

INCH-POUND
MIL-DTL-13735G
6 March 2008
SUPERSEDING
MIL-DTL-13735F
21 December 2005

## DETAIL SPECIFICATION

### SWITCHES, TOGGLE: 28 VOLT DC

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

#### 1. SCOPE

1.1 Scope. This specification covers toggle switches for use in direct current (dc) electrical circuits. The toggle switch will be referred to as "switch" herein (see [6.1](#)).

1.2 Classification. Switches will be of the following types, classes, and grades as specified (see [6.2](#) and [6.5](#)):

Type I - Single-pole, single-throw.  
 Type II - Single-pole, double-throw.  
 Type III - Multipole, single-throw.  
 Type IV - Multipole, multithrow.

Class A - Momentary contact.  
 Class B - Maintained contact.  
 Class AB - Momentary and maintained contact

Grade 1 - Waterproof  
 Grade 2 - Nonwaterproof

1.3 Part or Identifying Number (PIN). Except when part numbers are specified on the drawing, MS standard or military specification sheet (MS sheet), the PIN to be used for switches acquired to this specification is created as follows:

<u>M</u>	<u>13735</u>	<u>X</u>	<u>X</u>	<u>X</u>
Prefix to indicate military specification	Specification number	Type number (1 = Type I, 2 = Type II, 3 = Type III and 4 = Type IV) (see <a href="#">1.2</a> )	Class letter ( x = Class A, y = Class B and z = Class AB) (see <a href="#">1.2</a> )	Grade number (see <a href="#">1.2</a> )

#### 2. APPLICABLE DOCUMENTS

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 documents cited in [sections 3](#) and [4](#) of this specification, whether or not they are listed.

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@dla.mil](mailto:switch@dla.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil/>

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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-H28/2](#) - Screw-Thread Standards for Federal Services Section 2 United Inch Screw Threads-UN and UNR Thread Forms.

DEPARTMENT OF DEFENSE SPECIFICATIONS

- [MIL-DTL-13486](#) - Cables, Special Purpose, Electrical: Low-Tension, Heavy Duty Single-Conductor and Multiconductor Shielded and Unshielded, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

- [MIL-STD-130](#) - Identification Marking of US Military Property.
- [MIL-STD-202](#) - Test Methods for Electronic and Electrical Component Parts.
- [MS33800](#) - Connector, Receptacle, Electrical-Pin Contact. No 12, 14 and 16 A.W.G. Waterproof.
- [MS39061](#) - Switch. Toggle-SPST. SPDT 24 Volt dc, 25 Amp (Waterproof).

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

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-001](#) - Soldered Electrical and Electronic Assemblies, Requirements for s.
- [ANSI-Z540-1](#) - Calibration Laboratories and Measuring and Test Equipment, General Requirements for.

(Copies of these documents are available online at <http://dod.nssn.org/search.html> or from the American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036-8002, telephone 212-642-4900, fax 212-302-1286.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- [ASTM B117](#) - Standard Method of Salt Spray (Fog) Testing.
- [ASTM G21](#) - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

(Copies of these documents are available online at <http://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; Metrological Confirmation System for Measuring Equipment.

(Copies of these documents are available online at <http://dod.nssn.org/search.html> or from the American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036-8002, telephone 212-642-4900, fax 212-302-1286.)

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(Non-Government standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

3.1 Qualification. Switches furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list (QPL) at the time of award of contract (see [4.3](#) and [6.3](#)).

3.2 Materials. Materials shall be as specified herein and in referenced specifications and standards (see [4.8.1](#)).

3.2.1 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.

3.2.2 Solder. Solder and soldering flux shall conform to [ANSI J-STD-001](#) (see [4.8.1](#)).

3.2.3 Metal parts. Metal parts shall be of a corrosion resistant material or shall be protected from corrosion in accordance with the manufacturer's standard practice or in accordance with the applicable MS standard or drawing (see [4.8.1](#)).

