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Switches, Toggle, Electrically Held, Sealed, General Specification For

FSC 5930

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature. Design authorities may determine that this document is no longer to be used for new design. This determination should be made by each design authority.

STABILIZED NOTICE

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NOTICE

This document has been taken directly from U.S. Military specification MIL-S-5594B(AS), Supplement 1, Amendment 1, Notice 1 and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE Technical Standards. The initial release of this document is intended to replace MIL-S-5594B(AS), Supplement 1, Amendment 1, Notice 1. Any part numbers established by the original specification remain unchanged.

The original military specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DoD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this technical report.

1. SCOPE:

1.1 Scope:

This specification covers general requirements for direct current electrically held, environmentally sealed toggle switches for use in alternating current (AC) and direct current (DC) applications. (See 6.1.)

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

PPP-B-566	Box, Folding, Paperboard
PPP-B-636	Box, Fiberboard
PPP-B-676	Box, Set-Up
PPP-T-60	Tape, Pressure-Sensitive Adhesive, Waterproof, For Packaging
ZZ-R-765	Rubber, Silicone, Low and High-Temperature and Tear Resistant

Military

MIL-M-14	Molding Plastics and Molded Plastic Parts, Thermosetting
MIL-P-116	Preservation, Methods of
MIL-P-997	Plastic Material, Laminated, Thermosetting, Electric Insulation, Sheets, Glass-Cloth, Silicone Resin
MIL-W-5088	Wiring, Aircraft, Installation of
MIL-S-5594/1(AS)	Switch, Toggle, Magnetic Hold-in, SPDT
MIL-S-5594/2(AS)	Switch, Toggle, Magnetic Hold-in, DPDT
MIL-S-5594/3(AS)	Switch, Toggle, Magnetic Hold-in, DP3T

2.1 (Continued):

MIL-P-15037	Plastic Sheet, Laminated, Thermosetting, Glass-Cloth, Melamine-Resin
MIL-F-15160	Fuses, Instrument, Power, and Telephone
MIL-W-22759	Wire, Electric, Fluoropolymer Insulated, Copper or Copper Alloy
MIL-S-28786	Switches, Preparation for Delivery of
MIL-C-45662	Calibration System Requirements
MIL-I-81023	Inductor, 28 V, D.C. Laboratory Test, General Specification for

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-456	Electronic Parts, Date and Source Coding for
MS25017	Circuit Breaker, Trip-Free, Push-Pull, 5 to 50 Amp, Type I, Size A

(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.)

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.

National Bureau of Standards

Handbook H28 Screw-Thread Standards for Federal Services

(Applications for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.)

SD-6 Provisions Governing Qualification

(Applications for copies should be addressed to: Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.)

3. REQUIREMENTS:

3.1 Specification sheets:

The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern (see 6.2).

3.1.2 Requirements for switches not covered by specification sheets: When specified (see 3.1 and 6.2.1), switches furnished under this specification, which are not covered by specification sheets, shall be products which will meet the requirements specified on the order or contract.

3.2 Qualification:

Switches furnished under this specification, which are covered by specification sheets listed in supplement 1, shall be products which have been tested, have passed the qualification tests specified in 4.5, and have been listed on or approved for listing on the applicable Qualified Products List (see 6.3).

3.3 Quality conformance:

Switches furnished under this specification shall have demonstrated that it fulfills all of the requirements of this specification by satisfactorily performing all the quality conformance tests specified herein.

3.4 Material:

Material shall be as specified herein. When a definite material is not specified, a suitable material shall be used which will enable the switches to conform to the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.4.1 Metals: All external metal parts, other than current-carrying parts, shall be of corrosion-resistant material, or shall be suitably protected to resist corrosion.

