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SUPERSEDING
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MILITARY SPECIFICATION

VALVES, FUEL SHUTOFF, ELECTRIC MOTOR OPERATED

This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 Scope. This specification covers electric motor operated fuel shutoff valves for use in aircraft and missile fuel systems.

1.2 Classification. Fuel shutoff valves shall be of the following types and sizes, as specified (see 6.2):

Type I—Valve, motor operated
Type II—Valve, motor operated with manual override
Type III—Valve, motor operated with thermal relief
Type IV—Valve, motor operated with manual override and thermal relief
Size 1—For use with 1-inch OD tubing
Size 1¼—For use with 1¼-inch OD tubing
Size 1½—For use with 1½-inch OD tubing
Size 2—For use with 2-inch OD tubing
Size 2½—For use with 2½-inch OD tubing
Size 3—For use with 3-inch OD tubing
Size 3½—For use with 3½-inch OD tubing
Size 4—For use with 4-inch OD tubing

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

P-S-661—Solvent, Dry-Cleaning
NN-P-515—Plywood, Container Grade
QQ-C-320—Chromium Plating (Electrodeposited)
QQ-P-416—Plating, Cadmium (Electrodeposited)
PPP-B-566—Boxes, Folding, Paperboard
PPP-B-601—Boxes, Wood, Cleated-Plywood
PPP-B-621—Boxes, Wood, Nailed and Lock-Corner
PPP-B-636—Box, Fiberboard
PPP-B-676—Boxes, Set-Up, Paperboard

MILITARY

MIL-P-116—Preservation, Methods of
MIL-B-131—Barrier Material; Water Vaporproof, Flexible
MIL-A-140—Adhesive, Water-Resistant, Waterproof Barrier-Material
MIL-S-3136—Standard Test Fluids, Hydrocarbons
MIL-C-5015—Connectors, Electric, "AN" Type
MIL-W-5086—Wire, Electrical, 600-Volt, Copper, Aircraft
MIL-E-5272—Environmental Testing, Aeronautical and Associated Equipment, General Specification for
MIL-C-5501—Caps and Plugs, Protective, Dust and Moisture Seal
MIL-E-5557—Enamel; Heat-Resisting, Glyceryl-Phthalate, Black
MIL-G-5572—Gasoline, Aviation: Grades 80/87, 91/96, 100/130, 115/145
MIL-J-5624—Jet Fuel, Grades JP-4 and JP-5
MIL-I-6181—Interference Control Requirements, Aircraft Equipment
MIL-P-6906—Plates, Identification
MIL-F-7024—Fluids, Calibrating, for Aircraft Fuel System Components

FSC 2915

MIL-S-7742—Screw Threads, Standard Optimum Selected Series: General Specification for
MIL-P-7936—Parts and Equipment, Aeronautical, Preparation for Delivery
MIL-P-8585—Primer Coating, Zinc Chromate, Low-Moisture-Sensitivity
MIL-M-8609—Motors, Direct-Current, 28-Volt System, Aircraft Class A and B, General Specification for
MIL-F-8615—Fuel System Components, General Specification for
MIL-A-8625—Anodic Coatings, for Aluminum and Aluminum Alloy
MIL-W-16878—Wire, Electrical, Insulated, High Temperature
MIL-N-25027—Nut, Self-Locking, 250° F, 450° F and 800° F, 125 KSI FTU, 60 KSI FTU, and 30 KSI FTU
MIL-D-70327—Drawings, Engineering and Associated Lists

STANDARDS

FEDERAL

Fed. Test Method
Std. No. 151—Metals; Test Methods

MILITARY

MIL-STD-129—Marking for Shipment and Storage
MIL-STD-130—Identification Marking for U.S. Military Property
MIL-STD-143—Specification and Standards, Order of Precedence for the Selection of
MS3106—Connector, Plug, Electric, Straight
MS20995—Wire, Lock
MS29513—Packing—"O" Ring Hydrocarbon Fuel Resistant
MS33540—Safety Wiring, General Practices for
MS33586—Metals, Definition of Dissimilar
MS33588—Nuts and Plate Nuts, Self-Locking, Functional Limitations of
MS33786—Fitting Installation, Flared Tube and Hose, Swivel

PUBLICATIONS

AIR FORCE-NAVY AERONAUTICAL BULLETIN

No. 432—Age Controls for Synthetic Rubber Parts

(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 Preproduction. This specification makes provisions for preproduction testing (see 4.3.1 and 6.2).

3.2 Materials. Materials and processes used for the manufacture of fuel shutoff valves shall be suitable for the purpose, and shall conform to applicable Government specifications. Materials conforming to contractor's specifications may be used provided the specifications are released by the Services and contain provisions for adequate tests. The use of contractor's specifications will not constitute waiver of Government inspection. All materials used in the valve shall be sufficiently resistant to fuels conforming to Specifications MIL-S-3136, MIL-G-5572, and MIL-J-5624 with aromatics of 0 to 30 percent to assure satisfactory operation as herein defined.

3.2.1 *Metals.* All metals used in the construction of fuel shutoff valves shall be of a corrosion-resistant type or shall be suitably protected to resist corrosion during the normal service life of the valve. The use of dissimilar metals shall be avoided wherever practicable, or used in accordance with Standard MS33586. The use of magnesium or any alloy thereof is prohibited.

3.2.2 *Castings.* Castings shall be clean, sound, and free from blowholes, porosity, cracks, and any other defects.

3.2.3 *Selection of materials.* Specifications and standards for all materials, parts, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with Standard MIL-STD-143, except as provided in the following paragraph.

3.2.3.1 *Standard parts.* Standard parts (MS and AN) shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their part numbers. Commercial utility parts such as screws, bolts, nuts, and cotter pins may be used, provided they

possess suitable properties and are replaceable by the standard parts (MS and AN) without alteration, and provided the corresponding standard part numbers are referenced in the parts list and, if practicable, on the contractor's drawings. In the event there is no suitable corresponding standard part in effect on date of invitation for bids, commercial parts may be used, provided they conform to this specification.

3.3 Design and construction.

3.3.1 *Design.* The valves shall permit the shutoff of fuel in either direction. They shall withstand the pressures that may be encountered in fueling services as specified herein.