3.2.4 Pure tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. Tin content of components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead (see [6.4.3](#)).

3.3 Design and construction. Switch dimensions and construction shall be in accordance with [MS39061](#), or as specified by the acquiring activity (see [4.8.1](#), [4.8.2](#), and [6.2](#)).

3.3.1 Cable. Cable used in leads shall conform to type I of [MIL-DTL-13486](#) (see [4.8.1](#) and [4.8.2](#)).

3.3.2 Threaded parts. Screw threads of the form, number per inch, and class specified on the applicable drawing or military standard shall be in accordance with [FED-STD-H28/2](#) (see [4.8.1](#) and [4.8.2](#)).

3.3.3 Lever positions. Lever positions and locations of momentary and maintained contact positions shall be in accordance with the applicable MS standard or drawing (see [4.8.1](#) and [4.8.2](#)).

3.3.4 Electrical connections. Electrical connections or terminals shall be in accordance with [MS33800](#) or applicable drawing for each lever position (see [4.8.1](#) and [4.8.2](#)).

3.4 Performance.

3.4.1 Electrical.

3.4.1.1 Contact voltage drop. The voltage drop across all pairs of closed electrical contacts shall be not more than 50 millivolts (mV) when the switch is carrying the rated resistive load current specified on the applicable MS or drawing (see [4.8.3](#)).

3.4.1.2 Overload. The switch shall carry a current equal to 150 percent of the rated resistive load current specified on the applicable MS or drawing without damage (see [4.8.4](#)).

3.4.1.3 High voltage. The switch shall evidence no sparking, arcing, burning, smoking, charring, cracking, loosening, rupturing or damage after or while, 440 V root mean square (rms) at 60 hertz (Hz) is applied for 1 minute to all pairs of open electrical contacts (see [4.8.5](#)).

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3.4.2 Mechanical.

3.4.2.1 Withstanding force. Unless otherwise specified on the applicable MS or drawing, the switch shall withstand a force of 25 pounds in all actuating directions without damage (see [4.8.6](#)).

3.4.2.1.1 Connector or terminal strength. Connectors or terminals shall withstand a force of 25 pounds without deformation (see [4.8.6.1](#)).

3.4.2.2 Average operating force. The average force required to actuate the switch shall be in accordance with applicable MS standard or drawing except as specified in 3.5.5 (for low temperature). If no operating force is specified, the average operating force shall be .75 to 3 pounds for maintained positions and 2 to 3.5 pounds for momentary positions. Momentary position, on release, shall be self-canceling. The average time required for the switch to return from a momentary contact shall be no more than 1 second (see [4.8.7](#)).

3.5 Environmental.

3.5.1 Corrosion. Switch performance shall not be adversely affected by corrosion when exposed to 5 percent salt water spray for 144 hours (see [4.8.8](#)).

3.5.2 Fungus. Switch performance shall not be adversely affected by fungus when subjected to the fungus resistance test of [ASTM G21](#) for 90 days (see [4.8.9](#)).

3.5.3 Sand and dust. Grade 2 switches shall not be adversely affected by sand and dust when subjected to test [method 110](#) of [MIL-STD-202](#) for 12 hours (see [4.8.10](#)).

3.5.4 Waterproofness. Grade 1 switch performance shall not be affected after submersion, nor shall the switch show signs of leakage during submersion (see [4.8.11](#)).

3.5.5 Extreme temperature. Switches shall operate in a temperature range of  $-67 \pm 2$  degrees Fahrenheit ( $^{\circ}\text{F}$ ) [ $-55 \pm 1$  degree Celsius ( $^{\circ}\text{C}$ )] through  $170 \pm 2^{\circ}\text{F}$  ( $77 \pm 1^{\circ}\text{C}$ ). The material used in the switch body shall not shrink, crack, become brittle or soften. While at  $-67 \pm 2^{\circ}\text{F}$  ( $-55 \pm 1^{\circ}\text{C}$ ), the force required to move the switch from any position to any adjacent position shall be no more than 140 percent of the average operating force previously determined at room temperature (see [4.8.12](#)).

