and subjected to a 1/2-inch static water head on the outside of the basket. The basket shall be rotated and examined for leakage. Nonconformance to 3.4.3.2 shall constitute failure of this test.

4.4.3.5 Hydrostatic pressure.

4.4.3.5.1 Filter-separator vessel. Subject the filter-separator to a hydrostatic test pressure as specified in the end item specification. When not specified in an end item specification, the hydrostatic pressure tests shall conform to the requirements specified in 3.4.1 of this specification. Nonconformance to the requirements in the end item specification or 3.4.1 shall constitute failure of these tests.

4.4.3.5.2 Differential pressure dial gage. Subject each gage to a hydrostatic pressure equal to the maximum scale pressure, and hold at this pressure for a minimum of 30 minutes. Within 10 minutes after the pressure is released and without recalibration or adjustment, readings shall be taken at not less than eight equal intervals over the entire scale. The gage shall be tapped sharply with the finger at approximately the center of the scale area before each reading. Bourdon tube and piston type gages shall be calibrated at three intervals on the scale; the anticipated initial operating pressure, the pressure at which the filter elements are charged, and the maximum scale pressure. A dead weight tester or mercury manometer with air pressure or calibrated check gage shall be used in calibrating the gage. Testing of the gage shall be in a temperature of 20° C plus or minus 5.6° C (68° F plus or minus 10° F). Nonconformance to 3.4.5 shall constitute failure of this test.

4.4.3.6 Differential pressure and media migration (first set of elements). Using a new set of dry elements which have not been subjected to any other test, the filter-separator shall be subjected to a flow test at the rates shown in table IV, to determine the amount of media migration, fiber migration, pressure drop across the filter-separator housing, and filter-separator elements.

Pressure drops shall be recorded at the end of each period. Test data sheet No. 1 shall be used to record data. Nonconformance to 3.3.1 or 3.3.2 shall constitute failure of this test.

TABLE IV. Rate of flow for 60 minutes.

Period	Time (Minutes)	Percent of Rated Flow
1	0 to 10	100
2	10 to 20	80
3	20 to 30	60
4	30 to 40	40
5	40 to 50	20
6	50 to 60	115

4.4.3.7 Red iron oxide (dry). During the test, dry red iron oxide shall be continuously injected into the fuel at the rate of 0.143 grams per gallon of fuel circulated until 75 psi differential pressure is reached across the media. The 75 psi differential pressure shall be maintained for a period of 5 minutes. At the end of 80 minutes, the oxide addition may be increased to 0.4 grams per gallon. Following this test, the filter-separator shall be disassembled and examined. Test data sheet No. 2 shall be used to record data. Evidence of structural failure of the filter-separator or media or nonconformance to 3.3.4.1(b) shall constitute failure of this test.

4.4.3.8 Water removal (second set of elements). The water removal tests shall consist of two separate 1-hour runs. A third 1-hour run shall be required when fuel containing above 5 percent water is specified. The total input rate shall be 115 percent of the rated capacity of the filter-separator. During testing, the filter-separator shall be so operated that the automatic drain valve (when supplied) will control the water drainage in all tests. During the last 15 minutes of the second and third hour runs, the amount of fuel in the discharge water shall be checked by taking a 5-gallon water sample from the filter-seperator sump (see 4.6.11). Water shall be introduced at the following concentrations:

First hour:	0.5 percent by volume
Second hour:	5.0 percent by volume
Third hour:	10.0 percent by volume, only for fixed equipment.

Test data sheet No. 3 shall be used to record data. Nonconformance to 3.3.3 shall constitute failure of this test. Water removal tests are not applicable in temperatures below plus 33° F.

4.4.3.8.1 Water removal-fuel shutoff control. With the manual and automatic water drain valve closed, the filter-separator shall be operated at 100 percent of rated capacity. Water at 3 percent of the flow rate shall be introduced into

the inlet of the filter-separator to check the operation of the fuel shutoff valve. The water level shall be observed, and the shutoff valve should activate and prevent the water level in the filter-separator from rising to a height which will reach the bottom of the filter coalescer elements. Nonconformance to 3.4.6.2 shall constitute failure of this test.

