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MILITARY SPECIFICATION

PUMP, CENTRIFUGAL, FUEL BOOSTER, AIRCRAFT, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 This specification covers the general requirements for aircraft tank mounted centrifugal type, fuel booster pumps, used for engine feed or transfer.

2. APPLICABLE DOCUMENTS

2.1 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

QQ-P-416	Plating, Cadmium (Electrodeposited)

Military

MIL-D-1000	Drawings, Engineering and Associated Lists
MIL-W-5088	Wiring; Aircraft, Selection and Installation of
MIL-P-5315	Packing, Preformed, Hydrocarbon Fuel Resistant
MIL-H-5440	Hydraulic Systems, Aircraft Types I & II, Design, Installation, and Data Requirements for
MIL-G-5572	Gasoline, Aviation, Grades 80/87, 100/130, 115/145
MIL-T-S624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-C-6021	Casting, Classification and Inspection of
MIL-E-6051	Electromagnetic Compatibility Requirements, Systems
MIL-R-6855	Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series, General Specification for
MIL-V-7899	Valve, Check, Aircraft Fuel System
MIL-F-8615	Fuel System Components, General Specification for
MIL-T-8879	Screw Threads, Controlled Radius, Root with Increased Minor Diameter, General Specification for

MIL-H-8891	Hydraulic Systems, Manned Flight Vehicles, Type III, Design Installation, and Data Requirements for
MIL-P-15024	Plates, Tags, Bands, for Identification of Equipment
MIL-A-21180	Aluminum Alloy Castings, High Strength
MIL-C-22263	Coupling, Fuel Line, Flexible, 125 psi, General Specification for
MIL-R-25988	Rubber, Fluorosilicone Elastomer, Oil-&-Fuel-Resistant, Sheets, Strips, Molded Parts, and Extruded Shapes
MIL-R-83248	Rubber, Fluorocarbon Elastomer, High Temperature Fluid and Compression Set Resistant

STANDARDS

Federal

FED-STD-151	Metal, Test Methods

Military

MIL-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of US Military Property
MIL-STD-143	Standards and Specifications, Order of Precedence for the Selection of
MIL-STD-202	Test Methods for Electronic and Electrical Components
MIL-STD-461	Electromagnetic Interference Characteristics Requirements for Equipment
MIL-STD-704	Electric Power, Aircraft, Characteristics and Utilization of
MIL-STD-810	Environmental Test Methods
MIL-STD-831	Test Reports, Preparation of
MIL-STD-882	System Safety
MIL-STD-889	Dissimilar Metals
MIL-STD-1523	Age Controls of AGE Sensitive Elastomeric Materials
MS16142	Boss, Gasket Seal, Straight Thread Tube Fitting
MS33540	Safety Wiring and Cotter Pinning
MS33588	Nut, Self-Locking, Aircraft Design and Usage Limitations
MS33649	Boss, Fluid Connection - Internal Straight Thread

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

3. REQUIREMENTS

3.1 First article. The pump assemblies furnished under this specification shall have been inspected and passed the First Article Inspection specified herein.

3.2 Detail specification. A specification providing design and performance requirements shall be submitted by the contractor to the procuring agency for approval. The detail specification shall reiterate all basic requirements of this specification, shall use the same paragraph headings and numbers, and shall insert all applicable specific and special requirements according to this format.

3.2.1 Drawing. At the site designated for First Article review, the contractor shall have available all drawings for Government inspection. This shall include but not be limited to: top drawing, assembly drawings and that data delineated thereon, e.g., specifications, manufacturing instructions, etc. All drawings shall be prepared in accordance with MIL-D-1000, as specified in the contract.

3.2.2 Calibration data. The detail specification shall include specific performance charts and data on power input, fuel flow, output pressure, and the maximum operational altitude.

3.2.3 Climb performance. The detail specification shall establish the minimum pump output requirements during and following a maximum rate of climb with fresh unweathered fuel at a temperature no less than 125°F.

3.2.4 Temperature. The detail specification shall state the applicable ambient and fuel temperature class of MIL-F-8615.

3.2.5 Fuels. The detail specification shall state the principal fuel and other fuels expected to be encountered in use. In normal operations, it shall be assumed that the fuels contain various quantities of dissolved and free water, salts, gases, solid contaminants and up to 30 percent aromatics.

3.3 Components. The pump shall consist of a pump and a driving motor, assembled as an integral unit. The motor may be electric or hydraulic.

3.4 Standards and specifications. Standards nnd specifications for commodities and services not specified herein, shall be selected in accordance with MIL-STD-143.

3.5 Materials. Materials and processes used shall be of high quality, suitable for the purpose, and shall conform to applicable Government specifications. Materials conforming to contractor's specifications may be used, provided the specifications are approved by the procuring activity and contain provisions for adequate tests. The use of contractor's specifications shall not constitute waiver of Government inspection. All materials used shall demonstrate adequate resistance to the fuels, fuel vapors, humidity, salt fog, and other materials likely to be encountered in service.

