

INCH-POUND

MIL-DTL-83731D

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SUPERSEDING

MIL-DTL-83731C

30 March 2004

DETAIL SPECIFICATION
SWITCHES, TOGGLE, UNSEALED AND SEALED,
GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the military requirements for unsealed and toggle sealed toggle switches.

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL

STANDARDS

[FED-STD-H28](#) - Screw Thread Standards for Federal Services.

DEPARTMENT OF DEFENSE

SPECIFICATIONS

[MIL-DTL-5624](#) - Turbine Fuel Aviation, Grade JP-4 or JP-5.
[MIL-PRF-7808](#) - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base.
[MIL-PRF-15160/2](#) - Fuses, Instrument, Power and Telephone (Non-indicating) Style F02.
[MIL-PRF-87252](#) - Coolant Fluid, Hydrolytically Stable, Dielectric.

STANDARDS

[MIL-STD-202](#) - Electronic and Electrical Component Parts
[MIL-STD-1285](#) - Marking of Electrical and Electronic Parts.

(Copies of these documents are available online at <https://assist.daps.dla.mil/quicksearch> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

Comments, suggestions or questions on this document should be addressed to Defense Supply Center Columbus, ATTN: VAT, Post Office Box 3990, Columbus, OH 43218-3990, or emailed to switch@dlamail. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.daps.dla.mil/>.

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2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- [ANSI/J-STD-002](#) - Solderability Tests for Component Leads, Termination's, Lugs, Terminals and Wires.
- [ANSI/NCSL Z540.3](#) - Calibration of Measuring and Test Equipment, Requirements for

(Application for copies can be found online at <http://www.ansi.org/> or American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036-8002, telephone 212-642-4900, fax 212-302-1286)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- [ASTM-E1119](#) - Glycol, Industrial Grade Ethylene, Standard Specification for.

(Copies of these documents are available online at www.astm.org or from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, 19428-2959.)

INTERNATIONAL ORGANIZATION FOR STANDARDS (ISO)

- [ISO 10012-1](#) - Quality Assurance Requirements for Measuring Equipment - Part 1; Meteorological Confirmation System for Measuring Equipment.

(Application for copies can be found online at <http://www.ansi.org> or should be addressed to the American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036-8002, telephone 212-642-4900, fax 212-302-1286).

SOCIETY OF AUTOMOTIVE ENGINEERS

- [SAE-AS7928](#) - Terminals, Lug: Splices, Conductor: Crimp Style Copper, General Specification for.
- [SAE-AS50861](#) - Wire, Electrical, Hook-up and Interconnecting, Polyvinyl Chloride Insulation, Nylon Jacket, Tin-Coated Copper Conductor, 600 Volt, 105°C.

(Copies of these documents are available online at www.sae.org or from Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania, 15096-0001)

UNDERWRITERS' LABORATORIES, INC. (UL)

- [UL94](#) - Test for Flammability of Plastic Materials for Parts in Devices and Appliances.

(Copies of these documents are available online at www.ul.com or from the Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062-2002.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications or specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless specific exemption has been obtained.

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3. REQUIREMENTS

3.1 MS military standards or military specification sheets. Individual switch requirements shall be as specified herein and in accordance with the applicable MS military standard or military specification sheet. In the event of any conflict between the requirements of this specification and the MS military standard or military specification sheet, the latter shall govern.

3.2 Switch categories. Switches furnished under this specification shall be category I, or II, as defined in [3.2.1](#), or [3.2.2](#), respectively.

3.2.1 Category I switches. Switches completely defined by an MS military standard or military specification sheet. Category I switches shall be ordered in accordance with [6.2.1](#).

3.2.2 Category II switches. Switches the same as category I switches except for minor differences such as termination configuration, operating characteristics, and minor actuator variations, which do not change the basic design or construction of the qualified item (see [4.5](#)). Category II switches shall be acquired from a source listed on the applicable qualified products list for the particular similar product in category I. Category II switches shall be ordered in accordance with [6.2.2](#). These switches are nonstandard.

3.3 Qualification. Category I switches furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified products list before contract award. (see [4.4](#) and [6.3](#))

3.4 Materials. Materials shall be used which will enable the switches to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of acceptance of the finished product.

3.4.1 Metals. All 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 material. Ferrous material shall not be used for current carrying parts.

3.4.1.2 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are defined as metal specimens that are in contact or otherwise electrically connected to each other in a conductive solution to generate an electrical current. For additional information and guidance on dissimilar metals (see [6.8](#)).

3.2.1.2 Pure tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. Tin content of switch components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see [6.13](#))

3.4.2 Insulation. Materials for insulation shall be used which will enable the switch to meet the performance requirements of this specification. Plastic materials shall be fungus inert and shall meet flammability requirements of V-0 in accordance with [UL94](#). For additional information and guidance on ceramic and thermoplastic material see [6.9](#).

3.4.3 Silicone rubber. Silicone rubber parts, when used, shall be selected to enable the switch to meet the performance requirements of this specification. For additional information and guidance on silicone rubber material see [6.10](#).

3.4.4 Potting compounds. Potting compounds, when used, shall be selected to enable the switch to meet the performance requirements of this specification. For additional information and guidance on potting compounds, see [6.11](#).

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3.5 Interface and dimensions. Switches shall be so constructed as to insure proper operation when mounted in any position. The switches shall meet the interface and dimensions specified (see 3.1).

3.5.1 Toggle lever. The toggle lever shall have a lusterless finish and shall be insulated from all current carrying parts.

3.5.2 Terminals. Terminals shall be as specified (see 3.1). Only the number of terminals required to accomplish the circuit characteristics shall be furnished.

3.5.2.1 Solderable terminals. Solderable terminals shall be treated to facilitate soldering. Silver plating shall not be used as an external coating. Terminals shall be designed so that wires can be mechanically secured prior to soldering. Terminals may be tapped or drilled after coating.

3.5.2.2 Screw terminals. Screw terminals shall be provided with the hardware specified (see 3.1 and the appendix).

3.5.2.3 Integrated wire termination. Switches with integrated wire termination shall be designed to accept terminal pins as specified (see 3.1).

3.5.3 Mounting bushing. The mounting bushing shall be as specified (see 3.1). For toggle sealed switches, the bushing shall be provided with a seal between the toggle lever and the switching mechanism. The body of the elastomer seal shall not protrude from the top of the bushing with the exception of the tapered joint or meniscus where the seal joins the toggle lever, which may be permitted to exceed the height of the mounting bushing slightly.

3.5.3.1 Anti-rotational means. All switches shall be designed to have an anti-rotational mounting means which shall be as specified (see 3.1).

3.5.4 Hardware. Each switch shall be provided with the mounting and terminal hardware as specified (see 3.1 and the appendix). Crimp pin contacts, for switches with integrated wire termination, are not supplied with the switch.

3.5.5 Screw threads. Screw threads on external threaded parts shall be in accordance with [FED-STD-H28](#). All threaded parts shall engage by at least two full threads. Threading of nonmetallic parts is not permitted.

3.5.6 Weight. Weight shall be as specified (see 3.1).

3.6 Performance.

3.6.1 Solderability (applicable to solderable terminals). When tested as specified in 4.7.2, solder shall be of such a quality as to enable the switch to meet the performance requirements of this specification. For guidance on solder, see 6.12. Solder shall not be used to obtain mechanical strength.

3.6.2 Resistance to soldering heat (applicable to solderable terminals). When switches are tested as specified in 4.7.3, the switches shall remain operable. When opened, there shall be no internal deformation or damage.

3.6.3 Switching characteristics. When tested as specified in 4.7.4, switches shall operate as specified (See 3.1).

3.6.4 Strength of terminals. When switches are tested as specified in 4.7.5, there shall be no breakage, loosening or rotating of terminals, and no damage to the switch.

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3.6.5 Strength of toggle lever, pivot and lever stop. When switches are tested as specified in 4.7.6, there shall be no malfunction, damage, breakage or short circuit; switches shall operate mechanically and electrically.

3.6.6 Strength of mounting bushing. When switches are tested as specified in 4.7.7, there shall be no loosening of the mounting bushing or other mechanical damage.

3.6.7 Contact voltage drop. When switches are tested as specified in 4.7.8, the contact voltage drop shall not exceed 2.5 millivolts initially and 5 millivolts after mechanical endurance.

3.6.8 Dielectric withstanding voltage. When switches are tested as specified in 4.7.9, the switches shall withstand the application of the specified voltages without arcing, flashover, breakdown of insulation, or damage; there shall be no momentary flashover or leakage current in excess of 500 microamperes.

3.6.9 Mechanical endurance. When switches are tested as specified in 4.7.10, there shall be no deterioration of the toggle seal, mechanical breakage or malfunction. Circuitry and degree of toggle lever movement shall be as specified (see 3.1).