4.4.3.9 Red iron oxide and water. During the red iron oxide and water tests, the input fuel shall be continuously contaminated with 0.143 grams of dry red iron oxide per gallon of fuel and 3.0 percent by volume of water. The test shall continue until a 40 psi differential pressure is reached across the filter-seperator (see 6.3.2). The pressure differential across the media (see 6.3.3) should not exceed 20 psi before 30 minutes nor 40 psi before 70 minutes. Test data sheet No. 4 shall be used to record data. Nonconformance to 3.3.4.1(a) shall constitute failure of this test.

4.4.3.10 Inhibitied fuel (third set of elements). Inhibited fuel shall be used during testing. The fuel shall be contaminated with water and AC test dust for the time and rates listed below. Upon completion of the 130 minutes test, the pressure drop across the media should not exceed 40 psi. Test data sheet No. 5 shall be used to record data. Time and rates shall be as follows:

(a) For 60 minutes with only water being injected at a rate of 1 percent by volume.
(b) An additional 70 minutes with water and AC dust being injected simultaneously. The rate shall be 1 percent by volume for the water and 0.143 grams per gallon of rated flow for the AC test dust. Nonconformance to 3.3.4, 3.3.4.1(c), or 3.3.5 shall constitute failure of this test.

4.4.3.11 Life (fourth set of elements). Test data sheet No. 6 shall be used to record data. Fuel shall be pumped through the filter-separator at rated input flow for up to 125 hours. Nonconformance to 3.3.6 shall constitute failure of this test. Test conditions shall be as follows:

(a) The life test may be accomplished in a maximum of 16 operating increments of 8 hours per day for 15 consecutive workdays and a final operating increment of 5 hours on the 16th day. Start-up and shutdown shall be accomplished by the starting and stopping of the pump.
(b) The fuel shall be unihibited.
(c) Water shall be injected at the beginning of each increment for 1 hour or during the time solids are added, whichever is longer. The rate of water injection shall be 0.5 percent by volume, except for the final 1 hour (125th hour), during which time the rate of water injection shall be increased to 3 percent by volume.
(d) Solids contamination shall be red iron oxide, added dry at the rate of 0.143 grams per gallon of flow rate at the beginning of each increment as required to produce and maintain a pressure differential of 10 psi across the filter-separator. The start of the solids addition shall be immediately after the start of the water addition.

4.4.3.12 Environmental. The environmental tests shall be conducted in the order listed in the following paragraphs, on a complete filter-separator, a complete set of filter-coalescer elements and separator stages. In addition, samples of the gasket material, O-rings seals, element mounting hardware, and other material that may be a possible cause of fuel contamination shall be subjected to these environmental tests.

4.4.3.13 Storage, high temperature. The following tests shall be conducted as applicable.

4.4.3.13.1 Storage, high temperature, filter-separator. Install new elements and subject the complete filter-separator to test in accordance with MIL-STD-810, method 501.1, procedure I, steps 1 through 7. Nonconformance to the high temperature storage requirements specified in 3.3.7.2 shall constitute failure of this test.

4.4.3.13.2 Operation, high temperture filter-separator. When specified (see 6.2), install the complete filter-separator including correct number of filter-coalescer elements in a pumping system of the required flow rate. Operate the filter-separator at rated flow in an ambient temperature of plus 125° F for a period of not less than 1 hour. Nonconformance to the high temperature operating requirements specified in 3.3.7.1 shall constitute failure of this test.

4.4.3.13.3 Storage, high-temperature, filter-coalescer elements (fifth set of elements). Test the new filter-coalescer elements in accordance with MIL-STD-810, method 501.1, procedure I, steps 1, 2, 3, and 6.

4.4.3.14 Storage, low temperature. The following tests shall be conducted as applicable.

4.4.3.14.1 Storage, low temperature, filter-separator. Install new filter-coalescer elements and test the complete filter-separator in accordance with MIL-STD-810, method 502.1, procedure I, steps 1 through 7. Storage temperature shall be minus 50° F. Nonconformance to the low temperature storage requirements specified in 3.3.7.2 shall constitute failure of this test.

4.4.3.14.2 Operation, low temperature filter-separator. When specified (see 6.2), install the complete filter-separator including correct number of filter-coalescer elements in a pumping system of the required flow rate. Operate the filter-separator at rated flow in an ambient temperature of minus 25° F. for a period of not less than 1 hour. Nonconformance to the low temperature operating requirements specified in 3.3.7.1 shall constitute failure of this test.