3.3.1.1 *Manual override.* For valves which require provisions for manual override, the operation shall not require the use of special tools, and the valve shall be capable of being completely opened or closed in a time not exceeding 10 seconds for either operation.

3.3.1.2 *Position indication.* Valves shall provide an external position indicator. The manual override handle may be used as a position indicator.

3.3.1.3 *Thermal relief.* For valves which require provision for thermal relief of fuel pressure, the unit shall relieve in either direction to the low pressure side of the valve at a differential pressure of 120±15 psi.

3.3.1.4 *Drains.* Drain openings, ⅛-inch minimum diameter, or equivalent, shall be provided to prevent any leakage past the shaft seal from entering the actuator case for any valve mounting position.

3.3.1.5 *Weight.* Minimization of weight shall be a design consideration to the maximum degree attainable consistent with all other requirements of this specification.

3.3.2 *Construction.* The valve shall be constructed to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installations, and service use.

3.3.2.1 *"O" rings.* All "O" rings shall conform to Standard MS29513.

3.3.3 *Dimensions.* Valves shall conform to the manufacturer's drawings, as approved by the procuring activity.

3.3.3.1 *Ports.* Ports shall conform to Standard MS33786.

3.3.4 *Lubrication.* The valve shall operate satisfactorily without the use of lubricants, for any moving part, other than fuel in the valve. Valves requiring lubrication of any moving part shall be designed and constructed to provide adequate protection to insure that the lubricant will be retained at all times during normal operation and during all of the tests specified herein, and care shall be taken to prevent the use of an excess of lubricant which could adversely affect low temperature operation.

3.3.5 *Indicator circuit.* Provision shall be made for indicator circuits which indicate full-open and full-closed positions. The circuit connections shall be specified on the manufacturer's drawings.

3.4 Interchangeability. All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance. Changes in manufacturer's part numbers shall be governed by the drawing number requirements of Specification MIL–D–70327. Actuators shall be removable and interchangeable without disassembly or adjustment of either the valve or the actuator.

3.5 Electric motors.

3.5.1 *Lubrication.* Motor shall not require lubrication during the entire life of the valve.

3.5.2 *DC operating voltage.* Valves used in a 28-volt direct current (dc) electrical system shall operate satisfactorily over a range of voltage from 18 to 30 volts dc at pressures from zero to the maximum operating pressure.

3.5.2.1 *Brush life.* It shall not be necessary to replace the brushes during the life of the equipment. Brushes shall conform to Specification MIL–M–8609 with respect to fit and position.

3.5.3 *AC operating voltage and frequency.* Valves used in 115/200-volt, 400-cycle electrical systems shall operate satisfactorily at any applied frequency between 380 and 420 cps and at any applied line-to-line terminal voltage between 190 and 220 volts, at pressures from zero to the maximum operating pressure.

3.5.4 *Operating torque.* Actuator must have sufficient torque to close against a shutoff

pressure of 60 psi and open against pressure as determined by the thermal relief setting.

3.5.5 *Electrical receptacles.* Electrical receptacles shall conform to Specification MIL-C-5015, and shall mate with MS3106-14S-5S, whose pin arrangement is as follows:

Pin A—Energize to open
Pin B—Energize to close
Pin C—Signal open
Pin D—Signal close
Pin E—Common ground—circuits not to be internally grounded to frame

3.5.6 *Interrupted operation.* When the control switch is reversed while the valve is in motion, the valve motion shall be reversed without completing its motion in the original direction.

3.5.7 *Electrical failure.* The valve shall be so designed that in the event of inadvertent energization of both the opening and closing terminals or electrical power failure, the valve will remain in the selected position. The valve shall not change position due to normal mechanical forces.

3.5.8 *Radio interference.* The valve shall be designed to conform to Specification MIL-I-6181.

3.6 **Wire.** Internal wire shall be in accordance with Specification MIL-W-5086 or MIL-W-16878.

3.7 **Screw threads.** All screw threads shall be in accordance with Specification MIL-S-7742.

3.8 **Locking of parts.** All threaded parts shall be securely locked by cotter pins, safety wiring, self-locking nuts, or other approved method. Self-locking nuts shall conform to Specification MIL-N-25027 and shall be used in accordance with Standard MS33588. Self-locking nuts shall not be used when loosening or disengagement of the nut could result in nut or other parts entering the fuel system. Safety wire shall conform to Standard MS20995 and shall be installed in accordance with Standard MS33540. The use of staking or lock washers is prohibited.

3.9 **Synthetic rubber parts.**

3.9.1 *Age controls.* Age controls shall conform to ANA Bulletin No. 438.

3.9.2 *Serviceability.* All synthetic rubber parts shall be readily replaceable with a minimum removal of attaching parts.

3.9.3 *Uniformity.* For valves which include parts fabricated from synthetic material in contact with fuel, manufacturers shall control subsequent batches to provide for uniformity.

3.10 **Finish.**

3.10.1 *Anodizing.* All aluminum-alloy parts in contact with the fluid or atmosphere shall be anodized in accordance with Specification MIL-A-8625 or shall be adequately treated in some other acceptable manner for corrosion prevention.

3.10.2 *Surface treatment of parts.* Steel parts, other than corrosion-resistant steel not in moving contact, shall be cadmium plated in accordance with type II of Specification QQ-P-416. Wearing surfaces shall be chromium plated in accordance with Specification QQ-C-320 or adequately treated in some other acceptable manner for corrosion prevention where the galling of cadmium plating would cause malfunctioning. Brass, bronze, and copper-alloy parts shall be cadmium plated or adequately treated in some other acceptable manner for corrosion prevention. Stainless steel parts shall be passivated.

3.10.3 *Paint finish.* Any part painted shall be finished with one coat of primer conforming to type I of Specification MIL-P-8585, and one coat of enamel conforming to type II or IV of Specification MIL-E-5557. Parts or portion of parts that come in direct contact with fuel shall not be painted.

3.11 **Performance.** The valve shall satisfy the performance requirements of section 4 and shall satisfactorily complete the tests.

3.12 **Markings.** All markings shall be permanent to prevent obliteration resulting from service usage.

3.13 **Identification of product.** Equipment, assemblies, and parts shall be marked in accordance with Standard MIL-STD-130.