3.6.10 Electrical overload, electrical endurance, intermediate current and temperature rise. When switches are tested as specified in 4.7.11, 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 malfunction or damage during or after the test and any blown fuse or tripped circuit breaker shall constitute failure. When switches are tested as specified in 4.7.11.6, the temperature rise of the switch terminals shall not exceed 50°C. At the conclusion of the test, switches shall be electrically and mechanically operable while controlling the test load, at the test environment and at room conditions. Electrical tolerances are as follows:

Voltage: ± 5 percent for 28 V, 125 V, and 250 V; DC
 ± 7 percent for 125 V and 250 V; AC
 Frequency: ± 5 percent
 Current: ± 5 percent on all voltages

3.6.11 Short circuit. When tested as specified in 4.7.12, switch contacts under test shall open after each closure and there shall be no mechanical failure or electrical damage.

3.6.12 Vibration. When switches are tested as specified in 4.7.13, there shall be no separation of closed contacts or closure of open contacts in excess of 10 microseconds. There shall be no damage.

3.6.13 Shock. When switches are tested as specified in 4.7.14, there shall be no separation of closed contacts or closure of open contacts in excess of 10 microseconds for Method I (see 4.7.14.1), and 20 milliseconds for Method II (see 4.7.14.2). There shall be no damage.

3.6.14 Salt spray (corrosion). When switches are tested as specified in 4.7.15, there shall be no warping, cracking, excessive corrosion, or other damage and the specified cycling shall be completed without failure. The mounting hardware shall be readily removable at the conclusion of the test.

3.6.15 Thermal shock. When switches are tested as specified in 4.7.16, there shall be no mechanical or electrical damage, or loosening of rivets or other fastening devices.

3.6.16 Moisture resistance. When switches are tested as specified in 4.7.17, there shall be no electrical failures, or breaking, spalling, cracking or loosening of terminals.

3.6.17 Sand and dust. When switches are tested as specified in 4.7.18, switches shall, at the conclusion of the test, be electrically and mechanically operable as evidenced by ability to control a pilot lamp circuit.

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3.6.18 Explosion. When switches are tested as specified in 4.7.19, there shall be no explosion within the test chamber whether or not explosion occurs within the switch.

3.6.19 Toggle seal (applicable to toggle seal switches only). When switches are tested as specified in 4.7.20, there shall be no leakage of water into the switch due to entry through the toggle seal.

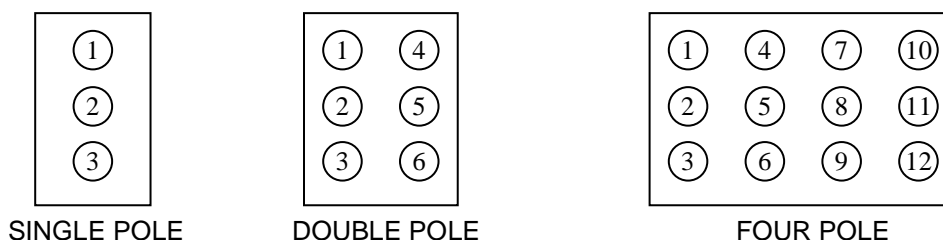
3.6.20 Terminal sealing, fluid submersion (applicable to switches with integrated wire terminals). When switches are tested as specified in 4.7.21, the switches shall meet the requirements for dielectric withstanding voltage, there shall be no cracking, loosening of bonds and seams, and the switches shall be operable.

3.7 Marking.

3.7.1 Identification of product. As a minimum, switches shall be marked in accordance with MIL-STD-1285 as follows:

- (a) MS military standard part number or M number (category I only).
- (b) Manufacturer's part number (category II only).
- (c) Manufacturer's name, trademark or source code.
- (d) Date code
- (e) Switch positions (on-off, etc.).

3.7.2 Terminal identification. When specified (see 3.1), terminals shall be marked in accordance with figure 1. Terminal positions not used need not be identified. Terminal marking on the side of the case is permissible.



NOTES:

1. All views are rear of switch with keyway or flat down as applicable (see 3.1).
2. Terminals 2, 2 and 5, and 5 and 8 are considered inboard terminals for single, two and four pole, respectively. All others are outboard terminals.

FIGURE 1. Terminal Identification.

3.8 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.9 Workmanship. Switches shall be processed in such a manner to be free from cracked or displaced parts, sharp edges, burrs and other defects which will affect life, serviceability or appearance.

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4. VERIFICATION

4.1 Classification of inspection. The inspections specified herein are classified as follows:

- (a) Qualification Inspection (see [4.4](#)).
- (b) Inspection requirement for Category II (see [4.5](#)).
- (c) Conformance Inspection (see [4.6](#)).

4.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the supplier. The establishment and maintenance of a calibration system to control accuracy of the measuring and test equipment shall be in accordance with [ANSI/NCSL Z540.3, ISO-10012-1](#) or equivalent system as approved by the qualifying activity.

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the General Requirements of [MIL-STD-202](#).

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see [6.3](#)), on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample size. The number of switches to be subjected to qualification inspection shall be as specified in [table I](#).

4.4.2 Inspection Routine.

4.4.2.1 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.

4.4.2.2 Group submission. A sample consisting of the required number of specimens of each basic switch listed in [table II](#) shall be submitted and shall be subjected to the qualification test sequence in [table I](#) in the order shown. In addition, two specimens of each of the other switches listed in [table II](#) shall be submitted and shall be subjected to visual and mechanical examination and switching characteristics test of [table I](#).

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

4.4.4 Verification of qualification. Every 12 months, the manufacturer shall provide verification of qualification to the qualifying activity. Continuation is based on meeting the following requirements:

- a. Design of the switch has not been modified (every 12 months).
- b. Verification of group A lot acceptance (every 12 months) (see [4.6.2](#))
- c. Periodic group B inspection (every 36 months) (see [4.6.3](#)).

4.5 Inspection requirements for category II switches (see [3.2.2](#)). Inspection requirements for category II shall be performed by the contractor after award of contract and prior production. Additional tests to verify suitability of the variations from the category I switches shall be performed as specified (see [6.2.2](#)).

4.6 Conformance Inspection. Inspection of product for delivery shall consist of group A inspection.

4.6.1 Inspection lot. An inspection lot shall consist of all category I and category II switches of the same specification sheet, of the same enclosure requirement, temperature characteristic and interface and dimensions, produced under essentially the same conditions and offered for inspection at one time. Similar switches conforming to these requirements but having different circuitry may be combined to form a lot.

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4.6.2 Group A inspection. Group A inspection shall consist of the inspections specified in [table III](#). The inspection may be performed in any order.

4.6.2.1 Sampling plan. Statistical sampling shall be in accordance with [table III](#) and [IV](#). A randomly selected group(s) of samples is required for subgroup 1 and subgroup 2. For acceptance of the lot, there shall be zero occurrences of defects.

4.6.2.1.1 Subgroup 1. A sample of parts shall be randomly selected in accordance with [table IV](#), subgroup 1 sampling plan.

4.6.2.1.2 Subgroup 2. A sample of parts shall be randomly selected in accordance with [table IV](#), subgroup 2 sampling plan.

4.6.2.2 Rejected lots. If an inspection lot is rejected, the lot shall be 100 percent inspected for the defects noted. The contractor may correct the defects or remove all of the defective units from the lot. The lot shall then be sampled again in accordance with [tables III and IV](#). For acceptance, there shall be zero occurrences of defects. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification. Such lots shall be separate from new lots and shall be clearly identified as reinspected lots.

4.6.3 Periodic inspection. Periodic inspection shall consist of group B. Except where the results of these inspections show noncompliance with the applicable requirements (see [4.6.3.1.4](#)), delivery of products which have passed group A shall not be delayed pending the results of these periodic inspections.

4.6.3.1 Group B inspection. Group B inspection shall consist of the inspections specified in [table V](#), in the order shown. When a manufacturer has switches qualified under various MS military standards or military specification sheets, the qualifying activity may authorize group B tests that do not require redundant testing on similar features. Group B inspection shall be performed on sample units selected from inspection lots which have passed group A inspection. 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; however, all of group B inspection shall be completed as specified in [table V](#). Data used may be accumulated within the previous 24 months.

4.6.3.1.1 Sampling plan. Group B inspections shall be completed in accordance with [table V](#) within 36 months after the date of notification of qualification and within each subsequent 36 month period. The sample units shall be selected either from stock or a current production lot unless the Government considers it more practical to select a sample from current production. Switches selected from stock shall have been produced after the date of notification of qualification or subsequent to the date code of the previous group B inspection sample units. Group B inspection shall be performed on sample units produced using the same manufacturing facilities and processes as units normally offered for acquisition. When there has been no production of a particular type of switch for 36 months or more, sample units shall be selected from the next production lot presented for acceptance and for each subsequent 36 month period. When the specification sheet covers more than one part number, the part number subjected to group B inspection shall be the same part number specified for qualification; however, the group B inspection sample unit(s) need not be submitted to inspections not specified for qualification.