4.4.3.14.3 Storage, low temperature filter-coalescer elements. Subject the same filter-coalescer elements, which were tested in 4.4.3.13.3, to the low temperature test in accordance with MIL-STD-810, method 502.1, procedure I, steps 1, 2, 3 and 6. Storage temperature shall be minus 50° F. Nonconformance to the low temperature storage requirements in 3.3.7.2 shall constitute failure of this test.

4.4.3.15 Resistance to fuel (filter-coalescer elements). When specified (see 6.2), the following fuel resistance test shall be conducted. Using filter-coalescer elements from tests in 4.4.3.13.3 and 4.4.3.14.3, establish the fuel resistance of these elements by immersing in the test fuel for a minimum period of 100 hours at a temperature of 77° F plus 5° F, and examine for defects. Nonconformance to the fuel immersion requirements specified in 3.3.7.3 shall constitute failure of this test.

4.4.3.16 Resistance to salt water (filter-coalescer element). When specified (see 6.2) establish the salt water resistance of the filter-coalescer element using the elements from test specified in 4.4.3.15 by immersion in a solution consisting of 4 percent sodium chloride and 96 percent distilled water for a period of 72 hours, and examine for defects. Nonconformance to the salt water immersion requirements specified in 3.3.7.3 shall constitute failure of this test.

4.4.3.17 Post environmental performance (filter-coalescer element). After successful completion of the tests specified in 4.4.3.13.3, 4.4.3.14.3, 4.4.3.15 and 4.4.3.16 install the same filter-coalescer elements in the test filter-separator and subject these elements to the 0.5 percent water removal test as specified in 4.4.3.8. Nonconformance to 3.3.8 shall constitute failure of this test.

4.5 Sampling containers and solvents.

4.5.1 Preparation of sampling containers. The sample containers used for analytical determinations shall be either plastic or glass. If plastic is used, the plastic shall not affect nor be affected by the test fuel. The following procedure has been found suitable:

(a) Wash the container and cap thoroughly with hot water and detergent and rinse thoroughly in hot tap water.
(b) Rinse twice with particle-free distilled water.
(c) Rinse with particle-free isopropyl alcohol to remove water.
(d) Rinse with particle-free hexane. Hold bottle in an inverted position while flushing with filtered air from a millipore aerosol holder until the hexane has evaporated, and cap bottle.

4.5.2 Preparation of particle-free solvents for use in cleaning procedures. Particle free solvents shall be prepared by repeated filterations through a type HA Millipore filter (or equal). The filter solvent should subsequently be protected from contamination by storing it in containers described herein and equipped with filtered air bleeds.

4.6 Analysis of samples.

4.6.1 Free water detection, turbidimeter. The analysis of effluent fuel for free water shall be made by using the Bowser Model 861-F Totamitor or equal. The turbidimeter shall be the determining factor as to conformance or nonconformance of free water limitation. Calibration instructions for the turbidimeter shall be in accordance with the manufacturer's standard practice.

4.6.2 Free water detection, viewer kit. As a spot check for the presence of free water in the effluent fuel a free water detector viewer kit conforming to MIL-D-81227 may be used. The viewer kit shall not be a determining factor as to conformance or nonconformance of free water limitation. To analyze for free water a fuel sample shall be taken directly from the pressurized fuel system through a Millipore Coporation turbofuel sampler (or equal). The sampler shall be equipped with a stainless steel monitor (Millipore Part No. XH00 000 05 or equal), stainless steel dispenser screen (Millipore Catalogue No. XH00 000 06 or equal), and a detector pad in accordance with MIL-D-81248, except the diameter shall be 37 mm. A 300 ml fuel sample shall be passed through the uranine-dyed detector pad, which shall then be transferred to a view kit which has been equipped with a standard conforming to MIL-S-81282. The pad shall be observed under the ultraviolet light, and the presence of free water in the fuel shall cause the pad to fluoresce. The amount of fluorescene shall be compared to the fluorescence of the four standards labeled 0 ppm, 5 ppm, 10 ppm, and 20 ppm.

4.6.3 Solid contaminants. The analysis of the 1000 ml sample shall be in accordance with Appendix B of this specification.

4.6.4 Fiber determinations. The analysis for fibers in the effluent fuel samples shall be in accordance with Appendix D of this specification.