3.13.1 *Nameplate.* A nameplate conforming to Specification MIL-P-6906, properly and legibly filled in, shall be securely attached to the valve or the same information may be etched,

engraved, or embossed in a suitable location on the valve. In addition to the marking required by Standard MIL–STD–130, the following shall be included:

VALVE, FUEL SHUTOFF*, ELECTRIC MOTOR OPERATED**
Specification MIL–V–8608A
Purchaser's Part No. (if applicable)
Manufacturer's Part No.
Manufacturer's Serial No.
Manufacturer's name or trademark
US

3.14 Approval for production. Valves furnished under this specification shall be of a design, model, and type which has satisfactorily passed the preproduction tests.

3.15 Workmanship. Attention shall be given to neatness and thoroughness of assembly, alignment of parts, tightness of assembly screws and bolts, marking of parts, and removal of burrs and sharp edges.

3.15.1 *Cleaning.* All parts shall be clean and free from dirt, sand, metal chips, and other foreign matter during and after assembly.

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. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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 tests. The inspection and testing of fuel shutoff valves shall be classified as follows:

(a) Preproduction tests (4.3)
(b) Quality conformance tests (4.4)

4.3 Preproduction tests.

4.3.1 *Preproduction test samples.* The preproduction test samples submitted shall consist of six fuel shutoff valves of each manufacturer's part number upon which approval is desired. Three of these valves shall have been tested by the manufacturer in accordance with this specification prior to being forwarded to the testing activity. (Each manufacturer's part number shall be approved separately.) An opportunity shall be given to the Government inspector to witness the tests, and his signature shall appear on the test report. These valves shall be accompanied by one complete set of detail and assembly drawings, wiring diagrams, and a complete test report showing results of the manufacturer's tests. These drawings shall be in accordance with Specification MIL–D–70327. The test report should indicate conformance to all requirements of this specification referring specifically to the applicable paragraphs in the specification. Samples identified as required shall be forwarded to the testing laboratory designated by the procuring activity.

4.3.2 *Tests.* The preproduction tests of fuel shutoff valves shall consist of the following tests, conducted in the order listed, as described under 4.6. The preproduction tests may, at the option of the procuring activity, be supplemented with tests under actual or simulated service conditions.

Tests		Samples Valve 1
Examination of product	(4.6.1)	
Explosion proof[1]	(4.6.13.1)	
Valve body and shaft seal leakage	(4.6.3.1)	
Closed valve air pressure leakage	(4.6.3.3)	
Closed valve fuel pressure leakage	(4.6.3.2)	
Closed valve air suction leakage	(4.6.3.4)	
Contaminated fuel endurance	(4.6.8)	
Accelerated corrosion	(4.6.9)	
Sand and dust	(4.6.13.3)	
Fungus	(4.6.13.4)	
Burst pressure	(4.6.13.6)	
Disassembly and inspection	(4.6.13.7)	

Tests		Valve 2
Examination of product	(4.6.1)	
Pressure drop	(4.6.2)	
Valve body and shaft seal leakage	(4.6.3.1)	
Closed valve air pressure leakage	(4.6.3.3)	
Closed valve fuel pressure leakage	(4.6.3.2)	
Thermal relief operation	(4.6.5)	

[1] If the method of conducting the explosion-proof test will render the unit unsatisfactory for the remaining tests, this test shall be conducted on a separate additional test sample.

*The applicable additional modifiers, such as globe, gate. (To be entered by the manufacturer.)
**The applicable voltage. (To be entered by the manufacturer.)

Tests		Samples Valve 2 (cont'd)
Closed valve air suction leakage	(4.6.3.4)	
Endurance	(4.6.6)	
Functional	(4.6.10)	
Dynamic leakage	(4.6.3.5)	
Vibration	(4.6.4)	
Dielectric strength and insulation resistance	(4.6.11)	
Salt spray	(4.6.13.2)	
Disassembly and inspection	(4.6.13.7)	

Tests		Valve 3
Examination of product	(4.6.1)	
Valve body and shaft seal leakage	(4.6.3.1)	
Closed valve fuel pressure leakage	(4.6.3.2)	
Fuel resistance and low temperature	(4.6.7)	
Radio interference	(4.6.12)	
Humidity	(4.6.13.5)	
Disassembly and inspection	(4.6.13.7)	

4.4 Quality conformance tests. The quality conformance tests shall consist of individual tests and periodic sampling tests.

4.4.1 *Individual tests.* Each valve shall be subjected to the following tests, as described under 4.6:

Examination of product	(4.6.1)	
Valve body and shaft seal leakage	(4.6.3.1)	
Closed valve air pressure leakage or closed valve fuel pressure leakage	(4.6.3.3)	(4.6.3.2)
Thermal relief operation	(4.6.5)	
Dielectric strength and insulation resistance	(4.6.11)	
Functional	(4.6.10)	

4.4.2 *Periodic sampling tests.* One valve shall be selected by the inspector from each lot of not more than 200 or fraction thereof on the order, and subjected to the burst pressure test specified in 4.6.13.6.

4.4.3 *Rejection and retest.* When one item selected from a production run fails to meet the specification, no item still on hand or later produced shall be accepted until the extent and cause of failure are determined.

4.4.3.1 *Individual tests may continue.* For operational reasons, individual tests may be continued pending the investigation of a sampling test failure. But final acceptance of items on hand or produced later shall not be made until it is determined that items meet all the requirements of the specification.

4.4.4 *Defects in items already accepted.* The investigation of a test failure could indicate that defects may exist in items already accepted. If so, the contractor shall fully advise the procuring activity of all defects likely to be found and methods of correcting them.

4.5 Test conditions.

4.5.1 *Cleaning.* Prior to testing the valve, all internal parts normally in contact with the fuel, shall be thoroughly cleaned to remove all lubricants and foreign matter.

4.5.2 *Closed valve leakage tests.* For the closed valve leakage tests, the test setups shall be similar to figure 1, or shall be such as to give equivalent results.