3.5.6 Shock. Switch performance shall not be adversely affected after being subjected to mechanical shocks of 75 gravity units (g) (peak) of sawtooth waveform in both directions along each of the three major axes. There shall be no spurious opening or closing of circuits during the shock application (see [4.8.13](#)).

3.5.7 Vibration. Switches shall be subjected to vibration testing under electric-load conditions for not less than 1 hour in each of three perpendicular axes. Vibration shall not cause spurious opening or closing of contacts, loosening of parts, noise, wear, or physical distortion to mechanical parts (see [4.8.14](#)).

3.5.8 Endurance. The switch shall evidence no mechanical or electrical failure during or after 10,000 operations while connected to rated resistive and inductive loads (see [4.8.15](#)).

3.6 Marking. In addition to any special marking specified on the applicable MS standard or drawing, switches shall be marked in accordance with [MIL-STD-130](#) (see [4.8.1](#) and [4.8.2](#)).

3.7 Workmanship. Workmanship shall be of the quality to assure a product free of burrs, rust, scratches, chips, sharp edges, loose or defective connectors, cracked insulation, faulty soldering, or other defects which affect serviceability or appearance (see [4.8.2](#)).

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## 4. VERIFICATION

4.1 Classification of inspection. The examination and testing of switches shall be classified as follows:

- a. Qualification inspection (see [4.3](#)).
- b. Conformance inspection (see [4.5](#)).

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 contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with [ANSI/NCSL Z540.1](#), [ISO-10012-1](#), or equivalent system as approved by the qualifying activity.

4.2.1 Additional inspection. Nothing specified herein shall preclude the supplier from taking such additional samples and making such additional inspections as he may deem necessary or desirable to assure conformance of the switches to this specification.

4.2.2 Government. Acceptance of the switches shall be based upon verification by the Government of the supplier's compliance with the requirements of this specification. The Government may, as its option, repeat any or all of the inspections specified herein.

4.3 Qualification inspection. For qualification inspection, the manufacturer shall furnish eight specimens of each type, class and grade of switch. The sample specimens shall be representative of the units proposed to be furnished to the Government. Qualification inspection shall be performed at a laboratory acceptable to the Government on sample units produced with equipment and procedures normally used in production. Qualification inspection shall consist of testing as specified in [table I](#) in the order listed.

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

4.4 Failures. One or more failures shall be cause for refusal to grant qualification approval.

4.5 Verification of qualification.

- a. Design of switch has not been modified (every 12 months).
- b. Verification of group A lot acceptance (every 12 months) (see [4.6](#))
- c. Periodic group B inspection (every 36 months) (see [4.7](#))

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

4.6.1 Inspection lot. An inspection lot shall consist of switches of the same specification sheet 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.

4.6.2 Group A inspection. Group A inspection shall consist of the inspections specified in [table II](#).

4.6.2.1 Sample size. Statistical sampling shall be in accordance with [table III](#). For acceptance there shall be zero occurrences of defects.

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 the defective units from the lot. The lot shall then be sampled again in accordance with [table III](#). For acceptance, there shall be zero occurrences of defects. If there are one or more defects in this second sample for the same characteristic that caused the original lot rejection, the lot is rejected. Such lots shall be separate from new lots and shall be clearly identified as reinspected lots.

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4.7 Periodic Inspection. Periodic inspection shall consist of group B in accordance with [table IV](#). Except where the results of these inspections show noncompliance with the applicable requirements delivery of products which have passed group A shall not be delayed pending the results of these periodic inspections.

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

4.7.2 Disposition of sample units. Sample units which have been 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.

4.7.3 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 (complete inspection, 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.