4.6.3.1.2 Failures. If one or more sample units fails to pass group B inspection, the sample shall be considered to have failed.

4.6.3.1.3 Disposition of sample units. Sample units subjected to group B inspection shall not be delivered on the contract or order but shall be kept on hand until the next inspection period for submittal to the qualifying activity if so requested.

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4.6.3.1.4 Noncompliance. If a sample fails to pass group B inspection, the contractor shall notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes and so forth, and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the government has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspections or the inspection which the original sample failed, at the option of the government). Group A inspection may be reinstated; however, final acceptance shall be withheld until the group B reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and the corrective action taken shall be furnished to the contracting officer and the qualifying activity.

4.7 Methods of inspection and test.

4.7.1 Visual and mechanical examination. Switches shall be examined to verify that the materials, physical dimensions, marking and workmanship are in accordance with the applicable requirements. Only two of the sample units shall be inspected for compliance with physical dimensions. The inspection shall be performed before any other test is performed on the sample units (see [3.1](#), [3.4](#) and [3.5](#)).

4.7.2 Solderability (applicable to solderable terminals, see [3.6.1](#)). Switches shall be tested in accordance with [method 208 of MIL-STD-202](#). The following details and exception shall apply:

- (a) Number of terminals to be tested - A minimum of one terminal of a closed contact per switch.
- (b) Depth of immersion in molten solder - Terminals shall be immersed to the maximum extent possible.
- (c) Examination of terminals - Method for evaluation of lugs and tabs shall apply.
- (d) Dipping machine - Need not be used.

4.7.3 Resistance to soldering heat (applicable to solderable terminals, see [3.6.2](#)). Switches shall be tested in accordance with method [210 of MIL-STD-202](#). The following details shall apply:

- (a) Number of terminals to be tested - A minimum of one terminal of a closed contact per switch.
- (b) Depth of immersion in molten solder - Terminals shall be immersed to the maximum extent possible.
- (c) Test condition letter - B
- (d) Cooling time prior to final examinations and measurements - Not applicable.
- (e) Examinations and measurements:
 - (1) Before - None.
 - (2) After - Switches shall be operable and there shall be no evidence of internal deformation or other damage when opened at the conclusion of the test sequence.

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TABLE I. Qualification test sequence.

Inspection	Requirement paragraph	Test paragraph	Specimen											2 Switches for each voltage, current and frequency			
			1	2	3	4	5	6	7	8	9	10	11				
Visual, mechanical examination	3.1	4.7.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Solderability	3.6.1	4.7.2											2				
Resistance to soldering heat	3.6.2	4.7.3						2									
Switching Characteristics	3.6.3	4.7.4	2	2	2	2	2	3	2	2				2	2	2	2
Strength of Terminals 1/	3.6.4	4.7.5												3			
Strength of toggle lever, pivot and lever stop 1/	3.6.5	4.7.6												4			
Strength of mounting bushing 1/	3.6.6	4.7.7												5			
Contact voltage drop	3.6.7	4.7.8							3	3				6	3	3	3
Dielectric withstand. voltage	3.6.8	4.7.9												7	4	4	
Mechanical endurance	y	4.7.10							4	4							
Electrical overload, electrical endurance, intermediate current and temperature rise	3.6.10	4.7.11												8	5	5	4
Overload circuit		4.7.11.1												9			
Resistive load		4.7.11.2													6		
Inductive load		4.7.11.3														6	
Lamp load		4.7.11.4															5
Intermediate current		4.7.11.5															
Temperature rise		4.7.11.6												10			
Contact voltage drop	3.6.7	4.7.8							5	5							
Short circuit	3.6.11	4.7.12			3	3											
Vibration	3.6.12	4.7.13	3	3													
Shock	3.6.13	4.7.14	4	4													
Salt spray (corrosion)	3.6.14	4.7.15			4	4											
Thermal shock	3.6.15	4.7.16					3	4									
Moisture resistance	3.6.16	4.7.17	5	5			4	5									
Dielectric withstand. voltage	3.6.8	4.7.9	6	6			5	6						11	7	7	
Sand and dust	3.6.17	4.7.18									2	2					
Explosion	3.6.18	4.7.19									3	3					
Visual, mechanical examination	3.1	4.7.1	7	7	5	5	6	7	6	6	4	4		12	8	8	6
Switching characteristics	3.6.3	4.7.4	8	8	6	6	7	8	7	7	5	5		13	9	9	7
Toggle seal 2/	3.6.19	4.7.20	9	9	7	7	8	9	8	8	6	6		14	10	10	8
Terminal sealing (when applicable) 2/	3.6.20	4.7.21	10	10													

1/ Test shall be performed on two specimens only.

2/ Only the odd-numbered specimens shall be opened by the manufacturer.

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TABLE II. Group submission for qualification inspection for complete listing.

Basic switch (all applicable tests)	Additional switches (Visual and mechanical examination and switching characteristics)	Basic switch (all applicable tests)	Additional switches (Visual and mechanical examination and switching characteristics)
MS25068-21 MS25068-27	MS25068-24 MS25068-28	MS27746-21 MS27746-27	----
MS25098-23 MS25098-29	----	MS27747-21 MS27747-27	----
MS25100-23 MS25100-29	----	MS27753-1 MS27753-6	----
MS25125-1 MS25125-7	MS25125-4 MS25125-8	MS27754-1 MS27754-6	----
MS25126-1 MS25126-7	MS25126-4 MS25126-8	MS27790-1 MS27790-6	----
MS25127-1 MS25127-7	MS25127-4 MS25127-8	MS35058-21 MS35058-27	MS35058-24 MS35058-28
MS25201-4 MS25201-6	----	MS35059-21 MS35059-27	MS35059-24 MS35059-28
MS27716-21 MS27716-27	----	MS75028-21 MS75028-27	----
MS27717-21 MS27717-27	----	MS75029-21 MS75029-27	----
MS27718-21 MS27718-27	----	MS75075-1	MS75075-4
MS27719-21 MS27719-27	----	M83731/1-21 M83731/1-27	----
MS27720-21 MS27720-27	----	M83731/2-21 M83731/2-27	----
MS27721-21 MS27721-27	----	M83731/3-21 M83731/3-27	----
		M83731/4-21 M83731/4-27	----

TABLE III. Group A inspection

Inspection	Requirement paragraph	Test method paragraph	Sampling plan <u>1/</u>
<u>Subgroup 1</u> Visual and mechanical examination	3.1	4.7.1	See 4.6.2.1.1
Material	3.4	4.7.1	
Design and Construction	3.5	4.7.1	
Marking	3.7	4.7.1	
Workmanship	3.9	4.7.1	
<u>Subgroup 2</u> Switching characteristics	3.6.3	y	See 4.6.2.1.2
Dielectric withstanding voltage	3.6.8	4.7.9	
Contact voltage drop	3.6.7	4.7.8	

1/ At the option of the contractor, documented in-process inspection may be used to satisfy the requirements provided that all of the contractor's in-process control data on these tests are made available to the Government upon request.

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TABLE IV. Zero defect sampling plan.

Lot size	Minimum number of switches to be tested	
	Subgroup 1	Subgroup 2
1 - 8	5	All
9 - 50	5	13
51 - 90	7	13
91 - 150	11	13
151 - 280	13	20
281 - 500	16	29
501 - 1,200	19	34
1,201 - 3,200	23	42
3,201 - 10,000	29	50
10,001 - 35,000	35	60

TABLE V. Group B inspection.

Inspection	Requirement paragraph	Test paragraph	Specimen											
			1	2	3	4	5	6	7	8	9	10	11	12
Solderability	3.6.1	4.7.2									x	x		
Strength of mounting bushing	3.6.6	4.7.7 4/			x	x								
Mechanical endurance	3.6.9	4.7.10	x	x										
Electrical overload, electrical endurance, intermediate current and temperature rise	3.6.10	4.7.11												
Overload circuit		4.7.11.1					x	x	x	x				
Resistive load (ac) 1/		4.7.11.2					x	x						
Inductive load (altitude) 2/		4.7.11.3							x	x				
Temperature rise		4.7.11.6					x	x						
Contact voltage drop	3.6.7	4.7.8	x	x										
Shock	3.6.13	4.7.14			x	x								
Salt spray (corrosion)	3.6.14	4.7.15											x	x
Moisture resistance	3.6.16	4.7.17			x	x								
Dielectric withstanding voltage	3.6.8	4.7.9					x	x	x	x				
Visual and mechanical examination	3.1	4.7.1	x	x	x	x	x	x	x	x	x	x	x	x
Switching Characteristics	3.6.3	4.7.4	x	x	x	x	x	x	x	x	x	x		
Toggle seal 3/	3.6.19	4.7.20	x	x	x	x	x	x	x	x	x	x		

1/ Test at 115 volts, 60 Hz, 71°C.