3.5.1 Fungus proof. Materials that are nutrients for fungi shall not be used where it is practical to avoid them. Where used and not hermetically Sealed, they shall be treated with a fungicidal agent acceptable to the procuring activity; however, if used in a hermetically sealed enclosure, fungicidal treatment will not be necessary.

3.5.2 Metals. Metals shall be of the corrosion-resistant type or suitably treated to resist corrosion due to fuels, salt fog, or atmospheric conditions likely to be met in storage or normal service. The use of any protective coating that will crack or scale with age or extremes of climatic and environmental conditions shall be avoided. Metals shall be inspected in accordance with FED-STD-151.

3.5.2.1 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are defined in MIL-STD-889.

3.5.2.2 Magnesium and copper. Magnesium and copper or alloys thereof shall not be used in contact with fuel.

3.5.2.3 Cadmium. Cadmium shall not be used in contact with fuel. Where plating is used (not in contact with fuel) it shall be in accordance with QQ-P-416, Type II, Class 2.

3.5.2.4 Castings. Castings shall be in accordance with MIL-C-6021, Class 1 or MIL-A-21180. The minimum acceptable elongation shall be 3 percent.

3.5.3 Rubber. Rubber materials shall conform to MIL-P-5315, MIL-R-6855 Class I, MIL-R-25988 or MIL-R-83248.

3.6 Design

3.6.1 Lubrication. The pump and motor assembly shall not require any lubrication or any other maintenance throughout its service life between overhauls. Any lubricated part shall be a replaceable.sealed assembly as approved by the procuring activity.

3.6.2 Electrical. The electrical equipment shall satisfactorily operate on power in accordance with the air vehicle requirements. The minimum requirements shall be in accordance with MIL-STD-704.

3.6.2.1 Wiring. All wiring shall be fuel resistant, and, other than windings, shall be in accordance with MIL-W-5088.

3.6.2.2 Electrical fault containment. The pump assembly housing shall be completely capable of containing any internal fault without failure of the housing. in no case shall an electrical short or internal explosion propagate to the outside of the housing or generate an unsafe condition. Thermal protection shall be incorporated to assure that the electric pump assembly is maintained within safe temperature limits under all operating or non-operating conditions. The peak temperature for any portion of the outside of the assembly due to electrical heating, shall not exceed 390°F or as required in the detail specification.

3.6.2.3 Vent. A vent connected to the electrical motor chamber shall not be connected to the seal drain chamber and shall incorporate a flame arrestor.

3.6.2.4 Electrical insulation resistance. The electrical components shall withstand, without damage, breakdown, or excessive leakage current, repeated applications of AC dielectric test voltage in accordance with the test procedure of Section 4. The insulation resistance shall not be less than 100 megohms when exposed to 500 volts DC. The dielectric leakage current shall not exceed 2 milliamperes.

3.6.2.5 Electromagnetic compatibility. The equipment shall comply with the requirements of the air vehicle and the applicable requirements of MIL-E-6051.

3.6.3 Inlet. The inlet to the pump shall be enclosed by a screen no coarser than 8 mesh and no finer than 20 mesh. The flow area shall be sufficient to permit maximum flow with 50 percent of the area blocked when operating at maximum altitude.

3.6.3.1 Suction feed. The rate of flow and pressure drop under suction feed shall be in accordance with the detail specification.

3.6.4 Pump drain. A chamber, incorporating a drain port, shall be provided between the shaft seals for the motor and the pump to isolate leakage. The drain port configuration and the allowable leakage shall be in accordance with the detail specification. Wherever the motor and pump are integral and shaft seals are not used this requirement does not apply.

3.6.5 Threaded connections. Threaded connections shall comply with MIL-T-7742, MIL-S-8879, MS16142 or MS33649 as applicable.

3.6.5.1 Pipe threads. Pipe threads shall not be used except for permanent closures.

3.6.6 Locking of parts. All threaded parts shall be locked by safety wiring, or cotter pins in conformance with MS33540 or the use of self-locking nuts in conformance with MS33588 or other approved methods. Wherever loosening of the self-locking nut could possibly result in the nut or other parts entering the fuel system, approval of the installation shall be obtained from the procuring activity. The use of cotter pins on studs, or the use of lockwashers or staking is prohibited.

3.6.7 Outlet. The outlet fitting shall utilize couplings in accordance with MIL-C-22263.

3.6.7.1 Check valve. A check valve shall be incorporated in the outlet of each pumping unit in accordance with the detail specification in order to prevent any reverse flow of fuel through the pump into the tank. The check valve shall be capable of satisfying all applicable performance requirements of MIL-V-7899. Reverse flow leakage shall not exceed lcc per minute initially (or 5CC per minute at the conclusion of the test program) from 4 inches of fuel head up to 60 psig.