3.4.1.1 Ferrous materials: Ferrous material shall not be used for current-carrying parts except for header terminals.

3.4.1.2 Dissimilar metals: When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. The use of dissimilar metals in contact, which tend toward active electrolytic corrosion (particularly brass, copper, or steel used in contact with aluminum or aluminum alloy) is not acceptable. However, metal plating or metal spraying of dissimilar base metals to provide similar or suitable abutting surfaces is permitted. The use of dissimilar metals separated by a suitable insulating material is also permitted. Dissimilar metals are defined in MIL-STD-454, requirement 16.

3.4.2 Plastic material: Unless otherwise specified (see 3.1), molded plastic material shall conform to MIL-M-14, and laminated plastic material shall conform to MIL-P-997 or MIL-P-15037; however, laminated plastics shall not be used for the switch body. Other types of plastic materials possessing superior characteristics may be used provided the manufacturer submits acceptable evidence to the activity responsible for qualification during this qualification test program on the submitted product. In addition to these specifications, the plastic material shall not cause any hazard when operating under the extremes of environment and performance as specified herein. Such hazards may be defined as an tendency to support combustion, give off noxious gases in harmful quantities, give off any gases in quantities sufficient to cause explosion of sealed housing, give off any gases in a sealed housing that will cause contamination of the contact or other parts of the component, or form current-carrying tracks when subjected to arcing conditions encountered when any of the tests in this specification are performed on the component.

3.4.3 Elastomer seals: The material for all elastomer seals shall be silicone rubber in accordance with ZZ-R-765.

3.5 Design and construction:

Switches shall be so constructed as to insure proper operation when mounted in any position. The switches shall be of the design, construction, and physical dimensions specified (see 3.1).

3.5.1 Actuating lever: The actuating lever shall be metal with a lusterless finish and shall be insulated from all current-carrying parts.

3.5.2 Terminals: Terminals shall be as specified (see 3.1).

3.5.2.1 Solder terminals: Solder terminals shall be treated to facilitate soldering. Coatings such a hot solder, hot-tin dip, or gold plating are acceptable. When gold plating is used, its thickness shall be a minimum of 30 millionths of an inch. Gold wash or water lacquer shall not be used as a coating.

3.5.2.2 Screw Terminals: Screw Terminals shall be provided with hardware as specified (see 3.1), assembled on the switch or packaged with each individual switch in accordance with MIL-S-28786.

3.5.2.3 Wire-lead terminals: Wire-lead terminals shall be No. 20 wire leads per MIL-W-22759 marked with circuit identification and wire gauge (1-20, 2-20, etc.) per MIL-W-5088.

3.5.2.4 Unused terminals: Terminals which are not functionally required as indicated in the applicable specification sheet (see 3.1) shall not be supplied.

3.5.3 Mounting means:

3.5.3.1 Mounting bushing: The mounting bushing shall be as specified (see 3.1). The bushing shall be provided with a seal between the toggle lever and the switching mechanism. The body of the seal shall not protrude from the top of the mounting bushing with exception of the tapered joint or meniscus where the seal joins the toggle lever.

3.5.3.2 Mounting Hardware: The mounting hardware shall be as specified (see 3.1). For direct Government acquisition, all mounting hardware shall be assembled in proper order as shown on the applicable Detail Specification Sheet (see 3.1) or packaged with each individual switch in accordance with MIL-S-28786.

3.5.4 Screw threads: Screw threads on external threaded parts shall be in accordance with Handbook H28. Threading of nonmetallic parts shall not be permitted. Terminal thread engagement shall be at least two full threads.

3.5.5 Soldering: Where soldering is employed, it shall be in accordance with MIL-STD-454 except that excess flux shall be removed.

3.6 Operating characteristics:

When switches are tested as specified in 4.9.2, the toggle lever angular travel, hold-in point, drop-out point, coil resistance, and override force shall be as specified (see 3.1).

3.7 Strength of terminals:

When switches are tested as specified in 4.9.3.1, 4.9.3.2, or 4.9.3.3, there shall be no breakage, loosening, rotation of terminals, or other damage which would affect subsequent operation of the switch.