#### 4.8 Methods of inspection.

4.8.1 Materials and construction. Conformance to [3.2](#) through [3.3.4](#) shall be determined by inspection of contractor records providing proof or certification that design, construction, processing, and materials conform to requirements. Applicable records shall include drawings, specifications, design data, receiving inspection records, processing and quality control standards, vendor catalogs and certifications, industry standards, test reports, and rating data.

4.8.2 Defects. Conformance to [3.3](#) through [3.3.4](#), [3.6](#), and [3.7](#) shall be visual or by measurement with standard inspection equipment.

4.8.3 Contact voltage drop. To determine conformance to [3.4.1.1](#), one terminal of type I or type II switch (if type II, the terminal shall be the common terminal) and two or more terminals of type III and type IV switch (if type IV, the terminal shall be the common terminal) shall be connected to an energy source. All terminals which are normally connected to a load in intended operation shall be connected to the rated resistive load specified on the applicable MS standard or drawing. With the lever in each closed position, the voltage drop(s) between the appropriate terminals shall be measured. If the switch has no leads, the contact voltage drop(s) shall be considered to be the measured voltage drop(s). If the switch has leads, the contact voltage drop(s) shall be determined by subtracting the voltage drop(s) due to the leads from the measured voltage drop(s).

4.8.4 Overload. To determine conformance to [3.4.1.2](#), switch shall be subjected to 100 cycles, as defined in [4.2](#), while being connected to an energy source and to a resistive load current 150 percent of the rated resistive load current specified on the applicable MS standard or drawing. The circuit shall be that specified in [4.8.3](#).

4.8.5 High voltage. To determine conformance to [3.4.1.3](#), with the switch open, 440 V rms at 60 Hz shall be applied for 1 minute to the switch between appropriate terminals, with the lever in each open position.

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TABLE I. Qualification and sequence of testing.

Specimen	Description	Requirement	Test
1 and 2	Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
	Terminal strength	<a href="#">3.4.2.1.1</a>	<a href="#">4.8.6.1</a>
	Contact voltage	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
	High voltage	<a href="#">3.4.1.3</a>	<a href="#">4.8.5</a>
	Shock	<a href="#">3.5.6</a>	<a href="#">4.8.13</a>
	Vibration	<a href="#">3.5.7</a>	<a href="#">4.8.14</a>
	Average operating force	<a href="#">3.4.2.2</a>	<a href="#">4.8.7</a>
	Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
	High voltage	<a href="#">3.4.1.3</a>	<a href="#">4.8.5</a>
	Fungus	<a href="#">3.5.2</a>	<a href="#">4.8.9</a>
	Average operating force	<a href="#">3.4.2.2</a>	<a href="#">4.8.7</a>
	High voltage	<a href="#">3.4.1.3</a>	<a href="#">4.8.5</a>
	Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
3 and 4	Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
	Withstanding force	<a href="#">3.4.2.1</a>	<a href="#">4.8.6</a>
	Average operating force	<a href="#">3.4.2.2</a>	<a href="#">4.8.7</a>
	Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
	Low temperature	<a href="#">3.5.5</a>	<a href="#">4.8.12.1</a>
	High temperature	<a href="#">3.5.5</a>	<a href="#">4.8.12.2</a>
	Average operating force	<a href="#">3.4.2.2</a>	<a href="#">4.8.7</a>
	Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
	High voltage	<a href="#">3.4.1.3</a>	<a href="#">4.8.5</a>
	Overload	<a href="#">3.4.1.2</a>	<a href="#">4.8.4</a>
	Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
	Corrosion	<a href="#">3.5.1</a>	<a href="#">4.8.8</a>
	Average operating force	<a href="#">3.4.2.2</a>	<a href="#">4.8.7</a>
	High voltage	<a href="#">3.4.1.3</a>	<a href="#">4.8.5</a>
Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>	
5 and 6	Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
	High voltage	<a href="#">3.4.1.3</a>	<a href="#">4.8.5</a>
	Sand and dust (grade 2 only)	<a href="#">3.5.3</a>	<a href="#">4.8.10</a>
	Average operating force (grade 2 only)	<a href="#">3.4.2.2</a>	<a href="#">4.8.7</a>
	Contact voltage drop (grade 2 only)	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
	High voltage (grade 2 only)	<a href="#">3.4.1.3</a>	<a href="#">4.8.5</a>
	Endurance	<a href="#">3.5.8</a>	<a href="#">4.8.15</a>
	Average operating force	<a href="#">3.4.2.2</a>	<a href="#">4.8.7</a>
	High voltage	<a href="#">3.4.1.3</a>	<a href="#">4.8.5</a>
Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>	
7 and 8	Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
	Waterproofness	<a href="#">3.5.4</a>	<a href="#">4.8.11</a>
	High voltage	<a href="#">3.4.1.3</a>	<a href="#">4.8.5</a>
	Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>