3.6.7.2 Proof pressure. The outlet and check valve(s) shall be capable of withstanding an applied pressure of 120 psig (or higher in accordance with the detail specification) without failure or permanent distortion.

3.6.8 Negative G and inverted operation. The pump shall be capable of being operated under negative G conditions or during inverted flight. The pump output under these conditions shall be in accordance with the detail specification.

3.6.9 Start-up. The rate of power input, acceleration, and output during start-up shall be stated in the detail specification. At any point during or following the climb of 3.2.3, when a non-operating pump is started, it shall develop the required flow and pressure within 5 seconds after power is applied.

3.6.10 Variations in power input. The pump assembly shall demonstrate compatibility with all the variations in the aircraft power supply system(s), without overspecd, overheating, stopping, or other failure. The minimum requirements are MIL-STD-704, MIL-H-5440, or MIL-H-8891, as applicable. It is not required that 3-phase electric motors must operate on 2 phase power.

3.6.11 Leakage. There shall be no external leakage from the pump assembly except from drains provided for that purpose. For plug-in pump units, the detail specification shall state the maximum allowable fuel loss during removal and reinstallation in a full fuel tank.

3.6.12 Pump down. The pump shall be capable of maintaining rated flow and pressure at any altitude when the head of fuel is no greater than 2 inches above the inlet and the fuel temperature is 65°F to 95°F. With higher temperature fuel, the flow rate, pressure, altitude and fuel head shall be in accordance with the detail specification. For dual inlet pumps, this requirement applies to each inlet. Uncovering of one inlet shall not deteriorate the performance of the other inlet in either the normal or the inverted position. Performance at less than the above heads shall be in accordance with the detail specification.

3.6.13 Reprime. The pump shall be capable of self repriming within 5 seconds following a period when the inlet is uncovered and then resubmerged in fuel. This capability shall exist up to the maximum operating altitude of the aircraft. The pump output depth of submersion and fuel temperature shall be in accordance with the detail specification, provided that the fuel temperature shall be no less than 125°F, and depth of submersion of the inlet no greater than 10 inches of fuel.

3.6.14 Dry operation. The pump shall be capable of accumulating 100 hours of dry operation in cycles of 5 hours each. The dry run test shall not cause any deterioration in performance or other failure, nor shall it cause a hot spot to develop that could ignite the fuel vapors in the tank. The peak temperature that any portion of the housing in contact with fuel is allowed to achieve is 390°F or as required in the detail specification, whichever is lower.

3.6. 14.1 Automatic dry cut-off. Where an integral automatic dry cut-off feature is required by the detail specification, it shall be capable of 10,000 cycles of operation without failure or causing degradation of pump performance.

3.7 Performance. The pumps shall demonstrate satisfactory performance when subjected to the applicable tests of table I.

3.8 Safety, reliability and maintainability

3.8.1 Safety analysis. All possible failure modes shall be examined and a complete safety analysis, Including the impact of each failure mode, shall be made, in accordance with MIL-STD-882.

3.8.1.1 Proof-of-safety tests. Tests shall be conducted to verify the safety analysis. The minimum proof-of-safety tests requirements are, for electric powered pumps, explosion and fault containment tests; for hydraulic power pumps, overspeed and dragging impeller tests; and for all pumps, proof and burst pressure tests. Additional tests shall be conducted in accordance with the detail specification and as approved by the procuring agency The requirements of MIL-STD-882 will be applied to the verification tests.

TABLE I. First Article Inspection Program

INSPECTIONS	REQUIREMENTS	TEST	TEST ARTICLE		
			1	2	3
0 Examination	3.2, 3.12	4.5.2	x	x	x
1 Insulation Resistance	3.6.2.1	4.5.20	x	x	x
2 Break-In Run	3.6	4.5.3	x	x	x
3 Calibration	3.2.2	4.5.5	x	x	x
4 Leakage	3.6.11	4.5.4	x	x	x
5 Fuel Resistance	3.5	4.5.14		x	
6 Corrosion Resistance	3.5	4.5.14	x		
7 Endurance	3.2, 3.7, 3.8.2	4.5.16	x		
8 Dry Endurance	3.6.14	4.5.17	x		
9 Dry Cut-Off Endurance	3.6.14.1	4.5.17.1	x		
10 Contamination Fuel	3.2.5	4.5.18		x	
11 Altitude Climb Performance	3.2.3	4.5.11	x		
12 Pump Down	3.6.12	4.5.7		x	
13 Blocked Inlet Screen	3.6.3	4.5.6		x	
14 Reprime	3.6.13	4.5.8	x	x	
15 Negative G	3.6.8	4.5.9		x	
16 Suction Feed	3.6.3.1	4.5.10			x
17 Vibration	3.7	4.5.12			x
18 Shock	3.7	4.5.13			x
19 Fungus Resistance	3.5.1	4.5.15			x
20 Power Input	3.6.10	4.5.19	x		
21 Electromagnetic Interference	3.6.2.5	4.5.22			x
22 Explosion Proof	3.8.1.1	4.5.23.1			x
23 High Temperature Dry Run	3.8.1.1	4.5.23.2.1			x
24 Locked Rotor	3.8.1.1	4.5.23.2.2			x
25 Overspeed	3.8.1.1	4.5.23.3			x
26 Dragging Impeller	3.8.1.1	4.5.23.4			x
27 Pressure	3.8.1.1	4.5.23.5	x	x	
28 Thermal Protectors	3.6.2.2	4.5.21			x
29 Water in Fuel	3.2.5	4.5.24.2	x		
30 Icing	3.2.4, 3.2.5	4.5.24.3	x		
31 Disassembly and Inspection	3.1	4.5.25	x	x	x