3.8 Strength of actuating lever pivot and lever stop:

When switches are tested as specified in 4.9.4, there shall be no malfunction, damage, breakage, or short circuit; the switch shall operate mechanically and electrically.

3.9 Dielectric withstanding voltage:

When switches are tested as specified in 4.9.5 there shall be no arcing, flashover, or leakage current in excess of 1.0 milliamperes.

3.10 Mechanical endurance:

When switches are tested as specified in 4.9.6, there shall be no mechanical damage and the switch must properly control a pilot lamp circuit for a total of 10 operations at the conclusion of the test.

3.11 Electrical overload and endurance:

When switches are tested as specified in 4.9.7, each pair of switch contacts under test shall open and close the circuit in proper sequence during each cycle of the switch actuating member. There shall be no external evidence of malfunction or damage during or after the test. This includes deterioration, electrical discharge, overheating, or evidence of combustion. At the conclusion of the test, the switch shall be electrically and mechanically operable while controlling the test load, at the test environment and at room conditions.

3.12 Seal:

When switches are tested as specified in 4.9.8, the leakage rate shall not exceed 1×10^{-6} standard atmosphere cubic centimeter per second (atm cc/sec).

3.13 Vibration:

When switches are tested as specified in 4.9.9, there shall be no separation of closed contacts exceeding 10 microseconds or closure of open contacts exceeding 10 microseconds. There shall be no evidence of damage.

3.14 Shock:

When switches are tested as specified in 4.9.10, there shall be no separation of closed contacts exceeding 10 microseconds or closure of open contacts exceeding 10 microseconds. There shall be no evidence of damage.

3.15 Acceleration:

When switches are tested as specified in 4.9.11, there shall be no separation of closed contacts or closure of open contacts. There shall be no evidence of damage.

3.16 Salt spray:

When switches are tested as specified in 4.9.12, there shall be no warping, cracking, or corrosion which will adversely affect subsequent operation. The specified cycling shall be completed without failure. After the test, the mounting hardware shall be readily removable.

3.17 Moisture resistance:

When switches are tested as specified in 4.9.13, there shall be no damage which would adversely affect subsequent operation.

3.18 Sand and dust:

When switches are tested as specified in 4.9.14, the switch shall properly control a pilot lamp circuit for a total of 10 operations at the conclusion of the test.

3.19 Explosion:

When switches are tested as specified in 4.9.15, there shall be no explosion. If the switch causes an explosion at any of the test altitudes, it shall be considered to have failed to pass the test and no further testing may be attempted.

3.20 Marking:

Switches shall be marked in accordance with MIL-STD-130 with the manufacturer's name or trademark, the manufacturer's part number, and the applicable specification sheet part number. The date of manufacture shall be marked in accordance with MIL-STD-456. The terminals shall be permanently identified. The switch case shall be permanently marked with the switch circuit diagram as shown on the applicable specification sheet (see 3.1).

3.21 Workmanship:

Switches shall be manufactured and processed in a careful and workmanlike manner in accordance with good design and sound practice.

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 in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, 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. Nothing specified herein shall prevent the supplier or manufacturer from taking additional samples and making such additional inspection as he may deem necessary or desirable to assure conformance of switches in this specification.

4.2 Classification of inspection:

The examination and testing of switches shall be classified as follows:

(a) Component-materials inspection (see 4.3).

(b) Qualification inspection (see 4.5).

(c) Inspection requirements for switches not covered by specification sheets (see 4.6).

(d) Quality-conformance inspection (see 4.7).

(1) Inspection of product for delivery (see 4.7.1).

(2) Inspection of preparation for delivery (see 4.8).