4.5.3 *Test fluid.* Unless otherwise specified, fluid in accordance with Specification MIL-G-5572 grade 100/130 or grade 115/145, or Specification MIL-S-3136, type I, shall be used for all tests. Any fluid conforming to Specification P-S-661 or any other fluid acceptable to the procuring activity may be used as a substitute for the test fluid for all tests, except those tests wherein a specific fluid is specified.

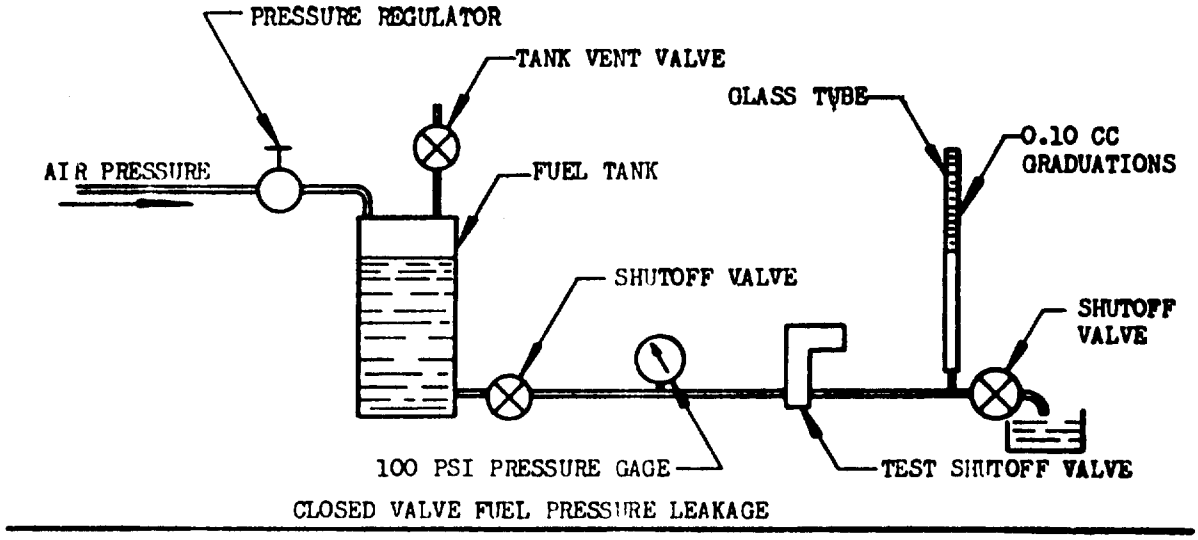
4.5.3.1 *Room temperature and pressure.* Unless otherwise specified, all tests shall be conducted with the valve and fuel at a room temperature between 60° and 90° F and at atmospheric pressure.

4.5.3.2 *Operating voltage.* Unless otherwise specified, valves shall be operated at a terminal voltage of 27±1 volts dc or 115±1 volts ac.

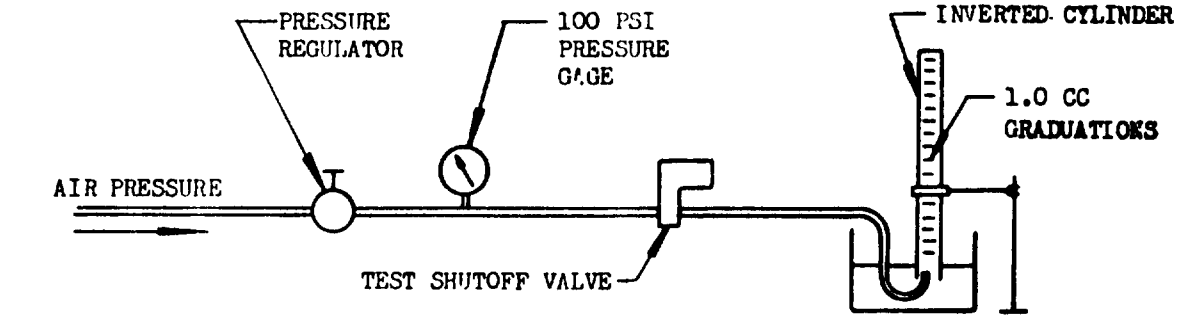
4.5.3.3 *Actuator.* At no time during testing of the valve shall the actuator be immersed in the test fuel or other liquid, unless the actuator is specifically designed for submerged installation.

4.6 Test methods.

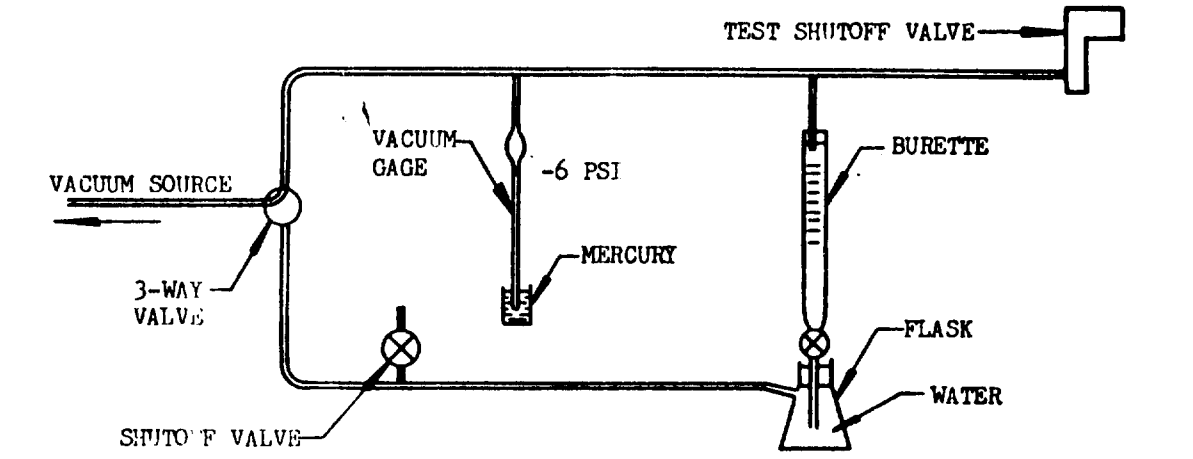
4.6.1 *Examination of product.* Each valve shall be examined to determine conformance with this specification. Particular attention shall be given to materials, workmanship, dimensional requirements, special processes, accuracy of test results, finish, and markings.