NOTES: A) Inspections 1, 2, 3 and 4 shall be repeated at end of test program prior to disassembly.

B) Inspections 5 thru 12 shall be accomplished in the order listed.

C) A 4th test article is optional for sharing the inspections of test article 3.

3.8.2 Reliability. The reliability of the pump to perform shall be stated in the detail specification, as required to satisfy system requirements.

3.8.3 Maintainability. The maintainability plan shall' provide an estimate of maintenance manhours, total clock-hours, and special tools needed for intermediate shop and overhaul maintenance of the-pump assembly.

3.9 Interchangeability. All component parts shall be interchangeable between units without selection for fit or performance. Part numbering shall be governed by the requirements specified in MIL-STD-1OO and the contract.

3.10 Nameplate. An aluminum or corrosion resistant steel (stamped or etched) metal nameplate, conforming to MIL-P-15024 shall include the identification requirements of MIL-STD-130 and the following:

PUMP, FUEL BOOSTER, AIRCRAFT
Specification MIL-P-5238C
Manufacturer's Part Number _____
Serial Number _____

3.11 AGE Control. The assembly date marking shall be in accordance with MIL-STD-1523.

3.12 Workmanship Workmanship shall be in accordance with all applicable specifications, drawings, and quality control plans.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. The supplier may use his own or other suitable facilities unless disapproved 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 inspections. The inspection and testing of the pump shall be classified as follows:

a. First Article Inspection

b. Quality Conformance Inspection.

4.3 First artlclc inspection. The first article inspection shall consist of all inspections and tests herein. Any additional tests shall be in accordance with the detail specification and the procurement document. The number of test articles and the order of tests shall be in accordance with table I.

4.3.1 Test report. The test report, covering all details of the First Article inspection shall be prepared in accordance with MIL-STD-831. The test report shall include, in addition to the description of the test samples, the assembly and cross-sectional drawings of the pump assembly, and of any details discussed in the test report. The required description of the test apparatus may be abbreviated by including sketches and photographs to provide a clear understanding of each test set-up.

4.3.2 Test samples for the procuring activity. All items subjected to test shall be available for submittal to the procuring activity for inspection and test for a period of at least 2 years following submittal of the test report.

4.4 Quality conformance inspections. The quality conformance inspections shall consist of individual tests and such additional sampling test as required by the acceptance test plan.

4.4.1 Individual tests. Each assembly shall satisfy specification requirements in the following individual tests:

a. Examination of product (4.5.4)

b. Break-in Run (4.5.3)

c. Calibration (4.5.5)

d. Leakage (4.5.4)

e. Insulation Resistance (4.5.20).

4.4.2 Sampling tests. Additional periodic inspections, based upon a production lot size or upon calendar intervals shall be in accordance with the approved acceptance test plan.

4.5 Test methods

4.5.1 Test fluid. Where not otherwise specified, the test fluid shall be the principal fluid the pump shall experience in use.

4.5.2 Examination of product. All pump assemblies shall be inspected and certified to be in accordance with the applicable drawings and specifications, including all requirements of section 3 for which tests. are not appropriate.. The unit shall be clean and free of any contaminants, oil, grease, preservatives or any other material not specified.

4.5.3 Break-in-run. The pump shall be run dry for a period of 3 to 5 minutes. During this time the pump shall be rotated such that the pump shaft is slowly rotated in a vertical plane through 180°. Any sounds indicating rubbing, binding, or excessive looseness shall be a cause for rejection. A wet run in fluid shall be conducted in accordance with the detail specification requirements.

4.5.4 Leakage

4.5.4.1 outlet. Apply fuel pressure to the pump outlet varying from 4 inches of fuel head up to 120 psig at seven different pressure levels for 5 minutes duration each. There shall be no permanent distortion, failure, or external leakage. Internal leakage across the check valve(s) shall not exceed the allowable. The individual test shall be conducted at the minimum and maximum pressure levels only for 2 minutes duration each.

4.5.4.2 External. There shall be no external leakage at any time except as allowed through the drive shaft seal (3.6.4). For individual tests, fluid pressure shall be applied to all internal fluid carrying cavities from 4 inches of fuel head up to the maximum pump pressure at three pressure levels for a duration of 5 minutes each. There shall be no external leakage except as allowed by the detail specification from drain ports.