4.6.5 Water separometer index modified, (wsim). The wsim test shall be performed in accordance with ASTM D2550.

4.6.6. Icing inhibitor. The icing inhibitor shall conform to MIL-I-27686. The concentration of the icing inhibitor shall be determined in accordance with FED-STD-791, method 5327.3

4.6.7 Corrosion inhibitor. The concentration of Hitec E-515, shall be determined by the method described in Appendix C of this specification.

4.6.8 Interfacial tension (ift). The ift determinations shall be performed in accordance with ASTM D1331, method B. Each fuel sample tested shall be run separately over distilled water and over the injected water.

4.6.9 Surface tension. The surface tension of the water shall be performed as specified in ASTM D1331, method A.

4.6.10 pH determination. The pH of the water shall be determined by using a direct reading instrument such as a Leeds and Northrup Model 7401 pH meter or approved equal.

4.6.11 Fuel in discharge water. The 5-gallon sample drawn during the last 15 minutes of each water run shall be allowed to settle for a period of 24 hours prior to determining the volume of fuel.

4.6.12 Electrical conductivity additive (ECA) determination. The electrical conductivity of the test fuel shall be determined by the method described in ASTM D2624.

4.6.13 Specific gravity. The specific gravity of the test fuel shall be determined by the method described in ASTM D1298.

5. PACKAGING

This section is not applicable to this specification.

6. NOTES

6.1 Intended use. Inspection requirements and test procedures covered in this specification are intended for use in conjunction with end item specifications for testing of filter-separators, filter-separator conversion kits and filter elements or other components.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Whether materials are to be compatible with other than the fuels and inhibitors listed (see 3.1).
(c) When life test is required (see 3.3.6).
(d) Operating and storage temperature if other than as specified (see 3.3.7.1 and 3.3.7.2).
(e) Hydrostatic test pressure if other than 1-1/2 times the working pressure (see 3.4.1).
(f) When differential pressure gage is not required (see 3.4.5).
(g) When an automatic water drain valve is required (see 3.4.6.1).
(h) When fuel shutoff control is required (see 3.4.6.2).
(i) When four-element 50 gpm filter-separator is not required (see 3.5.5).
(j) Inhibitors if other than as specified (see 4.4.2.2).
(k) When electrical conductivity additive is required (see 4.4.2.2.1).
(l) Test fuel temperature if other than as specified (see 4.4.2.3).
(m) When tests other than as specified are required (see 4.4.3).
(n) When high temperature operating test on vessel is required (see 4.4.3.13.2).
(o) When low temperature operating test on vessel is required (see 4.4.3.14.2).
(p) When fuel resistance test on elements are required (see 4.4.3.15).
(q) When salt water resistance test on elements are required (see 4.4.3.16).

6.3 Definitions.

6.3.1 Clean fuel. Clean fuel is defined as fuel containing not more than 0.5 mg per liter of solids contamination and no free water, or an irreducible minimum amount of free water as indicated by the test system fuel quality monitor, while circulating the test fuel through the test loop prior to the start of testing.

6.3.2 Pressure drop across the filter-separator. Unless otherwise specified in the end item specification, the pressure drop across the filter-separator is defined as the pressure drop measured from fuel inlet coupling to fuel coupling. This shall not include the accessory valve.

6.3.3 Pressure drop across the media. The pressure drop across the media is defined as the pressure drop across the filter-separator with the first and second stages installed measured from fuel inlet coupling to fuel outlet coupling, less the pressure drop across the filter-separator without the first and second stage installed.

6.3.4 Fiber. A fiber is defined as any particle with a length-to-diameter ratio of 20 or greater and at least 20 microns in length.

6.3.5 Media. The media is defined as those components comprising the first and second stages of the filter-separator.

6.4 Turbidimeter. When a turbidimeter is furnished on an "or equal" basis, it shall be subjected to approval by the contracting officer.

6.5 Qualification. When filter elements are submitted to a Government laboratory for qualification, the responsible activity will require the contractor to furnish at the same time a complete set of test data DRDME FM 13-34 a-f (see appendix A) covering the test results obtained from tests conducted at his own facility.

6.6 Quality conformance. When a contractor is required to submit sample filter elements to the Government for quality conformance inspection, such sampling should be as specified in MIL-F-52308 or the end item specification as applicable.