TABLE II. Group A Inspection

Description	Requirement	Test
Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
High voltage	<a href="#">3.4.1.3</a>	<a href="#">4.8.5</a>
Waterproofness	<a href="#">3.5.4</a>	<a href="#">4.8.11</a>
Withstanding force	<a href="#">3.4.2.1</a>	<a href="#">4.8.6</a>
Average operating force	<a href="#">3.4.2.2</a>	<a href="#">4.8.7</a>
Visual and mechanical	<a href="#">3.1</a>	<a href="#">4.8.1</a>

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TABLE III. Zero defect sampling plan.

Lot size	Minimum number of switches to be tested
1 - 12	All
13 - 150	13
151 - 280	20
281 - 500	29
501 - 1,200	34
1,201 - 3,200	42
3,201 - 10,000	50
10,001 - 35,000	60

TABLE IV. Group B.

Description	Requirement	Test
Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
Withstanding force	<a href="#">3.4.2.1</a>	<a href="#">4.8.6</a>
Average operating force	<a href="#">3.4.2.2</a>	<a href="#">4.8.7</a>
Overload	<a href="#">3.4.1.2</a>	<a href="#">4.8.4</a>
Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>
Waterproofness (grade 1 only)	<a href="#">3.5.4</a>	<a href="#">4.8.11</a>
Terminal strength	<a href="#">3.4.2.1.1</a>	<a href="#">4.8.6.1</a>
High voltage	<a href="#">3.4.1.3</a>	<a href="#">4.8.5</a>
Contact voltage drop	<a href="#">3.4.1.1</a>	<a href="#">4.8.3</a>

4.8.6 Withstanding force. To determine conformance to [3.4.2.1](#), the switch shall be mounted as in intended operation, to a suitable plate. With the lever in one extreme position, the specified withstanding force shall be applied to the lever in the direction opposite to the direction of travel of the lever for  $30 \pm 1$  seconds. This shall be repeated four times. With the lever in the other extreme position, the same force shall be applied in the same manner, the same number of times.

4.8.6.1 Connector or terminal strength. To determine conformance to [3.4.2.1.1](#), the switch shall be mounted as in intended operation, by means of a suitable mounting plate or fixture. If the switch has connectors conforming to [MS33800](#), or other male-female connectors directly attached to the switch body, the force specified in [3.4.2.1.1](#) shall be applied to each mating connector cable in a direction perpendicular to the connector pin. If the switch has leads, the force shall be applied to each lead in the direction of each major axis of the switch so that it will be transmitted to the body of the switch.

4.8.7 Average operating force. To determine conformance to [3.4.2.2](#), an average operating force shall be defined as the sum of all the forces required to move the switch lever between any two given adjacent lever positions during the test specified in [4.8.7.1](#) and [4.8.7.2](#) divided by the number of times the lever is moved between these same adjacent positions by a force during the same test.

4.8.7.1 Switches without a center position. The switch shall be mounted, in operational condition, to a suitable mounting plate or fixture. With the switch lever initially in a maintained contact position, a gradually increasing force shall be applied to the switch lever in the direction of lever travel, until the lever is in the opposite position. If the switch is class B, a gradually increasing force shall then be applied in the opposite direction until the lever is in the original position. If the switch is class A, the lever shall then be released and the release time measured. The same process shall be repeated four times. The average operating force and the average of the release times shall be computed.