4.5.4.3 Plug-in units. Plug-in pump assemblies shall be tested to demonstrate that the fuel loss occurring during removal and installation is in accordance with the detail specification allowances. This test may not be required for individual inspections except in accordance with the acceptance test plan.

4.5.5 Calibration. For the First Article inspection, a standard calibration shall consist of recording input power and output pressure for at least seven output flows from zero up to the maximum flow capacity at ground level and at three different altitude levels, in accordance with the detail specification. For individual inspections, the calibration may be conducted at ground level only and for four output flows. All ground level calibration runs shall be conducted with the fuel temperature between 60°F and 90°F. Altitude calibrations shall be conducted in two series, one with the fuel temperature at the maximum of 3.2.4, and another with the fuel temperature no higher than O°F.

4.5.6 Blocked inlet screen. With 50 percent of the inlet screen(s) blocked, altitude calibrations shall be accomplished with low and high temperature fuel.

4.5.7 Pump down. With the pump operating in the test stand, the fuel flow controls shall be adjusted to cause the fuel head above the pump to drop at a rate of 1 inch per minute while maintaining rated flow and pressure. The fuel head and output flow and pressure shall 1 be recorded at intervals no greater than l-inch change of head. Fuel returning to the tank shall not

impose any additional velocity or turbulence at the pump inlet. This test shall be conducted at ground level pressure with fuel at 60° to 90°F and also at maximum altitude with fuel at the high temperature of 3.2.4. These tests shall be repeated with output flow settings of 80 percent, SO percent, 25 percent, 10 percent, and 5 percent of rated flow. This data will be the basis for a family of curves as shown on figure 1.

4.5.8 Reprime. The pump shall be mounted in a test tank so that it can be rotated (or moved) to a position such that the inlet is out of the fuel. The pump output, depth of submersion of the inlet, fuel temperature and altitude shall be established (see 3.6.13). The pump shall then be moved to uncover the inlet(s) for at least 15 seconds. When the pump is again submerged to the original depth, the pump shall resume delivery of fuel at the required flow and pressure within 5 seconds. The test shall be conducted at least six times (twice at each of three different altitude levels). The altitude levels shall be in accordance with the detail specification.

4.5.9 Negative G and inverted operation. The pump shall be mounted in a test tank so that it can be rotated upside down to provide for inverted or simulated negative G operation. The initial pump output, fuel temperature, and altitude shall be established in accordance with 3.6.8. The pump shall then be rotated to the inverted position. The pump output in this position shall be in accordance with the detail specification. The pump shall be allowed to run dry for at least 30 seconds in this position. After the pump is rotated to the upright position in fuel, the pump shall resume delivery at the previous flow and pressure within 5 seconds.

4.5.10 Suction feed. Fuel shall be drawn through the inoperative pump from zero to the maximum required flow and the pressure drop data recorded.

4.5.11 Altitude climb performance. The pump shall be installed in an altitude test tank in fresh, unweathered fuel at the high temperature of its classification (3.2.4) with the fuel flow and head in accordance with the detail specification. With the pump not operating, the rate of climb shall be established in accordance with 3.2.3. The climb shall be terminated at 25,000 ft altitude (+2,500, -1,000). Power shall be applied to the pump within 5 seconds or less of climb termination. The pump shall achieve the required pressure and flow within 5 seconds and shall maintain these for at least 5 minutes. This test procedure shall be repeated at Increasing 5,000 ft intervals up to the maximum operational altitude. The Reid vapor pressure of the fuel used in this test shall be in accordance with the detail specification. In any case, the vapor pressure of the fuel at the test temperature shall not be less than 2.5 psia. During heating of the fuel there shall not be any hot spots on the surface of the heat exchanger which exceed the maximum fuel temperature by more than 10°F. Additional start-up tests during the climb and with the alternate fuel shall be accomplished in accordance with the detail specification.