2/ Test at 28 V dc, 65,000 feet.

3/ Only the odd-numbered specimens shall be opened by the manufacturer.

4/ Torque shall be applied to the switch body only.

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4.7.4 Switching characteristics (see [3.6.3](#)). Switching action (e.g., on-off, on-off-on, and so forth) and circuitry shall be inspected for compliance with the applicable requirements (see [3.1](#)). Circuit continuity shall be inspected using a maximum load of 6 volts dc, 100 milliamperes.

4.7.5 Strength of terminals (see [3.6.4](#)). Switches shall be mounted by their normal mounting means. Two terminals on each switch shall be tested (see [figure 1](#)). However, a terminal shall be tested only once in one direction.

4.7.5.1 Solderable terminals. Solderable terminals shall be tested in accordance with method [211 of MIL-STD-202](#). The following details and exceptions shall apply:

- (a) Test condition letter - A.
- (b) Applied force - 5 pounds.
- (c) Direction of applied force -
 - (1) With the terminals vertical and pointing downward, the specified pull shall be applied directly downward.
 - (2) With the terminals horizontal, the specified pull shall be applied directly downward.

4.7.5.2 Screw-lug terminals. Screw-lug terminals shall be tested in accordance with method [211 of MIL-STD-202](#). The following details and exceptions shall apply:

- (a) Test condition letter - A.
- (b) Applied force - 25 pounds, except that where 4-40 terminals are used, a 5 pound pull shall be used.
- (c) Direction of applied force -
 - (1) Parallel to the axis of the terminal screw.
 - (2) Perpendicular to the axis of the terminal screw.

4.7.5.3 Integrated wire terminals. Integrated wire terminals shall be subjected to a 15 pound pull, except 5 pound pull for miniature switches, for 5 to 10 seconds in the following directions:

- (a) Two outboard terminals on each switch shall be tested; however, a terminal shall be tested only once in one direction.
- (b) With the long dimensions of the terminal contact vertical and the contact opening facing downward, the specified pull shall be applied directly downward.
- (c) With the long dimension of the terminal contact horizontal, the specified pull shall be applied directly downward.

4.7.5.4 Screw-thread terminals. Screw-thread terminals shall be tested in accordance with [method 211 of MIL-STD-202](#), test condition letter E. The torque shall be applied in a direction which will tighten the screw.

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4.7.6 Strength of toggle lever, pivot and lever stop (see 3.6.5). The switch shall be operated mechanically and electrically at a maximum load of 6 volts dc, 100 milliamperes 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.

4.7.7 Strength of mounting bushing (see 3.6.6). Bushing-mounted switches shall be mounted on a metal panel using normal mounting means and hardware. A torque of 25-pound-inches shall be applied to the mounting nut on switches with 15/32-inch diameter bushings or larger and a torque of 15-pound-inches shall be applied to the mounting nut on smaller size bushings. With the mounting nut tightened using a maximum torque of 5-ounce-inches, a torque of 5-pound-inches shall then be applied to the mounted switch body.

4.7.8 Contact voltage drop (3.6.7). Switches shall be tested in accordance with [method 307 of MIL-STD-202](#). The following details and exceptions shall apply:

- (a) Measurements shall be made between the terminals of the contacts of the same pole forming a switching circuit. Measurements shall be made for each pole of multiple pole switches.
- (b) Test current - 100 milliamperes.
- (c) Open-circuit voltage - 2 to 6 volts dc.
- (d) Number of activation's prior to measurement - Three.
- (e) Number of test activation's - Three.
- (f) Number of measurements per activation - One.

4.7.9 Dielectric withstanding voltage (see 3.6.8). Switches shall be tested in accordance with [method 301 of MIL-STD-202](#). The following details and exceptions shall apply:

- (a) Special conditions - For qualification and group B inspections, switches shall be tested in accordance with [4.7.9.1](#) and [4.7.9.2](#). For group A inspection, switches shall be tested in accordance with [4.7.9.1](#).
- (b) Test voltage - The magnitude of the applied test voltage shall be as specified in [4.7.9.1](#) and [4.7.9.2](#).
- (c) Duration of application of test voltage -
 - (1) Qualification and group B inspections - 1 minute minimum.
 - (2) Group A inspection - 2 to 5 seconds.

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- (d) Points of application - The following points of application shall apply for each toggle lever position:
 - (1) Between current-carrying parts and all uncommon exposed or grounded metal parts.
 - (2) Between current-carrying parts of adjacent poles of multipole switches (not applicable after electrical endurance tests).
 - (3) Between mutually insulated current-carrying parts of the same pole (not applicable after electrical endurance tests).
- (e) Monitoring - The circuit shall be continuously monitored during the application of the test voltage to determine if the leakage current exceeds 500 microamperes.
- (f) Examination after test - Switches shall be examined for evidence of arcing, flashover, breakdown of insulation or damage.

4.7.9.1 At atmospheric pressure. The applied test voltage shall be:

- (a) Qualification and group B inspections - 1,000 Vrms minimum except:
 - (1) Switches rated above 250 volts shall be subjected to a minimum voltage of 1,000 Vrms plus 200 percent of the maximum rated voltage.
 - (2) 750 Vrms minimum after electrical endurance.
- (b) Group A inspection - Test shall be conducted at room ambient conditions and the potential shall be 1,200 Vrms minimum except switches rated above 250 volts shall be subjected to a minimum voltage of 1,200 Vrms plus 240 percent of the maximum rated voltage.

4.7.9.2 At reduced barometric pressure. The following details shall apply:

- (a) [Method 105 of MIL-STD-202](#) at 65,000 feet.
- (b) The applied test voltage shall be 500 Vrms minimum except switches rated above 250 Vrms shall be subjected to a minimum voltage of 500 Vrms plus 200 percent of the maximum rated voltage.

4.7.10 Mechanical endurance (see [3.6.9](#)). Unless otherwise specified (see [3.1](#)), the switches shall be subjected to 40,000 cycles of operation the following details shall apply:

- (a) One half of the cycles shall be at $-65^{\circ} +0^{\circ}/-4^{\circ}\text{C}$, while the other half of the cycles shall be at $+71^{\circ} +4^{\circ}/-0^{\circ}\text{C}$.
- (b) A cycle shall be the movement of the toggle lever from one extreme position to the other extreme position and return to the original position.
- (c) Cycling rate shall be 10 to 18 cycles per minute (cpm). At the manufacturer's option, a faster rate of cycling, up to 60 cpm may be used.
- (d) Lever-lock switch handles shall also be tested for 20,000 actuation's at room ambient conditions by pulling the lever to its fully extended position and then permitting it to return to its fully retracted position without operation of the switches, at a maximum of 60 cpm.
- (e) With the toggle lever in the unlocked position, lever-lock switches shall be tested with the toggle lever moving through all positions.
- (f) Momentary switches shall return from their momentary position(s) solely by the internal mechanism of the switch.

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4.7.11 Electrical endurance, electrical overload, intermediate current and temperature rise (see 3.6.10). The following details shall apply:

- (a) Test switches shall be mounted by their normal mounting means against a metal plate. Insulators shall not be interposed between the switch case and the metal plate or between the metal actuator of the actuating machine and the switch toggle.
- (b) The metal mounting plate, one side of the power supply and the metal actuator of the actuating machine shall all be connected to a common ground through a 3 ampere fuse per [MIL-PRF-15160/2](#), characteristic A, (F02A, 250V, 3A) (see [figure 2](#)). For dc, the negative side of the power supply shall be grounded. The test switch shall be connected to the power source and test load using a 1/2 to 6 feet length of wire as specified in [table VI](#).
- (c) The test voltage magnitude and electrical frequency shall be maintained within the tolerances specified when the test voltage is measured at the switch terminals. Each operation of the switch shall be monitored to determine whether any contact has failed to open or close its individual circuit in proper sequence. Each failure shall be recorded and reported. Monitoring circuits shall not shunt switch contacts or inductive components in the test circuit.
- (d) One throw of each pole of the switch shall be connected to an independent test circuit meeting the specified conditions. Multipole switches are to be tested with a load per pole and with opposite line polarity on adjacent poles in accordance with [figure 2](#). 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.
- (e) Switches shall be actuated at a frequency of 10 to 18 cpm and at a velocity of 3 to 5 inches per second by a power driven actuator. The switch shall be actuated for the specified number of cycles and shall be actuated only through the toggle lever positions necessary to make and break the test load. At the option of the supplier, cycling may be interrupted periodically after each 5,000 cycles of operation. Switches with lever lock toggle levers shall be tested with the toggle lever in the unlock position.
- (f) During the overload test, the closed time of the switch shall be 0.5 second minimum during each cycle of operation. Unless otherwise specified (see 3.1), the endurance test duty cycle shall be a minimum of 25 percent on.
- (g) Unless otherwise specified (see 3.1), two switches shall be subjected to the overload, resistive, inductive and lamp load endurance tests at each voltage, current and frequency specified (see [table I](#)).
- (h) Overload and endurance tests shall be performed on the same pair of contacts, using the same voltage and electrical frequency for both tests.