4.3 Component-materials inspection:

Component-materials inspection shall consist of verification that the component materials listed in Table I, used in fabricating the switches, are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

TABLE I
COMPONENT-MATERIALS INSPECTION

Component Material	Requirement Paragraph	Applicable Specification
Plastic	3.3.2	MIL-M-14, MIL-P-997, MIL-P-15037
Rubber	3.3.3	ZZ-R-765

4.4 Inspection conditions:

Unless otherwise specified herein, all tests required by this specification shall be made at room ambient conditions in accordance with the "general requirement" of MIL-STD-202.

4.4.1 Test equipment and inspection facilities: Test equipment and inspection facilities shall be of sufficient accuracy, quality, and quantity to permit performance of the required acceptance tests. The manufacturer shall establish adequate calibration of test equipment to the satisfaction of the Government. Calibration of standards which control the accuracy of the inspection equipment shall comply with the requirements of MIL-C-45662.

4.5 Qualification inspection:

Qualification inspection shall be performed at a Government laboratory or private test facility approved by the Government. Qualification inspection shall consist of the examinations and tests specified in Table II and in the order shown.

4.5.1 Sample: For qualification inspection, the sample size for each test shall be as specified in Table II.

4.5.1.1 Single submission: A sample consisting of the required number of specimens of each switch shall be submitted. Qualification shall be restricted to the type submitted.

4.5.1.2 Group submission: The extent of qualification shall be in accordance with the applicable specification sheet (see 3.1).

4.5.1.3 Failures: Failure of any switch to comply with the applicable requirements shall be cause for refusal to grant qualification.

4.5.1.4 Test data: Each submission shall be accompanied by test data covering the tests listed in Table II which have been performed on representative specimens. The representative specimens shall be the types of switches being submitted for test. All test data shall be submitted in duplicate.

4.5.1.5 Certification of material: When submitting samples for qualification, the manufacturer shall submit certification, in duplicate, that the materials used in his components are in accordance with the applicable specification requirements.

4.5.1.6 Description of items: The manufacturer shall submit his part number for each switch for which qualification is sought.

TABLE II
QUALIFICATION INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	Sample Number																					
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Examination of Product	3.1, 3.20, 3.21	4.9.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Operating Characteristics	3.6	4.9.2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Dielectric Strength	3.9	4.9.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Sealing	9.12	4.9.8	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Strength of Terminals	3.7	4.9.3	5	5																				
Strength of Actuating Lever	3.8	4.9.4	6	6																				
Moisture Resistance	3.17	4.9.13	7	7																				
Vibration	3.13	4.9.9			5	5																		
Shock	3.14	4.9.10			6	6																		
Acceleration	3.15	4.9.11			7	7																		
Salt Spray	3.16	4.9.12			8	8																		
Sand & Dust	3.18	4.9.14					5	5																
Explosion	3.19	4.9.15							5	5														
Overload	3.11	4.9.7.1									5	5	5	5	5	5	5	5	5	5	5	5	5	5
Electrical Endurance	3.11	4.9.7									6	6	6	6	6	6	6	6	6	6	6	6		
Resistive DC	3.11	4.9.7.2																					5	5
Inductive DC	3.11	4.9.7.3																					6	6
Motor Load DC	3.11	4.9.7.4																						
Resistive AC	3.11	4.9.7.2																						
Inductive AC	3.11	4.9.7.3																						
Motor Load AC	3.11	4.9.7.4																						
Mechanical Endurance	3.10	4.9.6									7		7		7		7		7		7		6	6
Sealing	9.12	4.9.8																						

4.6 Inspection requirements for switches not covered by specification sheets:

Inspection requirements for switches not covered by specification sheets will be performed by the supplier, as specified in 4.7.1 after award of contract and prior to production, at a location designated by the Government. When specified, the samples and test routine shall be as specified in 4.5.1.1 and 4.5.1.2. Group B inspection is not applicable for switches not covered by specification sheets. Approval of switches not covered by specification sheets may be extended to a contract, other than the one under which it is granted.