CLOSED VALVE FUEL PRESSURE LEAKAGE



CLOSED VALVE AIR PRESSURE LEAKAGE



CLOSED VALVE AIR SUCTION LEAKAGE

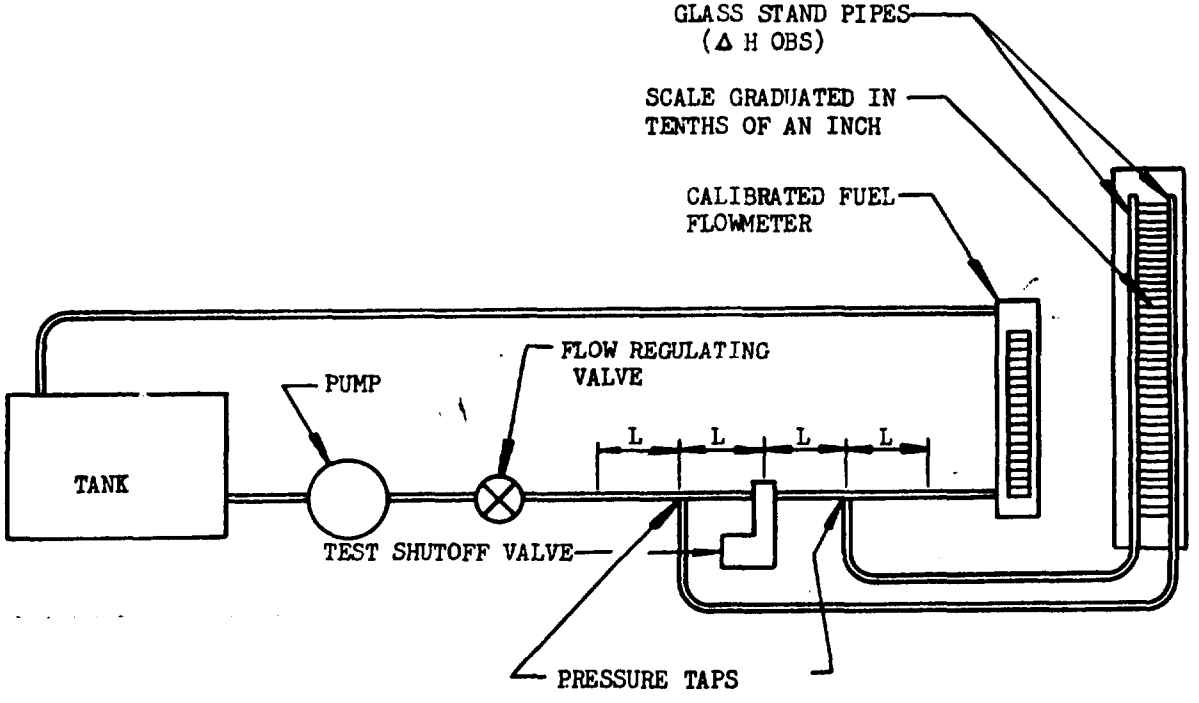
FIGURE 1. *Closed valve leakage test setups*

4.6.2 *Pressure drop.* The pressure drop through the valve shall be determined up to the fuel flow specified in the applicable drawing, using a test setup similar to that shown in figure 2. The pressure drop shall be obtained for the two lengths of tubing and fittings between the pressure taps and the valve connections. The pressure drop for the valve is the difference between the pressure drop for the valve and tubing with fittings, and the pressure drop for the tubing with fittings. The pressure drop across the valve only as calculated above shall not exceed 0.25 psi. Sufficient data shall be recorded to permit the plotting of curves. The pressure drop graph shall show the pressure drop of the valve using the test fluid and the pressure drop corrected to fuel in accordance with type II of Specification MIL-F-7024 (reference specific gravity 0.770, reference viscosity 1.17 centipoises). The graph shall indicate the formula used to correct from the test fluid to the corrected pressure drop.

4.6.3 *Leakage.*

4.6.3.1 *Valve body and shaft seal leakage.* Without immersing the actuator, the valve shall be immersed in fuel or other suitable liquid, and with one port plugged, air pressure from 0 to 120 psi shall be applied to the other port. The valve shall be operated through 5 complete cycles. There shall be no external or shaft seal leakage at any pressure from 0 to 120 psi.

4.6.3.2 *Closed valve fuel pressure leakage.* Fuel under pressures of from 4 inches of fluid to 5 psi in 1-psi increments and from 5 to 60 psi in 10-psi increments, shall be applied to each port in turn with the valve in the closed position. After a 2-minute maximum waiting period, leakage shall not exceed 0.5 cc per minute at any pressure from 0 to 60 psi for valves from 1- to 2-inch sizes, inclusive, and shall not exceed 1.0 cc per minute for valves of 3- and 4-inch sizes. For quality conformance tests only, leakage shall be measured at pressures of 4 inches of fluid, 25 and 60 psi only.



L = 10 x DIA OF TUBING

FIGURE 2. *Pressure drop test setup*

4.6.3.3 *Closed valve air pressure leakage.* With the internal parts of the valve wet with fuel, but not filled with fuel, air pressures equivalent to 4 inches of fuel to 5 psi in 1-psi increments, and from 5 to 60 psi in 10-psi increments, shall be applied to each port in turn with the valve in the closed position. For quality conformance tests only, leakage may be measured at pressures equivalent to 4 inches of fuel, 25 and 60 psi only. If the leakage exceeds 10 cc per minute of free air at pressures from 5 to 60 psi, the closed valve fuel pressure leakage test shall replace this test.

4.6.3.4 *Closed valve air suction leakage.* With the internal parts of the valve wetted with fuel, but not filled with fuel, air suction of 0 to 6 psi shall be applied to each port in turn with the valve in the closed position. The total leakage through the valve-sealing element, the shaft seal, joints, and the casing shall not exceed 10 cc per minute of free air at any suction from 0 to 6 psi.

4.6.3.5 *Dynamic leakage.* Fuel shall be directed through the valve at the rated flow specified in table I with the shutoff pressure at 60 psi. The valve shall be actuated from open to closed, and at the end of a 2-minute waiting period, with the shutoff pressure maintained at 60 psi, the leakage shall not exceed 0.5 cc per minute for the 1-inch through 2-inch valve and 1.0 cc for the 2½ and 4-inch sizes. The flow shall be reversed through the valve and the test repeated.