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

4.7.11.2 Resistive load (dc and ac). One half of the switches shall make and break the rated resistive load for 20,000 operating cycles at room ambient pressure and a temperature of 71° +4°/-0°C (or other temperature as specified). The other half of the switches shall make and break the rated resistive load for 20,000 operating cycles while at room temperature and a pressure equivalent to 65,000 feet altitude.

4.7.11.3 Inductive load (dc and ac). One half of the switches shall make and break the rated inductive load for 20,000 operating cycles while at a pressure equivalent to 65,000 feet altitude and at room ambient temperature while the other half shall make and break the rated inductive load for 20,000 operating cycles at room ambient temperature and pressure. The dc inductive loads shall use inductors which have the response and storage energy values as indicated on [figure 3](#), [figure 4](#) and [figure 5](#). The ac inductive loads shall have a power factor of 70 ±5 percent.

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4.7.11.4 Lamp load (dc and ac). Switches shall be subjected to 20,000 operating cycles when wired into a circuit having rated steady state lamp load current at the applicable rated voltage. For ac lamp loads, only tungsten filament lamps having a wattage not exceeding 200 watts at the specified voltage shall be used to make up the load. For dc lamp loads, only tungsten filament lamps having a wattage rating up to 50 watts at the specified voltage shall be used to make up the load. A minimum cooling period of 15 seconds shall be allowed between successive operations of the lamps. At the option of the manufacturer, a synthetic lamp load may be used for this test. The synthetic lamp load shall consist of making 10 times the rated lamp load and breaking the rated lamp load. The duration of the 10 times inrush shall be .015 seconds minimum.

4.7.11.5 Intermediate current. Switches shall be subjected to 20,000 operating cycles of making and breaking a 35 to 40 milliampere resistive load at the lowest rated dc voltage in an ambient temperature of 71° +4°/-0°C. Multipole switches shall be subjected to this test with alternate poles making and breaking the rated resistive load at the lowest rated dc voltage.

4.7.11.6 Temperature rise. Each pole of the switch shall be connected in a circuit carrying the resistive endurance test current at any convenient ac or dc voltage. At the end of a 1-hour period, the terminal temperature rise at a point adjacent to the insulating medium shall be determined by means of appropriate thermocouples consisting of No. 28-32 AWG iron-constantan wire. This test shall be performed on the same switch contacts previously subjected to the overload and resistive electrical endurance test. During this test, switches shall be mounted 6 inches apart in still air on a 1/16 inch thick steel panel at least 6 inches wide.

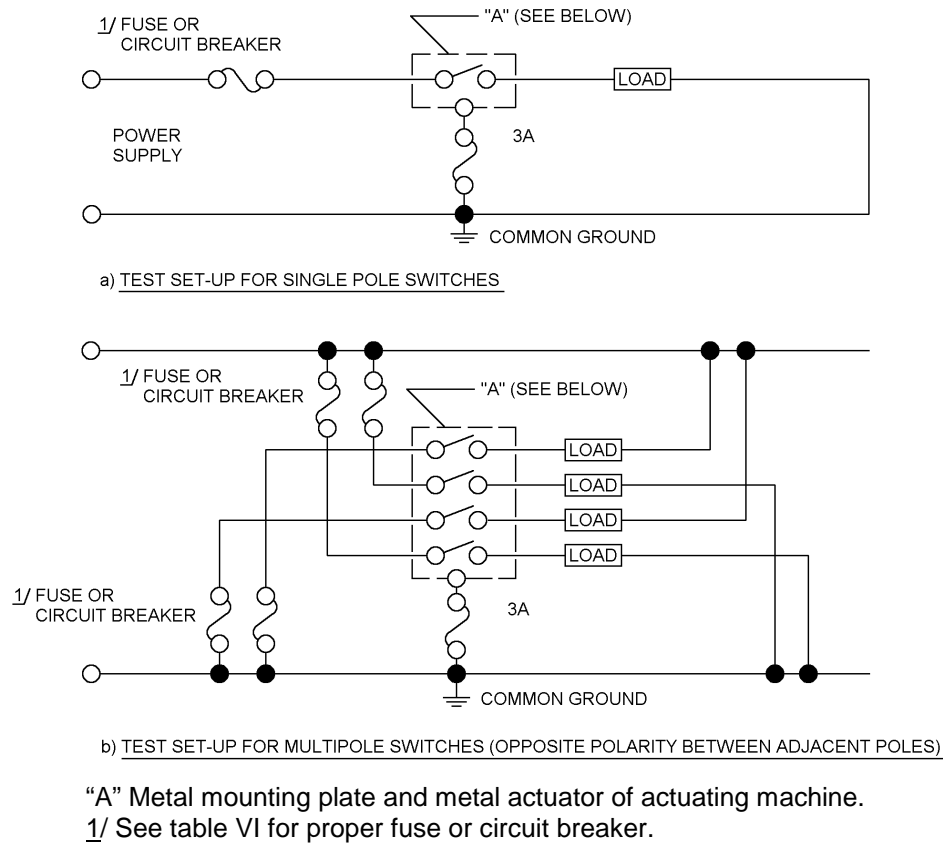
4.7.12 Short circuit (see 3.6.11). Switches shall be tested in accordance with 4.7.12.1, or 4.7.12.2 when specified (see 3.1). The following details shall apply to both methods:

- (a) The switches shall be inserted in a circuit calibrated to supply current equal to 60 times the rated resistive load at the lowest rated dc voltage specified (see 3.1).
- (b) The switches shall be connected in series to a thermal type circuit breaker or a fuse in accordance with figure 3 and table VI.
- (c) The wire shall be as specified in SAE-AS50861 and table VI, as determined by the rated resistive load of the switch (see 3.1).
- (d) Terminals shall be in accordance with SAE-AS7928.
- (e) Calibration shall be made with a substitute circuit breaker (or fuse), with the switch being tested, and with the switch leads in the circuit.
- (f) The calibrated circuit shall be closed by the appropriate switch (see 4.7.12.1 or 4.7.12.2) and after the circuit breaker or fuse interrupts the circuit, the appropriate switch shall be manually opened by means of the toggle lever. This procedure shall be performed 10 times. After each closure, the toggle lever of the switch under test shall be returned manually to the "OFF" or an alternate position, and the switch contacts shall be checked for proper opening by any suitable continuity test method. The circuit breaker shall be reset or the fuse replaced after each closure. Two minutes minimum shall elapse between closures.
- (g) For double through switches, one half shall be tested in one position and the other half shall be tested in the other position. For multipole switches, any (one) pole shall be tested.

4.7.12.1 Method I. The switch used to calibrate the circuit shall close the circuit.

4.7.12.2 Method II. The switch being tested shall close the circuit.

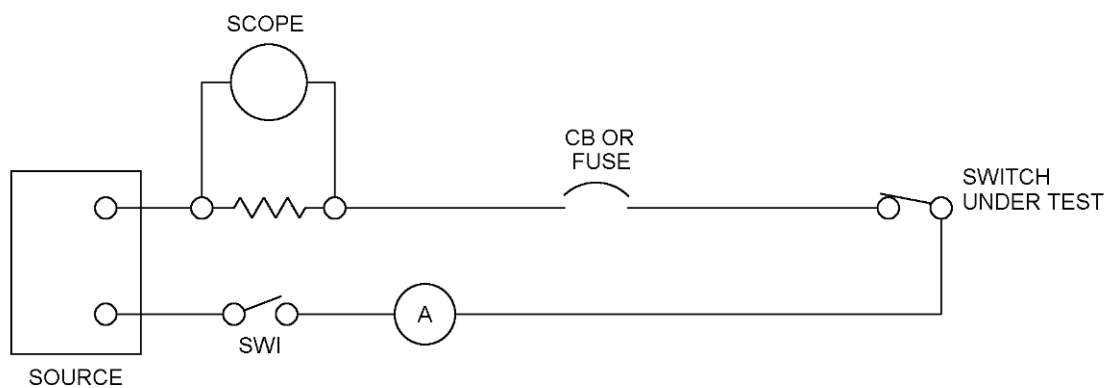
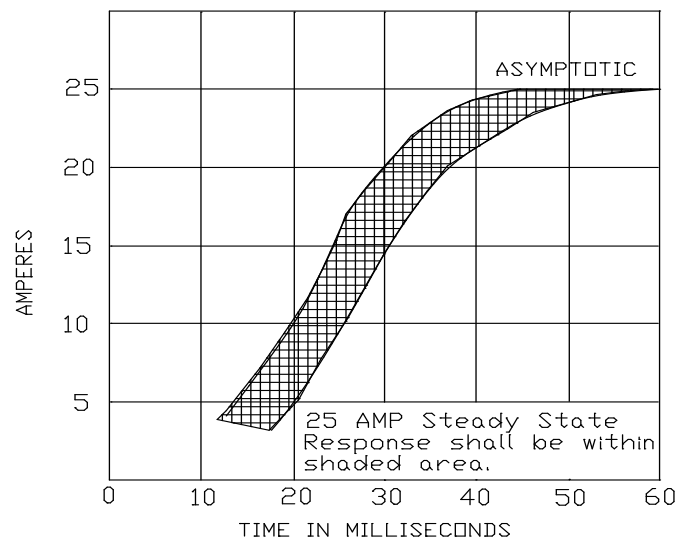
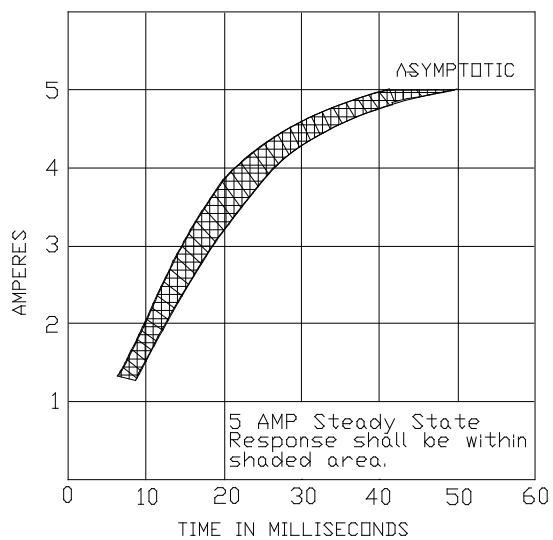
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FIGURE 2. Test set-up for electrical test.TABLE VI. Wire size and circuit breaker or fuse designations.