4.7 Quality-conformance inspection:

4.7.1 Inspection of product for delivery: Inspection of product for delivery shall consist of Group A inspection.

4.7.1.1 Group A inspection: Group A inspection shall consist of the performance of tests specified in Table III in the order shown. Examination of product shall be limited to the inspection of marking and workmanship (see 4.9.1).

TABLE III
GROUP A INSPECTION

Examination or Test	Method Paragraph	AQL (percent defective)	
		Major	Minor
Seal	4.9.8	1/	
Examination of product	4.9.1	1.0	4.0
Operating characteristics	4.9.2	1.0	2/
Dielectric withstanding voltage	4.9.5	1.0	2/

1/ 100% inspection, no defects allowed.
2/ All defects in these categories are considered major defects.

4.7.1.2 Sampling plan: Statistical sampling shall be in accordance with MIL-STD-105. The Acceptable Quality Level (AQL) shall be as defined in MIL-STD-105.

4.7.1.3 Inspection lot: An inspection lot shall be as specified in MIL-STD-105 with the following modifications:

(a) All switches that appear on the same specification sheet and that are offered for delivery at one time shall be considered a lot for purposes of sampling and inspection.

4.7.2 Group B inspection: Group B inspection shall consist of the tests specified in Table IV in the order shown.

TABLE IV
GROUP B INSPECTION

Examination of Test	Requirement Paragraph	Method Paragraph	1	2	3	4	5	6	7	8	9	10
Vibration	3.13	4.9.9	1	1								
Shock	3.14	4.9.10	2	2								
Mechanical endurance	3.10	4.9.6			1	1	1	1				
Overload	3.11	4.9.7.1							1	1	1	1
Electrical endurance	3.11	4.9.7										
Inductive DC	3.11	4.9.7.3							2	2	2	2
Sealing	3.12	4.9.8			3	3	3	3	3	3	3	3

4.7.2.1 Sampling plan: Group B inspection shall be performed on sample units selected from lots which have passed Group A inspection, unless the Government considers it more practical to select a sample from current production. The sample units shall be selected from those items covered by a single specification sheet. All samples shall be selected without regard to their quality. A manufacturer's normal quality control tests, production tests, environmental tests, and so forth, may be used to fulfill all or part of Group B inspection. All Group B inspection shall be completed as specified during each 36 month period following the initial qualification of the product.

4.7.2.2 Disposition of sample units: Sample units subjected to Group B inspection shall not be delivered on the contract or order.

4.7.2.3 Noncompliance: If a sample fails to pass Group B inspection, the manufacturer shall take corrective action on the process and on all units of product which can be corrected and which were manufactured under essentially the same conditions, and with the same materials, processes, etc., and are considered subject to the same test failure. Quality conformance inspection shall be discontinued until corrective action has been taken. After the corrective action, sample units shall be subjected to the necessary Group B inspection (all inspection, or the failed inspections, at the option of the Government). Group A inspection may be reinstituted; however, final acceptance shall be withheld until the Group B inspection has shown that the corrective action was successful.

4.7.2.4 Retention of qualification: To retain qualification, the manufacturer shall forward a summary of Group B tests performed during each 36 month period to the qualifying activity. Failure to submit the summary will result in loss of qualification approval for that product. When production for a particular type of switch has been suspended for 36 months or more, Group B tests shall be performed on the first lot produced when production of the item is resumed.

4.8 Inspection of preparation for delivery:

Packages shall be inspected for conformance with Section 5 of this specification.

4.9 Methods of examination and test:

Switch holding coils will not be energized unless otherwise specified.

4.9.1 Examination of product: Switches shall be examined to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements. (See 3.1, 3.4, 3.5, 3.20, and 3.21.)

4.9.2 Operating characteristics (see 3.6): Switches shall be examined to determine that the following characteristics are within specified limits.

4.9.2.1 Toggle lever angular travel: Switches shall be mounted in a suitable fixture and toggle lever angular travel shall be measured.