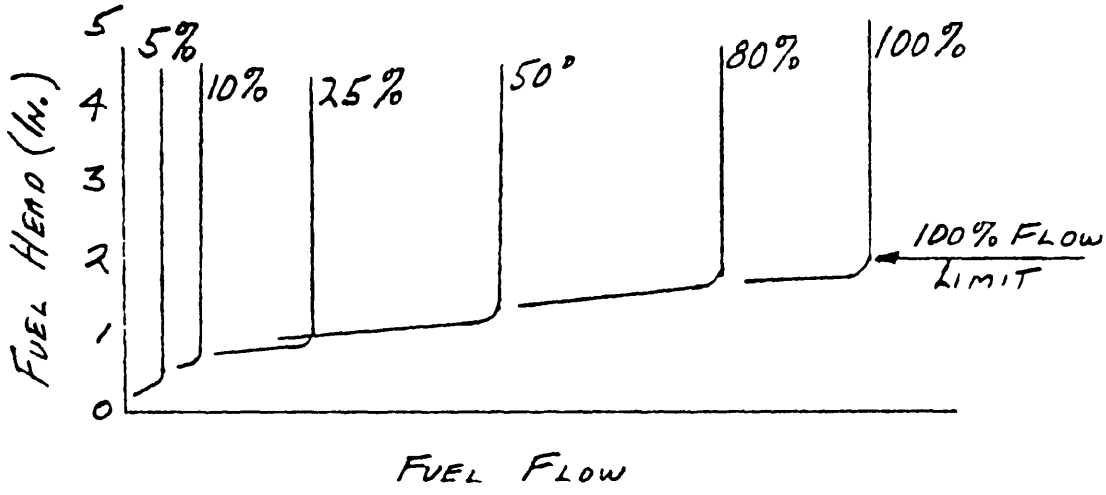

Figure 1. Pump Down Test

4.5.12 Vibration. The vibration test shall be conducted in accordance with MIL-STD-810 and the detail specification. The minimum vibration level shall be 10 g's acceleration between 74 and 2000 Hertz. All pump mounted switches and relays shall be monitored during the test for chatter, bounce, or variations in contact resistance.

4.5.13 Shock. The shock test shall be conducted in accordance with MIL-STD-810, Method 516, Procedure III. The mounting jig used in this test shall simulate the aircraft mount in mass and rigidity.

4.5.14 Environmental tests. The corrosion resistance and the fuel resistance and extreme temperature tests shall be conducted in accordance with MIL-F-8615. These tests shall not cause any leakage, malfunction, distortion or deterioration in performance, nor shall there be any evidence of corrosion beyond superficial.

4.5.15 Fungus resistance. A fungus-test shall be conducted in accordance with MIL-F-8615 if the pump contains any material which may possibly be a nutrient. The test report shall include a list of all materials used in the pump, whether this test is conducted or not. The fungus test shall not cause any deterioration in performance, or dielectric strength.

4.5.16 Endurance test. The endurance test shall consist of 1200 hours of operations in accordance with the schedule of table 11. The entire test shall be accomplished without disassembly, adjustment, replacement of any part or removal of the pump from the test set-up. At the conclusion, the pump shall be subjected to a standard calibration (4.5.5).

TABLE II

Fuel Temperature	Altitude	Hours
60°F to 90°F	Sea Level Max. Alt.	240 240
-40°F to -70°F	Sea Level Max. Alt.	120 120
High Temp of 3.2.4	Sea Level Max. Alt.	240 240

4.5. 16.1 Fuel flow The fuel flow schedule for each successive 120-hour period of this endurance test shall be, in order:

a. Maximum flow for 24 hours

b. 30 percent to SO percent for 24 hours

c. 2 percent to 6 percent for 20 hours

d. Zero flow for 4 hours (pump operating)

c'. 30 percent to 50 percent flow for 24 hours

f. Maximum flow for 24 hours.

4.5. 16.2 Fuel temperature. Each 120-hour low temperature period shall consist of at least 60 hours of operation at minus 65°F (±5°F). During high temperature operation, where fuel temperatures above 135°F are encountered, the duration of temperatures above 135°F may consist of only SO percent of the total high temperature operation.

4.5. 16.3 Stopping and starting. Six times during each successive 24-hour period of the endurance run, the pump shall be stopped for a period of 2 to 5 minutes and restarted. Upon restarting, the pump output pressure and flow shall resume within 5 seconds maximum of the application of power. These stopping and starting cycles shall occur at least 1 hour apart and may be 4 hours apart.

4.5. 16.4 Dual rated pumps. For pumps with a dual rating of low for normal operation and a high for emergency of infrequent use, the maximum fuel flow periods shall consist of maximum emergency flow for at least 10 percent of the total time.

4.5.17 Dry endurance. A dry endurance test shall be accomplished on all pumps to demonstrate compliance with 3.6.14. The pump shall be operated at rated flow and allowed to pump all fuel from the tank. After the fuel has been pumped out of the tank, the discharge valve shall be closed to prevent circulation of air through the pump section and any fuel remaining in the discharge line between the pump outlet and the discharge valve shall be drained. In addition, action shall be taken to prevent contact of the pump with arty other-residual fuel. The pump shall continue to be operated in this dry condition. The air vapor in the tank shall be maintained at the high temperature ambient of 3.2.4. After 5 hours of dry operation, the pump shall be stopped and the tank refilled with room temperature fuel. The above cycles shall be accomplished five times at sea level pressure and 15 times at the maximum operational altitude. The instrumentation shall locate and record the maximum case temperature.

4.5.17.1 Dry cut-off endurance. The pump and test rig shall be operated in a manner similar to the above to cause the dry cut-off feature to actuate. Seventy-five percent of the cycles shall be with the fuel and air temperatures as above, and 25 percent shall be with the fuel and air temperature at minus 65°F.