Amperes ^{1/}	SAE-AS50861 wire size	Circuit breaker or fuse
3.0 or less	20	The size of the circuit breaker or fuse shall be equivalent to the test current.
5.0	20	
7.5	18	
10.0	18	
15.0	18	
18.0	16	
20.0	16	
25.0	14	
30.0	14	
40.0	12	
60.0	10	
80.0	8	
175.0	2	

^{1/} Where the wire size, circuit breaker or fuse size does not coincide with the required current, the next larger wire size, circuit breaker or fuse shall be used.

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FIGURE 3. Circuit diagram for short circuit test.FIGURE 4. Response (current versus time) type I inductors only.

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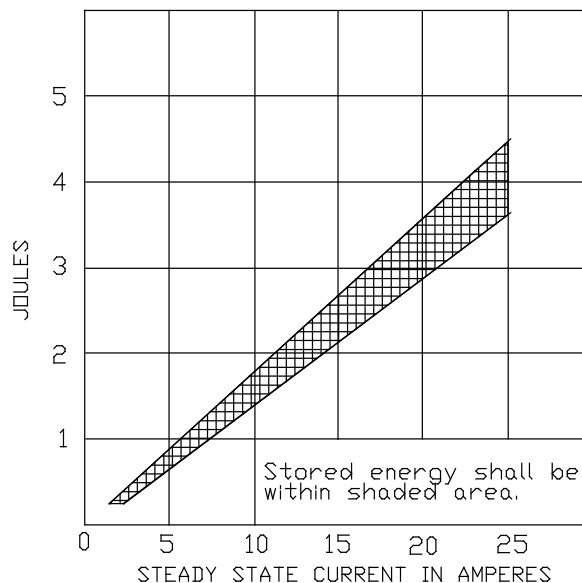


FIGURE 5. Stored energy (joules versus current) type I inductors only.

4.7.13 Vibration (see 3.6.12). Switches shall be tested in accordance with [method 204 of MIL-STD-202](#). The following details and exceptions shall apply:

- (a) Contact chatter shall be monitored in accordance with [method 310 of MIL-STD-202](#).
- (b) Test condition letter - A.
- (c) Tests and measurements prior to vibration - Not applicable.
- (d) 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. Half of the switches shall be tested in one lever position and the other half of the switches shall be tested in the alternate lever position.
- (e) Electrical load conditions - The electrical load shall consist of the monitor circuit only.
- (f) Measurements during vibration - Switch contact stability shall be continuously monitored during vibration. If more than one contact pair is being monitored simultaneously by one chatter indicator, open contact pairs shall be connected in parallel and closed contact pairs shall be connected in series during this test. In the event of indication of a contact opening greater than specified, the test shall be modified so that switches may be individually tested to determine if a switch is defective.
- (g) Measurements after vibration - Switching characteristics (see 4.7.4).
- (h) Examination after test - Switches shall be examined for change in actuated position and evidence of broken, deformed, displaced or loose parts.

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4.7.14 Shock (see [3.6.13](#)). Switches shall be tested in accordance with [4.7.14.1](#), and in addition [4.7.14.2](#) when specified (see [3.1](#)). The following details and exceptions shall apply to both methods:

- (a) Contact chatter shall be monitored in accordance with [method 310 of MIL-STD-202](#).
- (b) Mounting - Switches shall be mounted by their normal mounting means. Half of the switches shall be tested in one lever position and the other half of the switches shall be tested in the alternative lever position.
- (c) Electrical load conditions - The electrical load shall consist of the monitor circuit only.
- (d) Measurements during shock - Switch contact stability shall be continuously monitored during shock. If more than one contact pair is being monitored simultaneously by one chatter indicator, open contact pairs shall be connected in parallel and closed contact pairs shall be connected in series during this test. In the event of indication of a contact opening greater than specified, the test shall be modified by applying successive identical blows in the same plane to monitor contacts, switch by switch, to determine if a switch is defective.
- (e) Measurements after shock - Switches shall be inspected for switching characteristics (see [4.7.4](#)).
- (f) Examination after test - Switches shall be examined for evidence of broken, deformed, displaced or loose parts.

4.7.14.1 Method I.

- (a) [Method 213 of MIL-STD-202](#).
- (b) Test condition - B.
- (c) Allowable contact opening or closure - 10 microseconds maximum.

4.7.14.2 Method II.

- (a) [Method 207 of MIL-STD-202](#).
- (b) Allowable contact opening or closure - 20 milliseconds maximum.

4.7.15 Salt spray (corrosion) (see [3.6.14](#)). Switches shall be tested in accordance with [method 101 of MIL-STD-202](#). The following details and exceptions shall apply:

- (a) Test condition letter - B.
- (b) Switches shall be subjected to 10 cycles of operation using a 6 volt source and a maximum load of 100 milliamperes immediately following the wash.
- (c) Switches shall be examined for warping, cracking or excessive corrosion. Excessive corrosion is defined as corrosion which interferes with electrical or mechanical performance, or in the case of plated metals, corrosion which has passed through the plating and attacked the base metal. After the test, mounting hardware shall be readily removable.

4.7.16 Thermal shock (see [3.6.15](#)). Switches shall be tested in accordance with method [107 of MIL-STD-202](#). The following details shall apply:

- (a) Test condition letter - A.
- (b) Measurements before and after cycling - Not applicable.
- (c) Examinations after test - Switches shall be examined for mechanical and electrical damage and loosening of rivets or other fastening devices.

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4.7.17 Moisture resistance (see [3.6.16](#)). Switches shall be tested in accordance with [method 106 of MIL-STD-202](#). The following details and exceptions shall apply:

- (a) Mounting - By normal mounting means on a corrosion resistant metal panel positioned 15° from the vertical. One half of the switches shall be mounted with the toggle lever up and the other half with the toggle lever down. The mounting panel shall have appropriate mounting holes so that switches are at least 1 inch apart.
- (b) Polarization - During steps 1 to 6 inclusive, a dc potential of 100 volts shall be applied between current-carrying parts and panel. Negative polarity shall be applied to the panel. Steps 7a and 7b are not applicable.
- (c) Final measurements - Following a 24 hour drying period at 25 ±5°C and 50 ±5 percent relative humidity, switching characteristics shall be measured as specified in [4.7.4](#). Switches shall be examined for evidence of breaking, spalling, cracking or loosening of terminals and shall be electrically operable.
- (d) Water - Steam, deionized or distilled water shall be used.

4.7.18 Sand and dust (see [3.6.17](#)). Switches shall be tested in accordance with [method 110 of MIL-STD-202](#). The following details shall apply:

- (a) The switches shall be oriented so that the toggle lever is exposed to the dust stream.
- (b) During step 3, the switches shall be mechanically actuated for 2,500 cycles at a rate of 14 ±4 cycles per minute.
- (c) Step 3 shall be performed immediately after reaching stabilization in step 2.

4.7.19 Explosion (see [3.6.18](#)). Switches shall be tested in accordance with method [109 of MIL-STD-202](#). The following detail shall apply:

- (a) Electrical load - Switches shall be operated at their maximum rated dc inductive current (see [3.1](#)). If a dc inductive current is not specified, then the maximum dc resistive current shall be used.