6.7 International standardization agreement. Certain provisions of this specification are the subject of international standardization agreement ASCC Air Standard 11/3C STANAG 3105, and 3583 PHE. When amendment, revision or cancellation of this specification is proposed, the departmental custodians will inform their respective Departmental Standardization Offices so that appropriate action may be taken respecting the international agreement concerned.

Custodians:
Army - ME
Navy - AS
Air Force - 11

Review activities:
Air Force - 99
DLA - CS

User activities:
Army - AT, AV
Navy - SH

Preparing activity:
Army - ME

Project 4330-0016

APPENDICES

FOR

FILTER-SEPARATORS, LIQUID FUEL: AND FILTER-COALESCER ELEMENTS, FLUID PRESSURE: INSPECTION REQUIREMENTS AND TEST PROCEDURES FOR

Appendix A. Test Data Sheets.

Appendix B. In-Line Sampling and Analysis Procedures for Solids Contaminant.

Appendix C. Quantitative Infrared Analysis for the Determination of Hitec E-515 Rust Inhibitor in JP-5.

Appendix D. Fiber Determination Method.

APPENDIX A

TEST DATA SHEETS

10. SCOPE

10.1. Scope. This appendix details the format required for recording data during tests performed in accordance with this specification.

20. PROCEDURE

20.1 Complete the required data sheet as determined by the applicable test paragraph in this specification.

TEST DATA SHEET NO. 1

Item Designation: _____ Contract Number: _____

Test Paragraph Title: 4.4.3.6 Differential Pressure and Media Migration Specifications: _____

Set of Elements: _____ Date of Test: _____

Government Inspector: _____

Test Personnel: _____ Fuel: _____

Time of Day	Time Sample Drawn From Start Of Test (Minutes)	Percent Of Rated Flow	Inlet Pressure (PSI)	Outlet Pressure (PSI)	Δ P Across F-S (PSI)	Fuel Temp (° F)	Effluent Sample				Remarks
							Solids		Fibers		
							Sample No	Results mg/liter	Sample No	Results Number/liter	
		100									
	0	100									
		100									
		80									
	10	80									
		80									
		60									
	20	60									
		60									
		40									
	30	40									
		40									
		20									
	40	20									
		20									
		115									
	50	115									
	60	115									

Water Separometer/Index (Modified): Time Sample Taken _____ Results _____

Interfacial Tension: Time Sample Taken _____ Results (Test Water) _____ (Distilled Water) _____

X-1400

TEST DATA SHEET NO. 2

Item Designation: _____ Contract Number: _____

Test Procedure Paragraph Title: 4.4.3.7 Red Iron Oxide (Dry)

Specifications: _____

Set of Elements: _____ Date of Test: _____ Government Inspector: _____

Test Personnel: _____ Fuel: _____

Solids: Type: _____ Total Amount Added: _____ Add Rate: _____

Time of Day	Time From Start Of Test (Minutes)	Flow Rate (GPM)	Inlet Pressure (PSI)	Outlet Pressure (PSI)	Δ P Across F-8 (PSI)	Fuel Temp (°F)	Effluent Sample Solids		Remarks
							Sample No	Results mg/liter	
	5								
	10								
	20								
	30								
	40								
	50								
	60								
	70								
Sample each 10 minutes until a 40 psi differential pressure is reached, and then sample each 5 psi increase in differential pressure until 75 psi is reached.									

X-1401

TEST DATA SHEET NO. 3

Item Designation: _____ Contract Number: _____

Test Procedure Paragraph Title: 4.4.3.8 Water Removal Test Specifications: _____

Set of Elements: _____ Date of Test: _____ Government Inspector: _____

Test Personnel: _____ Fuel: _____

Water Add Rate: First Hour: _____ Second Hour: _____ Third Hour (If Required): _____

Time of Day	Time From Start Of Test (Minutes)	Flow Rate (GPM)	Inlet Pressure (PSI)	Outlet Pressure (PSI)	Δ P Across F-S (PSI)	Fuel Temp (°F)	Effluent Water		Remarks
							Totamitor Reading		
							Reading No	Results (ppm)	
								BLANK	
	0								
	10								
	20								
	30								
	40								
	50								
	60								
	70								
	80								
	90								
	100								
	110								
	120								