TABLE I. *Fuel flow*

Dash No. reference	Tubing OD (inches)	Flow in gallons per minute (gpm)
16	1	30
20	1¼	50
24	1½	70
32	2	130
40	2½	225
48	3	320
56	3½	460
64	4	600

4.6.4 *Vibration.*

4.6.4.1 *Vibration range.* The vibration test shall be conducted in accordance with Vibration tests, Procedure XII of Specification MIL-E-5272, with apparatus consisting of a suitable device for mounting and vibrating the connected component through the following ranges:

(a) 0.050 inch double amplitude (total excursion from 5 to 10 cps).
(b) 0.036 inch double amplitude from 10 to 75 cps.
(c) 10g vibratory acceleration from 75 to 300 cps.
(d) 15g vibratory acceleration from 300 to 500 cps.

4.6.4.2 *Resonant frequency.* The valve wetted with test fluid shall be operated at the test cycle frequency of footnote [1] of table II while concurrently scanning the frequency range for resonant frequencies. The frequency of vibration of the valve shall be varied slowly from 5 to 500 and back to 5 cps with the amplitudes indicated in 4.6.4.1. If resonant frequencies are encountered, the valve shall be vibrated successively along each of its mutually perpendicular axes for 4 hours; or 6 hours, with a circular motion in the horizontal plane, and 6 hours with a circular motion in the vertical plane at the resonant conditions with the applied double amplitude or vibratory acceleration as previously noted. When more than one resonant frequency is encountered with vibration applied along any one axis, or with circular motion in any one plane, the test period may be carried out at the most severe resonance, or the period may be divided among the resonant frequencies, whichever is considered most likely to produce failure. The valve shall be vibrated half of the test period in the open position and the other half in the closed position. The valve shall remain in the selected position. Upon completion of this test, the valve shall be subjected to the closed valve fuel pressure leakage test (4.6.3.2). There shall be no evidence of malfunctioning, damage, loosening, or leakage of the valve or valve parts as a result of this test.

TABLE II. *Endurance test schedule* [1]

Test	Dry endurance	Wet endurance		
Period	Endurance and altitude	Room temperature [2]	High temperature	Low temperature
Test setup or valve configuration.	Suitable test setup, 60,000 ft. pressure altitude.	Suitable recirculating test setup.	Suitable recirculating test setup.	Suitable recirculating test setup.
Test procedure during period.	(a) Dry with open ports, valve closed, 4 hours at 158° ±2° F at sea level pressure. (b) Cycle valve for 500 cycles dry at test altitude. (c) Wet valve with test fluid.	(a) Cycle valve for 5,500 cycles circulating test fluid through the valve at the flow rate of table I and imposing 60 psi on the valve in "off" position. (b) See. [2]	Cycle valve for 2,000 cycles as for room temperature period, except that the flow should be in the opposite direction and rated flow need not be achieved.	Cycle valve for 500 cycles as for room temperature period, except that the flow should be in the opposite direction and rated flow need not be achieved.
Ambient and test fluid temperature	Room	Room	130° ±5° F	−67° ±2° F
Number of periods	4	1	1	1
Test after completion of period.	After final period, conduct closed valve fuel pressure leakage test.	Conduct the following tests: (a) Valve body and shaft seal leakage test. (b) Closed valve air suction leakage test. (c) Closed valve fuel pressure leakage test.	None; however, there shall be no visible leakage from the valve during the test.	None; however, there shall be no visible leakage from the valve during the test.

[1] The test cycle frequency shall be such that the total operating time of the motor will be not less than 3 minutes nor more than 6 minutes out of each 20 minutes of operation.

[2] The dynamic leakage test shall be conducted at the beginning of the room temperature test period; at approximately half way through the period; and again at the conclusion of the period.

4.6.4.3 *Vibration endurance.* Should no resonant frequencies be encountered as described above, the valve shall be vibrated for 6 hours along each of its mutually perpendicular axes, or for 9 hours with a circular motion in each of two mutually perpendicular planes at an applied double amplitude of 0.036 inch and a frequency of 50 cps. The valve shall be vibrated half of the test period in the open position and the other half of the test period in the closed position. The valve shall remain in the selected position. The valve shall be operated throughout this test at the test cycle frequency of footnote,[1] table II. Upon completion of this test, the valve shall be subjected to the leakage tests of 4.6.3.2, 4.6.3.3, and 4.6.3.4. There shall be no evidence of malfunctioning, damage, loosening, or leakage of the valve or valve parts, either during or as a result of this test.

4.6.5 *Thermal relief operation.* This test is applicable only to valves with thermal relief provisions. With the valve closed, the pressure shall be slowly raised alternately on either side

of the valve from 100 to 140 psi or to the cracking pressure of the valve, whichever is the lesser. This shall be repeated six time and each time the thermal relief valve shall be observed to operate successfully under this condition.

4.6.6 *Endurance.* The endurance test shall be conducted in accordance with table II.

4.6.7 *Fuel resistance and low temperature test.* The fuel resistance and low temperature test shall be conducted in accordance with table III.

4.6.8 *Contaminated fuel endurance.* Fuel containing contaminants, in the concentrations specified in Specification MIL-F-8615 shall be pumped through the valve. The valve shall be operated at the test cycle frequency specified in footnote [1] of table II for 2,000 cycles of operation, 1,000 cycles of which shall be at rated flow shown in table I and 1,000 cycles at 10 percent of rated flow. The contaminant shall not be recirculated. A minimum quantity of 20 gallons of fuel shall be used for this test. After this procedure, the valve shall satisfy the requirements of the following tests:

(a) Valve body and shaft seal leakage ---------- (4.6.3.1)
(b) Closed valve fuel pressure leakage ---------- (4.6.3.2)
(c) Closed valve air suction leakage ---------- (4.6.3.4)
(d) Functional ---------- (4.6.10)

4.6.9 *Accelerated corrosion.* Without immersing the actuator, the valve, with open ports, shall be immersed in a solution consisting of 2½ percent by weight of sodium chloride in distilled water. After immersion, the solution shall be drained and the valve shall be heated in an oven to a temperature of 125° to 135° F for a period of not less than 1 hour. The immersion and heating cycle shall be repeated 50 times in which the first 25 cycles shall be with the valve open and the last 25 cycles with the valve closed. The valve shall not be operated during the immersion cycles. Immediately after completing the immersion cycles, the valve shall be washed out with warm water to remove all salt accumulations, after which the valve shall be dried, wetted with fuel, and subjected to the power and time of operation test (4.6.10). Corrosion of any part of the valve to a degree which might affect performance shall be cause for rejection.