4.7.20 Toggle seal (applicable only to toggle seal switches) (see [3.6.19](#)). Switches with suitable removable panel seals mounted behind the panel shall be mounted in the bottom of an open container. Tap water shall be added to the container to obtain a depth of one-half inch above the top of the bushing. The switch bushing shall remain submerged in water with the lever in any position for a period of 5 minutes. Then, while submerged, the switches shall be operated through all lever positions for five complete cycles. The switches shall remain under the one-half inch depth of water for an additional 5 minutes. The water shall then be removed from the container and the switches shall be removed, opened and examined for evidence of leakage of water into the switches due to entry through the toggle seal. Fixtures may be designed for testing more than one switch at a time.

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4.7.21 Terminal sealing, fluid submersion (applicable to switches with integrated wire terminals) (see 3.6.20).

- (a) Applicable to qualification and group B only. Switch terminals shall be immersed for three cycles as follows:
 - (1) Switches with integrated wire terminals shall be fully wired.
 - (2) Switch terminals shall be completely submerged in each of the following fluids for 2 +1/2, -0 minutes which shall consist of one cycle.
 - a. [MIL-DTL-5624](#) - Turbine Fuel, Aviation, Grade JP-4 or JP-5.
 - b. Skydrol 500 A - National Stock Number 9150-857-9069.
 - c. [MIL-PRF-87252](#) - Coolant Fluid, Hydrolytically Stable, Dielectric or equivalent.
 - d. [ASTM-E1119](#) - Ethylene glycol.
 - e. [MIL-PRF-7808](#) - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base.
 - f. After each immersion, the excess liquid is to be blown off the switch external surfaces with an air jet.
 - (3) At the end of the third cycle, the dielectric withstanding voltage shall be measured as specified in 4.7.9.1. The switches shall be examined for evidence of cracking and loosening of bonds and seams.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Switches furnished under this specification are intended for use in protected environments having a minimum of moisture and contaminants. Unless otherwise specified on the individual MS military standards or military specification sheets, the switches are not intended for use in circuits with ratings lower than the intermediate current.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of the specification.
- b. Packaging requirements (see 5.1).

6.2.1 Category I switches (items covered by specification sheets or MS standards and identified by a part number, see 3.2.1). Acquisition documents must specify the following:

- a. Title, number and date of this specification.
- b. Title, number and date of the applicable specification sheet or MS standard and the part number.
- c. Packaging requirements (see 5.1).
- d.. Type and amount of hardware to be included with the switch, if other than that specified on the applicable specification sheets or MS standard.

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6.2.2 Category II switches (qualified switches with modification, see 3.2.2). Acquisition documents must specify the following:

- a. Title, number and date of this specification.
- b. Title, number and date of the applicable specification sheet or MS standard and the part number.
- c. Packaging requirements (see 5.1).
- d. Part number of qualified switch.
- e. Manufacturer's part number of the modified switch (see 3.7.1(b)).
- f. Inspection requirements (in addition to group A): To verify suitability of variations from category I switches. Available manufacturing data showing compliance may be substituted as meeting these requirements at the option of the contracting activity.
 - (1) Tests to be performed (if any).
 - (2) The laboratory at which inspection is to be performed.
 - (3) Samples and submission of data, if other than that specified.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 83731 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, Post Office Box 3990, ATTN: DSCC-VQP, Columbus, OH 43216-5000 or by email to vqp.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.daps.dla.mil>.

6.3.1 Provision Governing Qualification. Copies of specifications and "Provisions Governing Qualification" may be obtained upon application to Defense Printing Service Department Office, Building 4D (Customer Service), 700 Robbins Avenue, Philadelphia, PA 19111-5094.

6.4 Luminescent tips. Luminescent material should conform to Type F of MIL-L-3891 (Luminescent Material and Equipment, Non Radioactive).

6.5 Panel seal. Panel seals should be in accordance with MIL-DTL-5423/16 (Boot, Dust and Water Seal, Bushing Seal, Type A).

6.6 Boots. Boots should be in accordance with MIL-DTL-5423 (Boot, Dust and Water Seal For Toggle and Push-button Switches and Rotary-actuated Parts).

6.7 Switch guards. When switch guards are required, they should be in accordance with MIL-DTL-7703 (Guard, Switch).

6.8 Dissimilar metals (see 3.4.1.2). Dissimilar metals and compatible couples are defined in MIL-STD-889.

6.9 Insulation (see 3.4.2).

6.9.1 Thermoplastic. It is recommended that thermoplastic materials be tested in accordance with MIL-M-24519 to the requirements specified in 3.4.2.

6.10 Rubber (see 3.4.3). It is recommended that rubber parts in accordance with ZZ-R-765 be considered for use.

6.11 Potting compounds (see 3.4.4). It is recommended that potting compounds that meet the hydrolytic stability requirements of MIL-PRF-8516, MIL-PRF-23586, MIL-M-24041 or MIL-I-16923 be considered for use.

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6.12 Solder. It is suggested that [ANSI/J-STD-002](#) be used for guidance only in dealing with solder.

6.13 Tin whisker growth. The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to [ASTM-B545](#) (Standard Specification for Electrodeposited Coatings of Tin).

6.14 Military standard part numbering. In order to provide uniform part number and format, MS27740 (Switches, MIL-DTL-3950 and MIL-DTL-83731, Military Standard Part Numbering) should be followed.

6.15 Part or Identifying Number (PIN). This specification requires a PIN that is as described in the appropriate reference to associated documents (see [3.1](#)).

6.16 Subject term (key word) listing.

Boots
guards
Switching, characteristics
lever

6.17 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmental Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals and additional information is available on their website at <http://www.epa.gov/osw/hazard/wastemin/priority.htm>. Included in the EPA list of 31 priority chemicals are cadmium, lead, and mercury. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see Section 3).

6.18 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where modifications from this revision were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.

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APPENDIX A

Procedure for qualification inspection and mounting and terminal hardware.

A.1. SCOPE

A.1.1 This appendix details the procedure for submission of samples for qualification and group B inspection of toggle switches covered by this specification. This appendix also lists mounting and terminal hardware used with toggle switches covered by this specification. Mounting and terminal hardware should be of the following design and construction as specified (see 31.).

A.2. SAMPLES

A.2.1 Qualification. For qualification inspection, the sample size shall be as specified in [table I](#) and the test shall be performed in the sequence shown.

A.2.1.1 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.

A.2.1.2 Group submission. A sample consisting of the required number of specimens of each basic switch listed in [table II](#) shall be submitted and shall be subjected to the qualification test sequence of [table I](#) in the order shown. In addition, two specimens of each of the other switches listed in [table II](#) shall be submitted and shall be subjected to the examination of product and switching characteristics test of [table I](#).

A.2.2 Group B inspection. Sample units shall be selected at random from lots that have passed group A inspection.

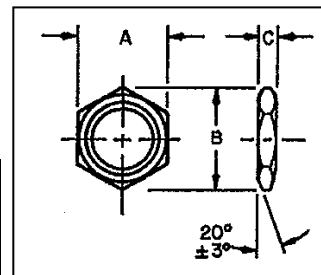
A.2.2.1 Sample submission. The sample size shall be as specified in [table V](#) and the tests shall be performed in the order shown.

A.2.2.2 Group submission. A sample consisting of the required number of specimens of each basic switch listed in [table V](#) shall be subjected to the test sequence of [table V](#) in the order shown. In addition, two specimens of each of the other switches listed in [table II](#) shall be submitted and shall be subjected to the examination of product and switching characteristic test of [table V](#). If the basic switches of a group are not in production at the time of selection of samples, other switches of the same group may be submitted, but maintained action switches shall not be substituted for momentary action switches.

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A.3. MOUNTING HARDWARE

A.3.1 Nut, plain, hexagon, electrical, thin.

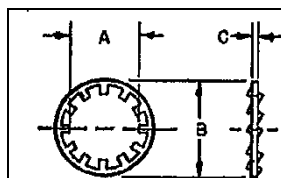


Threads	A		B		C ±.005
	Min	Max	Max	Min	
.250-40 UNS-2B	.302	.313	.348	.361	.062
.469-32 NS-2B	.553	.564	.630	.651	.078

Brass	Material	ASTM B16, alloy UNS C36000, half hard
	Finish	Nickel plate SAE-AMS-QQ-N-290 , class 1, grade G(matte)
	MIL- hardware	Can be replaced by MS25082-B14 (.250-40) MS25082-B8 (.468-32)
Steel	Material	FED STD No. 66, 55,000 PSI (min sulphur or phosphorus shall not exceed 0.05 by weight)
	Finish	Suitably protected to resist corrosion
	MIL hardware	Can be replaced by MS25082-14 (.250-40) MS25082-8 (.468-32)
Cres	Material	FED STD No. 66
	Finish	Passivate
	MIL hardware	Can be replaced by MS25082-C14 (.250-40) MS25082-C8 (.468-32)

INCHES	MM
.005	.13
.062	1.57
.078	1.98
.250	6.35
.302	7.67
.313	7.95
.348	8.84
.361	9.17
.468	11.89
.553	14.05
.564	14.33
.630	16.00
.651	16.54

A.3.2 Washer, lock, flat, internal tooth.