Water Surface Tension: Time Sample Taken _____ Results _____

Water pH Value: Time Sample Taken _____ Results _____

Water Discharge Sump Sample Taken _____ Results _____

Water Solids Content: Time Sample Taken _____ Results _____

IFT-Test Water: Time Sample Taken _____ Results _____

MSEP: Time Sample Taken _____ Results _____

Specific Gravity: Time Sample Taken _____ Results _____

Fuel, Solids Content: Time Sample Taken _____ Results _____

X-1402A

TEST DATA SHEET NO. 4

Item Designation: _____ Contract Number: _____

Test Procedure Paragraph Title 4.4.3.9 Rad Iron Oxide and Water Specifications: _____

Set of Elements: _____ Date of Test: _____ Government Inspector: _____

Test Personnel: _____ Fuel: _____

Solids: Type _____ Total Amount Added _____ Add Rate _____

Water: Add Rate _____

Time of Day	Time From Start Of Test (Minutes)	Flow Rate (GPM)	Inlet Pressure (PSI)	Outlet Pressure (PSI)	Δ P Across F-8 (PSI)	Fuel Temp (°F)	Effluent				Remarks
							Solids		Water Totameter		
							Sample No	Results mg/liter	Reading No.	Results (ppm)	
	0										
	5										
	10										
	20										
	30										
	40										
	50										
	60										
	70										
Samples taken each 5 psi increase in differential pressure until 40 psi is reached.											

Water pH Value (F-8 Sump): Time Sample Taken _____ Results _____

Water Surface Tension (F-8 Sump): Time Sample Taken _____ Results _____

X-1403

TEST DATA SHEET NO. 5

Item Designation: _____ Contract Number: _____
Test Procedure Paragraph Title: 4.4.3.10 Inhibited Fuel Test Specification: _____
Set of Elements: _____ Date of Test: _____ Government Inspector: _____
Test Personnel: _____ Fuel: _____ Volume: _____
Solids; Type: _____ Total Amount Added: _____ Add Rate: _____
Water Add Rate: _____ Inhibitor; Type: _____ Total Amount Added: _____

Time of Day	Time Sample Drawn from Start of Test	Flow Rate (gpm)	Inlet Press (psi)	Outlet Press (psi)	Δ P Across F/S		Fule Temp (°F)	Effluent Samples				Remarks
					(psi)	(Hg)		Solids		Water		
								Sample #	Results mg/liter	Reading #	Results (ppm)	

Sample #		WSI(M)	IFT Test	IFT Dist	ECA	Hitec E-515 Analysis	Icing-Inhibitor Analysis %	Time Sample Taken
	Before Inhibitors							
	Start of Test							
	End of Test							
	Water Surface Tension: Time Sample Taken: (End)						Results:	
	Water pH Value: Time Sample Taken: (End)						Results:	

X-1404A

TEST DATA SHEET NO. 6

Item Designation: _____ Contract Number: _____

Test Procedure Paragraph Test: 4.4.3.11 Life Test Specifications: _____

Set of Elements: _____ Date of Test: _____ Government Inspector: _____

Test Personnel: _____ Fuel: _____ Water Add Rate: _____

Solids Added: _____

Time of Day	Time Sample Drawn From Start Of Test (Minutes)	Flow Rate (GPM)	Inlet Pressure (PSI)	Outlet Pressure (PSI)	Δ P Across F-S (PSI)	Fuel Temp (°F)	Effluent						Remarks
							Solids		Water Totamitor		Fibers		
							Sample No.	Results m/g liter	Reading No.	Results (ppm)	Sample No.	Results	
	0 Hr, 1 Min												
	15												
	30												
	45												
	0 Hr, 60 Min												
	[redacted]												
	6 Hr, 1 Min												
	6 Hr, 15 Min												
	30												
	45												
	6 Hr, 60 Min												
	Repeat at 16, 24, 32, 40, 48, 56, 64, 72, 80, 88, 96, 104, 112, 120, and 124 hours												

X-1405

APPENDIX B

IN-LINE SAMPLING AND ANALYSIS PROCEDURES FOR SOLIDS CONTAMINANT

10. SCOPE

10.1 Scope. This appendix details the sampling and analysis procedures to be followed in determining the weight of solids contamination in the test fuel. The weight of solids is needed in order to determine if test item is functioning within the limits of this specification.

20. APPARATUS

20.1 Apparatus. The following apparatus is required for in-line sampling for solids:

Millipore Sampling Kit. Cat. No. XX64 037 00 (or equal) with legal (U.S) graduated polyethylene bottle, Cat. No. XX64 037 12 (or equal); and Matched Weight Monitors, Cat. No. MAWP 037 PM (or equal).