TABLE III. *Fuel resistance and low temperature test schedule*

Test	Fuel resistance				Low temperature
Period [1]	Phase I soak	Phase I dry	Phase II soak	Phase II dry	
Component configuration	Ports open [2]	Drained, valve closed, ports open	Ports open [2]	Drained, valve closed, ports open	Valve closed, figure 1
Test fluid	MIL-S-3136 type III [3]	Circulating dry air	MIL-S-3136 type III [3]	Circulating dry air	MIL-S-3136 type I
Period duration	96 hours (4 days)	24 hours	18 hours	30 hours	18 hours (3 days)
Ambient temperature	158° ±2° F	158° ±2° F	158° ±2° F	158° ±2° F	−67° ±2° F
Operation during period	Actuate valve at least 4 times per day	None	Actuate valve at least 40 cycles	None	None
Operation and tests immediately after period	Leakage test 4.6.3.2., using MIL-S-3136 type III	(a) Actuate valve 5 cycles dry (b) Leakage test 4.6.3.2, using MIL-S-3136 type I	Leakage test 4.6.3.2, using MIL-S-3136 type III	(a) Actuate valve 5 cycles dry (b) Leakage test 4.6.3.2, using MIL-S-3136 type I	With ambient test fluid at −65° F. (a) Conduct applicable minimum voltage test twice in accordance with 4.6.10, using 60-psi fuel shutoff pressure. The valve shall operate within 10 seconds. The power requirements of 4.6.10 shall not be exceeded. (b) Conduct applicable normal 27- or 115-volt voltage test in accordance with 4.6.10. (c) Conduct leakage test in accordance with 4.6.3.1, using MIL-S-3136 type I fluid. (d) Conduct leakage test in accordance with 4.6.3.2, using MIL-S-3136 type I fluid.

[1] Each period shall follow immediately after the preceding one in the order noted.
[2] During first half of soak period, valve shall be in full "open" position; during second half of soak period, it shall be fully closed.
[3] During period of soaking in the test fluid, the valve shall be maintained in such a manner as to insure complete contact of all synthetic parts with the fluid as would be expected under service conditions.

4.6.10 *Functional.*

4.6.10.1 *DC operation.* The valve shall be operated at 18, 27, and 30 volts dc against a fuel shutoff pressure of 60 psi. At no time shall the current exceed 10 amperes for valve sizes through 2 inches or 15 amperes for larger valves. The time of operation in either direction shall not exceed 2 seconds at 18 volts and 1 second at 27 volts, nor shall the time be less than ½ second at 27 volts. The valve shall be

operated from closed to open a minimum of 5 times at 27 volts at a shutoff pressure of 5 psi below the thermal relief cracking pressure of the valve.

The valve shall be tested in both open and closed positions. A voltage of 30V shall be applied simultaneously across both the open and closed terminals of the motor and maintained until the valve body temperature has stabilized. The valve shall remain in the selected position and the valve body temperature shall not exceed 200° F. Any damage to the motor as a result of this test shall be cause for rejection.

4.6.10.2 *AC operation.* The valve shall be capable of operation at 107, 115, and 117.5 volts against a fuel shutoff pressure of 60 psi. At no time shall the input power exceed 100 volt-amperes. The time of operation in either direction shall not exceed 2 seconds at 107 volts and 1 second at 115 volts. The valve shall be operated from closed to open a minimum of 5 times at 115 volts at a shutoff pressure of 5 psi below the thermal relief cracking pressure of the valve.

The valve shall be tested in both open and closed positions. A voltage of 117.5V shall be applied simultaneously across both the open and closed terminals of the motor and maintained until the valve body temperature has stabilized. The valve shall remain in the selected position and the valve body temperature shall not exceed 200° F. Any damage to the motor as a result of this test shall be cause for rejection.

4.6.11 *Dielectric strength and insulation resistance.*

4.6.11.1 *Dielectric strength.* While at room temperature, 1,000 volts (rms) 60 cycles for dc-operated valves; or 1,500 volts (rms) 60 cycles for ac-operated valves, shall be applied for 1 minute between windings and between windings and frame. For this test, all windings permanently connected together are to be considered one winding. Capacitors may be disconnected during this test. Capacitors shall be subjected to 150 volts dc for 1 second. There shall be no voltage breakdown during or as a result of the dielectric strength test.

4.6.11.2 *Insulation resistance.* The insulation resistance shall be measured at 25° ±5° C between windings and the frame before and after dielectric strength test. Insulation resistance shall be not less than 100 megohms when measured with a 500-volt dc megger.

4.6.12 *Radio interference.* The radio interference test shall be conducted in accordance with Specification MIL-I-6181.

4.6.13 *Environmental tests.*

4.6.13.1 *Explosion proof.* The explosion tests, Procedure III of Specification MIL-E-5272, shall be conducted on the motor compartment and any other compartment of the valve containing a source of ignition. These shall withstand and confine an explosion of gasoline and air mixture within each compartment and shall confine all sparks and flame within the compartment in order to prevent ignition of explosive mixtures surrounding the valve assembly. These tests shall be made using each of two mixtures of gasoline and air, such that one mixture will result in maximum pressure and the other in maximum duration of flame. Each compartment shall be subjected to 25 explosions of each mixture. The mixture surrounding the valve shall be ignited a sufficient number of times to demonstrate that it is explosive.

4.6.13.2 *Salt spray.* With the ports plugged and the electric connector capped as in service, the valve and actuator shall be subjected to a 50-hour salt spray test conducted in accordance with Federal Test Method Standard No. 151. At the conclusion of the test, the valve shall be visually inspected for evidence of corrosion after which it shall meet the power and time of operation test (4.6.10).