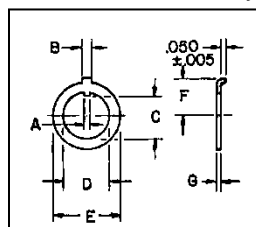


		Size	Min	Max	Min	Max	±.002
		.250	.256	.267	.395	.410	.018
		.468	.472	.480	.593	.607	.018
	Material	FF-W-100					
Steel	Finish	Suitably protected to resist corrosion					
	MIL hardware	Can be replaced by NASM35333-125 (.250 size) NASM35333-125 (.468 size)					
	Material	FF-W-100					
Cres	Finish	Passivate					
	MIL hardware	Can be replaced by NASM35333-135 (.250 size) NASM35333-136 (.468 size)					

INCHES	MM
.002	.05
.018	.46
.250	6.35
.256	6.50
.267	6.78
.395	10.08
.410	10.41
.468	11.89
.472	11.99
.480	12.19
.593	15.06
.607	15.42

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A.3.3 Washer, key.

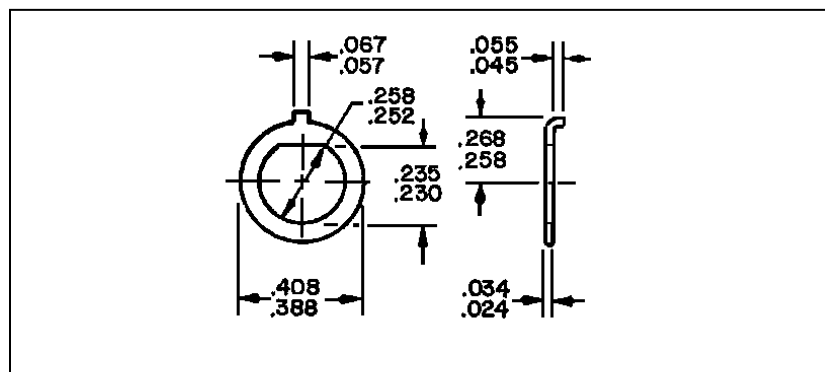


Bush Dia	A	B	C	D	E	F	G
.250	.049	.067	.226	.258	.408	.268	.034
	.043	.057	.220	.252	.388	.258	.024
.468	.065	.115	.440	.480	.735	.397	.043
	.059	.105	.433	.470	.703	.387	.037

Steel	Material	QQ-S-698
	Finish	Suitably protected to resist corrosion
Cres	MIL hardware	Can be replaced by MS25081-0 (.250 size) MS25081-4 (.468 size)
	Material	FED STD No. 66
	Finish	Passivate
	MIL hardware	Can be replaced by MS25081-C0 (.250 size) MS25081-C4 (.468 size)

Inches	mm
.005	.13
.024	.61
.034	.86
.037	.94
.043	1.09
.049	1.24
.050	1.27
.057	1.45
.059	1.50
.065	1.65
.067	1.70
.105	2.67
.115	2.92
.220	5.59
.226	5.74
.250	6.35
.252	6.40
.258	6.55
.268	6.81
.367	9.83
.388	9.36
.397	10.08
.408	10.36
.433	11.00
.440	11.18
.468	11.89
.470	11.94
.480	12.19
.703	17.86
.735	18.67

A.3.4 Washer, key "D".



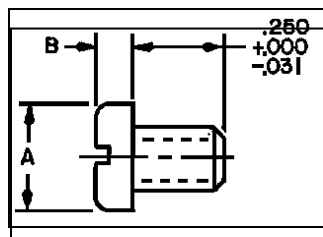
Steel	Material	QQ-S-698
	Finish	Suitably protected to resist corrosion
	MIL-hardware	None
Cres	Material	SAE-AIR4127
	Finish	Passivate
	MIL hardware	None

Inches	mm
.024	.61
.034	.86
.045	1.14
.055	1.40
.057	1.45
.067	1.70
.230	5.84
.235	5.97
.252	6.40
.258	6.55
.268	6.81
.388	9.86
.408	10.36

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A.4. TERMINAL HARDWARE

A.4.1 Screw (pan head).

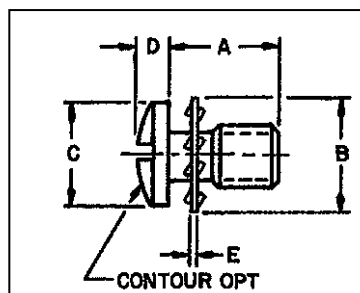


Thread size	A		B	
	Min	Max	Min	Max
.138-32 UNC-2A	.256	.270	.072	.062
.164-32 UNC-2A	.306	.322	.085	.096

INCHES	MM
.031	.79
.072	1.83
.082	2.08
.085	2.16
.096	2.44
.138	3.51
.164	4.17
.250	6.35
.256	6.50
.270	6.86
.306	7.77
.322	8.18

Brass	Material	ASTM B16, alloy UNS C36000
	Finish	Silver plate, tin plate or nickel plate SAE-AMS-QQ-N-290 , class 1, grade G (matte)
	MIL hardware	None
Steel	Material	SAE-AIR4127 , 55, 000 PSI (min sulphur or phosphorus shall not exceed 0.05 by weight)
	Finish	Suitably protected to resist corrosion
	MIL hardware	Can be replaced by NASM35206-226 (.138-32) NASM35206-241 (.164-32)
Cres	Material	SAE-AIR4127
	Finish	Passivate
	MIL hardware	Can be replaced by MS51957-26 (.138-32) MS51957-41 (.164-32)

A.4.2 Screw with captive internal tooth lockwasher.



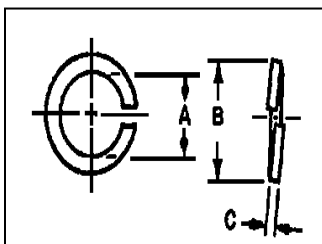
Thread size					
	A	B	C	D	E
.138-32 UNC-2A	.260	.295	.290	.087	.020
	.219	.285	.256	.071	.016
.164-32 UNC-2A	.250	.338	.322	.096	.022
	.219	.327	.306	.085	.018

Screw	Material	ASTM B16, alloy UNS C36000
(Brass)	Finish	Silver or tin plate
	MIL hardware	None
Lockwasher	Material	ASTM B139, alloy UNS C51000
(Phos bronze)	Finish	Silver or tin plate
	MIL hardware	None

Inches	mm
.016	.41
.018	.46
.020	.51
.022	.56
.071	1.80
.085	2.16
.087	2.21
.096	2.34
.138	3.51
.164	4.17
.219	5.56
.250	6.35
.256	6.50
.260	6.60
.265	6.73
.290	7.37
.295	7.49
.306	7.77
.322	8.18
.327	8.31
.338	8.59

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A.4.3 Washer, lock-spring, helical series.



Size	A		B		C
	Min	Max	Max	Min	Max
.138	.141	.151	.253	.031	.037
.164	.168	.178	.296	.040	.046

	Material	SAE-AMS-QQ-S-700
Steel	Finish	Suitably protected to resist corrosion
	MIL hardware	Can be replaced by NASM35338-41 (.138) NASM35338-42 (.164)
	Material	SAE-AIR4127
Cres	Finish	Passivated
	MIL hardware	Can be replaced by NASM35338-155 (.138) NASM35338-156 (.164)
	Material	ASTM B139, alloy UNS C51000
Bronze	Finish	Suitably protected to resist corrosion
	MIL hardware	Can be replaced by NASM35338-98 (.138) NASM35338-99 (.164)

Inches	mm
.031	.79
.037	.94
.040	1.02
.046	1.17
.138	3.51
.141	3.58
.151	3.84
.164	4.17
.168	4.27
.178	4.52
.253	6.43
.296	7.52

NOTES:

1. The captive internal tooth lockwasher on the terminal screw shall rotate freely.
2. The terminal screws with the captive internal tooth lockwasher shall be threaded to within .024 of the lockwasher.
3. The terminal screw (pan head) shall be used in conjunction with the helical series lock-spring washer.
4. Dimensions are in inches.
5. Metric equivalents (to the nearest .01 mm) are given for general information.

Custodians:
Army - CR
Navy - AS
Air Force - 85
DLA - CC

Preparing activity:
DLA - CC

(Project 5930-2009-025)

Review activities:
Army - AR, AV, MI
Navy - EC, MC

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