20.2 Apparatus. The following apparatus is required for determination of total contaminant in accordance with ASTM D2276:

Glassware as required to assemble apparatus as in ASTM figures.
Solvent filtering dispenser.
Analytical balance.
Oven for obtaining 105° C.

30. PROCEDURE

30.1 Withdraw sample in accordance with operating instructions.

30.2 Flush monitor according to ASTM D2276, using the method which employs flushing the monitor with a solvent filtering dispenser.

30.3 Remove the filters from the monitor. Note that each monitor contains two filters (one test filter on top of one control filter). Place each set of filters into glass petri dishes, using stainless steel forceps. Label dishes.

30.4 Dry in oven at 105° C for 45 minutes.

30.5 Remove filters from oven and allow to cool to equilibrate to ambient room conditions for a least 15 minutes. Separate test filter from control filter.

30.6 Weight filters.

30.7 To determine the weight of solids, subtract weight of the control filter

from the weight of the test filter. The difference is the weight of total solids.

30.8 Based upon the sample volume, report the final results in mg/liter.

APPENDIX C

QUANTITATIVE INFRARED ANALYSIS FOR THE DETERMINATION OF HITEC E-515 RUST INHIBITOR IN JP-5

10. SCOPE

10.1 Scope. This appendix details the method to be used for the quantitative analysis of HITEC E-515 in JP-5. A measure of the HITEC E-515 content is needed in order to determine if the correct amount is present in the JP-5 test fuel.

20. DESCRIPTION

20.1 Description of method. This method which determines HITEC E-515 to 25 lbs/1000 barrels, utilizes an alkaline extraction followed by a neutralization with hydrochloric acid. The regenerated acid portion is extracted with carbon tetrachloride and evaluated in the 5.9 micron absorption band region (carbonyl functional group) of the infrared spectrum. The data indicates the amount of HITEC E-515 present to be plus or minus 5 percent of the actual amount present.

30. APPARATUS

30.1 Apparatus. The following apparatus is required:

Perkin Elmer No. 21
Analytical balance
Separatory funnels
Volumetric pipettes
10mm Irtran - 2 sample cell
Hardware, clamps
Test tubes
Automatic wrist shaker
Wash bottle for distilled water

30.1.1 Reagents. The following reagents are required:

10 percent potassium hydroxide
4N hydrochloric acid
C.P. carbon tetrachloride
HITEC E515

40. CALIBRATION

40.1 Calibration curve.

40.1.1 Prepare the following blends of HITEC E 515 in carbon tetrachloride:

0.1, 0.2, 0.3, 0.5, 0.8, 1.0 gms/liter (l)

40.1.2 Run these blends to construct a calibration curve which produces a straight line on linear graph paper. The calibration curve can be used for future determinations.

40.1.3 Plot optical density (OD) on the y axis, VS concentration (grams/l) on the x axis. Calculate the absorbance band in the 5.9 micron region using the baseline method. Draw the baseline from shoulder to shoulder to cancel errors. It is recommended that the same fixed thickness cell for the calibration curve and the sample analysis be used. The samples should be run with the same instrument settings and the techniques as the calibration curve to cancel out errors in absorptivity and cell length. A variable beam attenuator is used in the reference beam to initiate the analysis at approximately 90 percent transmission.

50. PROCEDURE (ANALYZE DUPLICATE SAMPLES)

50.1 Measure a 250 ml fuel sample into a 500 ml separatory funnel equipped with a tetrafluorethylene polymer stopcock. Add 20 ml of 10 percent aquenous potassium hydroxide solution. Do not add grease to the stopcock. Vigorously shake the contents of the separatory funnel for 5 minutes, either by hand or on an automatic wrist shaker.

50.2 Allow the solution to settle out into two phases. Decant the lower aqueous phase into a 250 ml beaker, being careful to leave about 2 ml of the aqueous solution in the separatory funnel so as not to decant any of the fuel phase into the beaker.

50.3 To the fuel phase remaining in the separatory funnel add 20 ml of 10 percent aqueous potassium hydroxide solution. Shake vigorously for five minutes.

50.4 Again allow the solution to settle out into two phases. Decant the lower aqueous phase into the same beaker which contains the first extract, being careful to leave about 2 ml of the aqueous solution in the funnel.