4.5.18 Contaminated fuel endurance. An endurance test using contaminated fuel shall be accomplished in accordance with the solid particle contaminated fuel endurance test of MIL-F-8615.

4.5.19 Power input tests

4.5. 19.1 Electrical power variations. The power input, temperature rise, fuel flow and pressure output shall be determined by test for all power variations in the electrical system of the aircraft in accordance with the detail specification.

4.5.19.2 Hydraulic power variations. The power input, pump speed, fueI flow, and pressure output shall be determined by test for the possible power variations in the hydraullc system of the aircraft. The testing shall be in a system with characteristics of MIL-H-5440 or MIL-H-8891, as applicable, and the detail specification.

4.5.19.3 Start-up. Electric powered pumps shall be tested to determine that the current and voltage transients are within the approved limits. Hydraulic powered pumps shall be tested to determine that the starting acceleration (wet and dry) is within the approved limits and that no parts are overstressed.

4.5.20 Electrical insulation resistance. The insulation resistance and dielectric strength tests shall be conducted in accordance with MIL-STD-202, Method 301, using table III and Method 302, Condition B. There shall be no disruptive discharges, excessive leakage current or low resistance.

TABLE III. Dielectric Test Voltages

System Voltage	Initial, Test		80,000 Ft	Repeat Tests
	1 Minute	10 Seconds	1 Minute	10 Seconds
28 VDC	1050	1250	500	500
115 VAC	1250	1500	500	600
115/200 VAC	1500	1800	700	700

4.5.21 Thermal protectors. Pumps incorporating thermal protectors shall be tested to demonstrate compliance with the design requirements. The test procedure is the same as 4.5.23.2.1 except that the chamber temperature shall be raised sufficiently to cause the thermal protectors to actuate.

4.5.22 Electromagnetic interference. The electrical equipment shall be tested in accordance with MIL-STD-461 for Class Al equipment, using Method EC03. Additional tests shall be in accordance with the detail specification.

4.5.23 Proof-of-safety tests. Tests shall be conducted to demonstrate compliance with 3.8.1.1. The fluids to be used shall be MIL-T-5624 for pumps operating principally in jet fuels and MIL-G-5572 for those operating in gasoline.

4.5.23.1 Explosion proof. Explosion proof tests shall be conducted in accordance with MIL-F-8615 using the fluids specified above.

4.5.23.2 Electrical fault containment. Sufficient tests shall be conducted to demonstrate compliance with 3.6.2.2. These tests, as a minimum, shall consist of a high temperature dry run (4.5.23.2.1) and a locked rotor test (4.5.23.2.2). For both tests, the pump shall be installed in an explosion test chamber and electrically connected for operation. Circuit breakers or fuses shall not be used in the external circuit. Temperatures on the inside and outside surfaces shall be recorded throughout the test. The temperature inside the test chamber and in the pump shall be 160°F to 180°F at the start of the test. The explosive atmosphere shall be circulated throughout the intenal pump passages exposed to fuel. During these tests no portion of the surface of the pump shall reach the self-ignition-temperature of the fluid or 390°F, whichever is lesser.

4.5.23.2.1 High temperature dry run. With the pump installed in the above test chamber, it shall be operated dry for a sufficient length of time for temperatures to stabilize. If the pumps contain resetting type thermal cutout switches that are actuated during this test, at least three cycles of operating up to cutout shall be conducted. Power shall remain applied for a sufficient length of time after temperatures stabilize or the thermal cutout switches actuate to assure that a safe condition prevails. If no explosion occurs, the atmosphere inside the pump shall be ignited, and then if still safe, the outside atmosphere ignited, in order to demonstrate that a true hazard condition existed during the test.

4.5.23.2.2 Locked rotor test. With the rotor locked, the pump shall be installed in the above test chamber. Normal power shall be applied and maintained until all current ceases to flow or temperatures have stabilized for 1/2 hour. Whatever failure occurs inside the housing, shall not propagate to the outside or ignite the explosive mixture on the outside of the housing. If no electric

failure occurs, the chamber temperature shall be raised in 20°F steps up to a maximum of 350°F. At the conclusion of the test at each temperature level, the chamber atmosphere shall be exploded.

4.5.23.3 Overspeed. Some negative G tests (sudden unloading) are accomplished as a part of the normal First Article tests, but wherever the safety analysis indicates some additional tests are necessary, they shall be accomplished. For hydraulic powered units where a speed control device is used (whether integral or separate) sufficient tests shall be conducted to determine the possible effects of an inoperative speed control.

4.5.23.4 Dragging impeller. Apply a braking load on the pump which provides the same slow down and heat input effects of a dragging impeller. Adjust the drag until the no flow output pressure is less than 50 percent of normal. The fuel and air shall be at the high temperatures of 3.2.4. The fuel level shall be 1/4 to 1 inch above the rated flow pump down limit of 4.5.7. Operate the pump at this no flow condition for a minimum of 15 minutes or until temperatures stabilize on surfaces in contact with fuel or fuel vapor. At this point open up the outlet valve and allow the pump to deplete the tank until it is operating dry. Continue operation for at least 10 minutes. At no time during the entire test shall any point on surfaces in contact with fuel or fuel vapors exceed 390°F, or less, in accordance with the detail specification.