4.9.2.2 Drop-out point: Switch coils shall be energized with maximum rated voltage, the toggle lever shall be transferred to the "electrically held" position. Coil voltage shall then be reduced at an approximate rate of one-half volt per second until the drop-out point is reached.

4.9.2.3 Hold-in point: Switch coil voltage shall be increased with the lever manually held in the momentary position until the hold-in point is reached.

4.9.2.4 Override force: The force required to override the holding coil shall be determined with the coil energized at maximum operating voltage. The force shall be applied at the tip of the actuating lever, perpendicular to the lever axis, and parallel to the line of travel.

4.9.2.5 Coil resistance: The resistance of the coil shall be measured by any suitable means.

4.9.3 Strength of terminals (see 3.7):

4.9.3.1 Solder terminals: Solder terminals shall be subjected to a 5-pound pull for 1 minute in the following directions:

(a) With the long dimension of the switch case vertical and mounting means horizontal, the specified pull shall be applied directly downward.

(b) With the long dimension of the switch case horizontal and mounting means vertical, the specified pull shall be applied directly downward.

4.9.3.1 (Continued):

(c) With the long dimension of the switch case tipped 45° from horizontal, the specified pull shall be directly downward.

Any one terminal, however, shall be tested in one direction only.

4.9.3.2 Screw terminals: Screw terminals shall be subjected for 1 minute to:

(a) A 25-pound pull directly away from the switch body in each of the following directions:

(1) Parallel to the long axis of the terminal screw.

(2) Perpendicular to the long axis of the terminal screw.

Any one terminal, however, shall be tested in one direction only.

(b) A torque of 6 pound-inches applied clockwise to the terminal screw in a plane parallel to the face of the terminal.

4.9.3.3 Wire-lead terminals: Wire-lead terminals shall be subjected to a 15-pound pull for 1 minute in any direction (including the direction most likely to cause failure).

4.9.4 Strength of actuating lever pivot and lever stop (see 3.6): The switch shall operate a pilot lamp circuit for 10 cycles of operation after the following tests:

(a) A 25-pound load shall be applied to the tip of the actuating lever for 1 minute under each of the following conditions:

(1) Perpendicular to the lever axis and parallel to the line of lever travel at each end position of the lever. For lever-lock types, the test shall be conducted at each fixed position of the lever.

(2) Perpendicular to the lever axis and perpendicular to the line of travel at each lever position.

(3) Coaxial with the lever axis away from the lever pivot, throughout the entire range of lever travel.

(b) A 15-pound load shall be applied to the tip of the actuating lever, coaxial with the lever axis and toward the lever pivot, throughout the entire range of lever travel. For lever-lock types, this test is only applicable to those changes in lever position which may be accomplished without lifting the lever from its detent position.

4.9.5 Dielectric withstanding voltage (see 3.9): Switches shall be tested in accordance with Method 301 of MIL-STD-202. The following details shall apply:

(a) Test Voltage - 1000 volts rms, 60 cycles.

(b) Duration of Applications - 1 minute for qualification and Group B tests; 5 seconds for other tests.

(c) Points of Application -

(1) Between all terminals and the toggle lever.

(2) Between all adjacent contacts of adjacent poles.