50.5 To the fuel phase remaining in the separatory funnel add 10 ml of 10 percent aqueous potassium hydroxide and shake vigorously by hand for about 2 minutes.

50.6 Allow the solution to settle into two phases and decant and comb the lower aqueous layer with the two previous extracts, being careful to leave about 2 ml of the aqueous solution in the funnel.

50.7 Drop a piece of blue litmus paper into the beaker containing the extracts and acidify the solution with 4N hydrochloric acid. During this acidification continuously swirl the beaker so as to get uniform mixing.

50.8 Transfer the contents of the beaker to a 250 ml separatory funnel (do not grease any part of the funnel). Add 20 ml of CP carbon tetrachloride and vigorously shake by hand for 3 minutes. Allow the contents of the funnel to separate into two phases. Decant the lower CCL_4 extract layer and retain for subsequent analysis. Discard the top layer.

50.9 The I.R. instrument should be set at the following values:

Instrument Perkin Elmer No.	21
Resolution:	985
Response:	1
Gain:	6
Speed:	5.0
Suppression:	0
Source:	.3 amperes

Slit control - auto.
Filter - auto

50.10 Fill a 10mm Irtran-2 fixed thickness sample cell with CCL_4 extract and run the curve from 5.65 ml to 6.0 ml.

50.11 Make a blank determination by repeating the above procedure using a sample of the fuel (under test) taken before the introduction of the additive. The blank determination value should be subtracted from the value of the fuel-additive sample.

Calculation

Io	= incident radiation	
I	= transmitted radiation	
A	= Absorbance	
a	= absorptivity	l/gm mm
b	= col length	mm
c	= concentration, grams/l HiTec E-515	

$$\log \frac{Io}{I} = A = abc$$

To convert from g/l to lbs/1000 bbls multiply by 350.2

Use 28.016 conversion factor to change from g/l to lbs/1000 bbl if a 250 ml fuel sample is used and a 20 ml carbon tetrachloride extract is used.

$$\frac{\text{250 ml sample}}{\text{20 ml } CCL_4 \text{ extract}} = 12.5; \qquad \frac{350.2}{12.5} = 28.016$$

APPENDIX D

FIBER DETERMINATION METHOD

10. SCOPE

10.1 Scope. This appendix details the method to be used for determining the number of fibers present in a 1000 ml sample of test fuel. The number of fibers present needs to be known in order to determine if a test item is functioning within the limits of this specification.

20 APPARATUS

20.1 Apparatus. The following apparatus is required:

(a) Millipore Fluid Sample Kit, Cat. No. XX64 037 00 (or equal).
(b) Millipore Field Monitors, Particle Size Analysis, Cat. No. MAWG037PO (or equal).
(c) Vacuum pump.
(d) Oven for obtaining 90° C.
(e) Calibrated microscope capable of examining fibers.

30. PROCEDURE

30.1 Withdraw a 1000 ml sample through a pre-counted monitor (see note) in accordance with fluid sampling kit operating instructions. Sample shall be taken at the sampling site immediately after the solid feeder pump and shall be called to upstream monitor sample. Withdraw another 1000 ml sample through a pre-counted monitor at the sampling site immediately after the test vessel. This sample shall be called the downstream monitor sample (see 3.2(c) and figure 1 of this specification).

30.2 Remove excess fuel from monitors with a vacuum pump. Dry monitors intact in an oven for 1 hour (avoid heat above 90° C) with the inlet/outlet plugs removed. Cool monitors.

30.3 Count fibers on each monitor filter pad with a calibrated microscope, capable of examining fibers. Subtract upstream monitor sample from downstream monitor sample to obtain a net fiber count.

Note: Pre-count monitor to obtain a background fiber count blank. Subtract background fiber count blank from each monitor used. If Millepore monitors are used, average background counts are indicated on each carton of assembled Contamination Analysis Monitors. Pre-counting can be eliminated by using the average background fiber count as a blank.

INDEX

REQUIREMENTS

INDEX

TEST LOOP SYSTEM

INDEX

QUALITY ASSURANCE PROVISIONS

INDEX

TEST CONDITIONS

INDEX

TESTS

INDEX

TESTS (CONT'D)

INDEX

CONTAINERS AND SOLVENTS

INDEX

ANALYSIS OF SAMPLES

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