4.6.13.3 *Sand and dust.* With the ports plugged and the electric connector capped as in service, the valve shall be subjected to the Sand and Dust tests, Procedure I, of Specification MIL-E-5272. At the end of this test, the valve shall be subjected to the power and time of operation test (4.6.10) and the valve body and shaft seal leakage test (4.6.3.1).

4.6.13.4 *Fungus.* With ports plugged and the electrical receptacle capped as in service, the valve shall be subjected to the following test. At least five fungi shall be used in each test, one selected from each group shown in table V. In preparing the spore suspension,

distilled water (having a pH value between 6.8 and 7.2) at 77° F, shall be prepared by sterilization in convenient containers (approximately 100 cc each). Approximately 10 cc of the solution shall then be introduced directly into a stock culture of one fungus and shaken vigorously so that a well sporulated suspension will result without disturbing the agar. This process shall be repeated for each type fungus. The separate spore suspension from the five types of fungi shall be mixed together in an atomizer to provide a composite suspension. The valve shall then be placed into a mold chamber maintaining an internal temperature of 86° F and a relative humidity of 95 percent, and sprayed with the suspension of mixed spores. The valve shall remain in the chamber under the above specified conditions for 28 days. At the end of this time, it shall be removed and subjected to the power and time of operation test (4.6.10).

4.6.13.5 *Humidity.* With ports plugged and the electrical receptacle capped as in service, the valve shall be placed in a test chamber which is capable of being sealed, and the temperature and relative humidity raised to 160° F and 95±5 percent, respectively, during a 2-hour period. The source of heat for the chamber shall be so arranged that radiant heat shall not fall upon the valve. The valve shall remain in the chamber under the above conditions for a period of 6 hours. At the conclusion of the 6-hour period, the heat shall be turned off. During the following 16-hour period, the temperature must drop at a uniform rate with condensation to 100° F or less. The cycle shall be repeated a sufficient number of times to extend the total time of the test to 360 hours (15 cycles). At the conclusion of the 360-hour period, the valve shall be soaked at −67° F for a period of 2 hours, and while still at −67° F shall be subjected to the power and time of operation test (4.6.10). Distilled or demineralized water having a pH value of between 6.8 and 7.2 at 77° F, shall be used to obtain the desired humidity.

4.6.13.6 *Burst pressure.* With the valve in the open position, and with one port plugged, a fluid pressure of 180±2 psi shall be applied for a period of 1 minute. There shall be no evidence of distortion or other injury to any part of the valve. When the pressure is lowered to 60 psi there shall be no evidence of external leakage from any portion of the valve.

TABLE V. *Fungus cultures to be used in the fungus test*

Organisms	Source
Group I.	
Chaetomium globosum or Myrothecium verrucaria	USDA 1042.4, ATCC 6205 USDA 1334.2, ATCC 9095
Group II.	
Rhizopus nigricans or Aspergillus niger	S.N. 32, ATCC 10404 USDA TC215-4247, ATCC 6275
Group III.	
Aspergillus flavus or Aspergillus terreus	ASD No. 26, ATCC 10836 PQMD 82J, ATCC 10690
Group IV.	
Penicillium luteum or Penicillium ochro-chloron Penicillium citrinum	USDA 1336.1, ATCC 9776 USDA 1336.2, ATCC 9112 ATCC 9849
Group V.	
Memnoniella echinata or Fusarium moniliforme	ASD No. 37, ATCC 9597 USDA 1004.1, ATCC 10052

Culture designation and source

USDA	U.S. Department of Agriculture, Beltsville, Md.
ATCC	American Type Culture Collection, Georgetown University, Washington, D.C.
PQMD	Philadelphia Q.M. Depot, 2800 S. 20th Street, Philadelphia, Pa.
ASD	Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio.
S.N.	Dr. W. B. Weston, Biological Laboratories, Harvard University, Cambridge, Mass.

4.6.13.7 *Disassembly and inspection.* The valve shall be disassembled and inspected. There shall be no evidence of deterioration, corrosion, or wear of any part of the valve to a degree which might affect performance.

4.7 Preservation, packaging, packing, and marking. Preservation, packaging, packing, and marking shall be examined for conformance with section 5.

5. PREPARATION FOR DELIVERY

5.1 Preservation. Unless otherwise specified, all valve ports shall be sealed with clo-

sures conforming to Specification MIL-C-5501 and the valves shall be preserved in accordance with method IId of Specification MIL-P-116 without the use of preservative compound.

5.2 Packaging.

5.2.1 *Level A.* Valves shall be packaged in accordance with method IId of Specification MIL-P-116. The unit container shall be a reusable metal type.

5.2.2 *Level C.* When this level is required, packaging shall be in accordance with standard commercial practice.

5.3 Packing.

5.3.1 *Levels A, B, and C.* Valves shall be packed in accordance with Specification MIL-P-7936. The level shall be as specified (see 6.2). No rough-handling tests will be required.

5.4 Marking of shipments. In addition to any special marking required by the contract or order, unit packages, intermediate packages, and shipping containers shall be marked in accordance with Standard MIL-STD-129.

5.4.1 *Age control.* The exterior shipping container and unit and intermediate packages shall also be marked in accordance with ANA Bulletin No. 438.

6. NOTES

6.1 Intended use. The fuel shutoff valves covered by this specification are intended for use with aviation gasoline and jet fuels (JP-4 and JP-5). These valves are not to be used for flow regulation of fuel in the fuel system.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification.

(b) Type and size of valve required (see 1.2).

(c) Time and place for preproduction testing (see 4.3.1).

(d) Conditions applicable to items held or produced pending satisfactory completion of the preproduction tests.

(e) Selection of applicable levels of packaging and packing.

(f) Voltage, frequency, and power requirements.

6.3 Definitions.

6.3.1 *Valve.* Unless otherwise specified, the word "valve" shall be construed to mean a complete assembly.

6.3.2 *Cycle.* A cycle of operation of the valve shall be from full closed to full open and return to full closed, or from full open to full closed and return to full open.

6.3.3 *Operation.* A valve operation is one-half a cycle.

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Army—MO
Navy—Weps
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