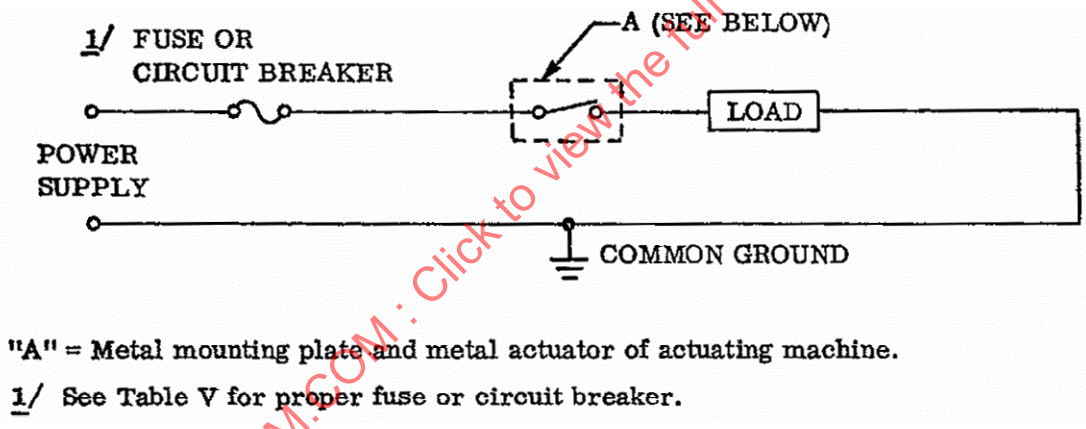
(3) Between all unconnected terminals of the same pole.

4.9.6 Mechanical endurance (see 3.10): The switches shall be subjected to 40,000 cycles of operation, 20,000 at -65 ±2° C, and 20,000 cycles at 71 ±2° C, at a rate of 50 to 60 cycles per minute. A cycle shall consist of movement of the toggle lever from one extreme position to the other extreme position and return to the original position. During testing of lever-lock switches, the pull-to-unlock mechanism may be by-passed to facilitate mechanical operation. In addition, pull-to-unlock switches shall be subjected to 5,000 cycles of pulling the toggle lever to the fully extended position and allowing it to return to the fully retracted position by internal spring action. Following the test the switch shall be examined and there shall be no mechanical breakage or malfunction as evidenced by its ability to control a pilot lamp circuit for 10 cycles of operation.

4.9.7 Electrical overload and endurance (see 3.11): Test switches shall be mounted by their normal mounting means against a metal plate. No insulator shall be interposed between the switch case and the metal plate. This metal plate, one side of power supply, one side of the test load, and the metal actuator of the actuating machine shall all be connected to a common ground. See Figure 1. In the case of a direct current circuit, the negative side of the power supply shall be grounded. No insulator shall be interposed between the grounded metal actuator and the switch actuating member. The test switch shall be connected between the power supply and the test load using a 1 to 3 foot length of wire of the size specified in Table V for connection to the switch. One throw of each pole of the test switch shall be connected to an independent test circuit meeting the specified conditions. Multipole switches are to be tested with all poles of the throw under test loaded. For double-throw switches, one half of the switches shall be tested with the load circuit connected to one throw and the remaining half of the switches shall be tested with the load circuit connected to the other throw. The switch shall be actuated at a frequency of 10 to 12 cycles per minute by a power driven metal actuator. During the overload test the closed time of the test switch shall be 0.5 second minimum duration during each cycle of operation. Unless otherwise specified the

4.9.7 (Continued):

endurance test duty cycle shall be approximately 50-percent on, 50-percent off. Overload, resistive endurance, inductive endurance, and motor load endurance tests shall be performed at each voltage and electrical frequency specified on the detail specification. On each switch the overload and endurance test shall be performed on the same pair(s) of contacts, using the same voltage and electrical frequency for both tests. The endurance tests shall be performed in each case for 20,000 make and break cycles. For the first 10,000 cycles, the toggle lever shall be mechanically actuated, electrically held, and electrically released by a suitable auxiliary device. For the remaining 10,000 cycles, the toggle lever shall be mechanically actuated, electrically held, and mechanically overridden to effect release. (Holding coil to be energized at maximum rated voltage.) During testing of lever-lock switches, the pull-to-unlock mechanism may be by-passed to facilitate mechanical actuation. The test voltage magnitude and electrical frequency shall be maintained within the tolerance specified when the test voltage is measured at the switch terminals. Monitoring circuits shall be provided to detect failure of any pair of contacts to open or close their circuit in proper sequence. Monitoring circuits shall not shunt switch contacts or inductive components in the test circuit.