4.5.23.5 Pressure tests. Proof and burst pressure tests shall be conducted on the hydraulic components in accordance with the pressure schedules of MIL-H-5440 and MIL-H-8891 as applicable.

4.5.24 Water in the fuel. The pump shall demonstrate its ability to operate in fuel containing .75 cc excess water per gallon. The room temperature test shall be conducted with all pumps. The icing test shall be conducted as required by the detail specification.

4.5.24.1 Conditioning of fuel. Free water shall be added to the fuel for preconditioning, in accordance with the following procedure:

a. Warm fuel to 80°F

b. Slowly add 1cc of water per gallon of fuel while the fuel is being circulated or agitated.

c. Agitate the fuel and water mixture for at least 2 hours. If the fuel is being circulated to mix, the entire quantity should be circulated at least three times.

d. After the fuel has been saturated, it is necessary to keep the proper humidity in the atmosphere above the fuel in order to prevent loss of water from the fuel to the atmosphere. Little water will be lost from the fuel if the difference between the vapor pressure of the water dissolved in the fuel and the vapor pressure of the water vapor In the atmosphere (Pvf-Pva) is 0.2 inch of mercury or less. The vapor pressure of the water in the fuel may be calculated by dividing the actual water content of the fuel by the saturated vapor pressure of the water at the fuel temperature. These tests should be conducted with saturated fuel, therefore, the vapor pressure of the water in the fuel should be the same as the saturated vapor pressure of the water at the temperature of the fuel.

e. Maintain fuel at 80°F. Allow the excess water to settle out, (at least 1 hour per foot depth of fuel)

f. Drain all excess water

g. Analyze samples from three points in the bulk of the fuel by the Carl-Fisher method. The average of the three samples shall be fully saturated with water at 80°F up to an excess of 15 parts per million. The water saturation point of fuels varies for different fuel blends. No fuel which is saturated with less than 90 parts per million water should be used for these tests.

h. After fuel is saturated and the excess water has been drained off, but before cooling, atomize 1cc per gallon of water over the surface.

1. Immediately begin rapid agitation and cooling simultaneously, thus keeping the free water suspended in the fuel.

j. Immediately upon reaching the test temperature, begin the test run.

k. Upon completion of each test, the fuel should contain not less than .75cc per gallon of water over the quantity required to saturate the fuel.

4. 5.24.2 Room temperature test. The pump shall be operated at rated flow and pressure in the fuel being conditioned above during step c. Every 15 minutes the pump shall be stopped for 1 minute and then restarted. Input and output shall be recorded during these runs. There shall be no indication of incorrect operation, disruptive electric discharges, or other failure. If the detail specification does not require an icing test, the 60°F to 90°F (Sea Level) portion of the endurance test (4.5.16) may be conducted with water as the test fluid, in lieu of the above. The water shall possess the mineral hardness and the degree of sal inity in accordance with the detail specification.

4.5.24.3 Icing test. The pump shall be operated in the above-conditioned fuel (step j) for 30 minute periods at 30°F, 20°F, 10°F and 0°F. The fluid temperature shall be maintained within the limits of plus 1°F and minus 5°F throughout the tests. The pump output and power input, and leakage, shall be recorded.

4.5.25 Disassembly and inspection. Following completion of all tests, each test pump shall be disassembled for inspection. There shall be no evidence of any problem that will affect either safety or performance or may cause premature wearout Photographs shall be taken of each part and of any critical area discussed in the test report.

4.6 Safety, reliability, and maintainability. The safety analysis report and the reliability and maintainability demonstration plans shall be provided in accordance with the procurement document.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging and packing shall be in accordance with the detail specification.

5.2 Marking of shipments. In addition to any special marking required by the contract or order interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

5.2.1 Reinspection dates. Reinspection data marking shall be added as specified by the procuring activity.

6. NOTES

6.1 Intended use. The pumps covered by this specification are intended for use in aircraft fuel tanks to pump fuel to the engines and to transfer fuel from tank to tank and may also have other specified USCS.

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number and date of this specification.

b. The reviewing and approval activity.

c. Instructions for delivering of data (6.3).

d. If additional testing is required, the number of test samples and the test activity. (See 4.3)

e. Applicable level of preservation, packaging, and packing.

f. Reinspection date marking.

6.3 Data. Data generated by this document shall not be delivered to the procuring activity unless specified on the Contract Data Requirements List (DD 1423).

6.4 Identification of changes. Asterisks arc not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

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

Reviewer Activity:
Army - AV
Navy - AS
Air Force - 11, 82

Preparing Activity:
Air Force - 11

Project No. 2915-0074

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

OMB Approval
No. 22-R255

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