"A" = Metal mounting plate and metal actuator of actuating machine.

1/ See Table V for proper fuse or circuit breaker.

Figure 1. Test set-up for electrical endurance test

TABLE V
ENDURANCE TEST WIRE SIZE AND CIRCUIT
BREAKER OR FUSE DESIGNATIONS

Endurance Test Current Amperes 1/	MIL-W-5088 Wire Sizes	Circuit Breaker or Fuse
3.0 or less	AN-20	MIL-F-15160/02, characteristic B, rating as applicable
5.0	AN-20	MS25017-5
7.5	AN-18	MS25017-7
10.0	AN-18	MS25017-10
15.0	AN-18	MS25017-15
18.0	AN-16	MS25017-20
20.0	AN-16	MS25017-20
25.0	AN-14	MS25017-25
30.0	AN-14	MS25017-30
40.0	AN-12	MS25017-35
60.0	AN-10	MIL-F-15160/10
80.0	AN-8	MIL-F-15160/6
175.0	AN-2	MIL-F-15160/9

1/ Where the wire size, circuit breaker, or fuse size do not coincide with the required test current the next larger wire size, circuit breaker, or fuse shall be used.

4.9.7.1 Overload circuit: The switch shall make and break 150 percent of rated resistive load at the applicable voltage and electrical frequency for 50 cycles of operation at room conditions.

4.9.7.2 Resistive load (DC and AC): One half of the switches for test shall make and break the rated resistive load for 20,000 operating cycles. The other half of the switches for test shall make and break the rated resistive load for 20,000 operating cycles while at a pressure equal to 65,000 feet altitude.

4.9.7.3 Inductive load (DC and AC): One half of the switches shall make and break the rated inductive load for 20,000 operating cycles. The other half shall make and break the rated inductive load for 20,000 operating cycles while at a pressure equal to 65,000 feet. The DC inductive circuit shall be in accordance with MIL-I-81023. The AC inductive circuit shall have a power factor of 70 ±5 percent. The duty cycle for this test shall be 25 to 30 percent on and 70 to 75 percent off.

4.9.7.4 Motor load (DC and AC): Switches shall be subjected to 20,000 operations of making six times the rated motor load current and breaking the rated motor load current. The duration of the inrush current shall not be less than .05 seconds. The test load shall consist of only resistive components.

4.9.8 Seal (see 3.12): Switches shall be tested in accordance with Method 112 of MIL-STD-202. The following details shall apply:

(a) Test condition letter - c.

(b) Procedure - I, Leakage rate not to exceed 1×10^{-6} atm cc/sec.

(c) Reduced pressure of chamber 1×10^{-4} torr approx.

(d) Detection exposure time - 1 second minimum.

(e) Gross leak check - not applicable.

4.9.9 Vibration tests (see 3.13).

4.9.9.1 Vibration: Switches and switch assemblies shall be tested in accordance with Method 204 of MIL-STD-202, as follows:

(a) Test condition letter - A. Total test duration shall be divided approximately equally between all toggle lever positions. When switches are tested in the "electrically held" position, the coil shall be energized with maximum rated voltage.

(b) Tests and measurements prior to vibration - Not applicable.

(c) Mounting - Switches shall be rigidly mounted by their normal mounting means on a rigid metal panel. The mounting fixture shall be free from resonances over the test frequency range.

(d) Tests and measurements during vibration - All open and closed circuits must be continuously monitored by a circuit capable of detecting contact opening or closing in excess of 10 microseconds duration.

(e) Tests and measurements after vibration - Shall be measured for operating characteristics (see 4.9.2).

(f) Examination after test - Switches and switch assemblies shall be examined for change in actuated position and evidence of broken, deformed, displaced, or loose parts.