4.8.7.2 Switches with a center position. With the switch lever initially in center position, the procedure specified in [4.8.7.1](#) shall be followed treating the center position and one extreme position as an individual switch. The same procedure shall also be followed, treating the center position and the other extreme position as an individual switch. The average operating forces (see [4.8.7](#)) and the average of the release times shall be computed.



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4.8.8 Corrosion. To determine conformance to [3.5.1](#), the switch shall be tested in accordance with [ASTM B117](#) as specified and examined for leakage.

4.8.9 Fungus. To determine conformance to [3.5.2](#), the switch shall be subjected to the applicable fungus test and examined to verify that fungal growth is not sustained and performance is not adversely affected.

4.8.10 Sand and dust. To determine conformance to [3.5.3](#), grade 2 switches shall be tested as specified in [method 110](#) of [MIL-STD-202](#) except:

- a. Switches shall not be tested under electrical load conditions.
- b. Sand and dust velocity shall be  $2,500 \pm 500$  feet per minute.
- c. Step 2 shall be omitted.

4.8.11 Waterproofness. To determine conformance to [3.5.4](#), grade 1 switches shall be tested as specified in step 1 and step 2.

Step 1: The component with its electrical connections, shall be submerged in a container with the uppermost surface a minimum of one inch below the surface of the saline solution (see [4.3](#)) and installed in the chamber. The component shall be carefully observed during its entire 30 minutes of submersion. The chamber shall be evacuated to a pressure six pounds below atmospheric so as to apply a minimum of six pounds per square inch (psi) in internal pressure to all voids within the component. During this period the component shall be carefully observed for poor seals, as evidenced by bubbles escaping from the interior of the component. Leakage thus indicated shall be considered as noncompliance with the waterproofness requirement and the component shall be rejected. Bubbles which are the result of entrapped air on the exterior surfaces of the component shall not be considered a leak.

Step 2: The chamber shall then be pressurized to six pounds above atmospheric and the component again observed for 30 minutes.

4.8.12 Extreme temperature. To determine conformance to [3.5.5](#), switches shall be subjected to the tests specified in [4.8.12.1](#) and [4.8.12.2](#).

4.8.12.1 Low temperature. Switches shall be conditioned for 4 hours at  $-67 \pm 2^\circ\text{F}$  ( $-55 \pm 1^\circ\text{C}$ ). After conditioning, and while in ambient air at that temperature, the force specified shall be applied to the lever of each switch. The switches shall then be operated for 1,000 cycles while connected to rated resistive load as specified on the applicable MS standard or drawing.

4.8.12.2 High temperature. Switches shall be conditioned for 4 hours at  $170 \pm 2^\circ\text{F}$  ( $77 \pm 1^\circ\text{C}$ ). After conditioning and while in ambient air at that temperature, the switches shall be operated for 1,000 cycles while connected to rated resistive load current as specified on the applicable MS standard or drawing. Switches shall then be cooled to room temperature and shall be examined for the defects listed in [3.5.5](#).

4.8.13 Shock. To determine conformance to [3.5.6](#), the switch shall be mounted by means of a suitable plate and subjected to the shock test specified in [method 213](#) of [MIL-STD-202](#), condition I. A suitable device shall be used to detect spurious opening and closing of contacts during the test.

4.8.14 Vibration. To determine conformance to [3.5.7](#), the switch shall be mounted as in intended operation by means of suitable mounting plate or bracket to assure that mounting is free from resonance over the test frequency range. The switch shall be subjected to a simple harmonic motion having an amplitude of .03 inch (no more than .06 inch total excursion), the frequency being varied uniformly between the approximate limits of 10 to 55 Hz. The entire frequency range, from 10 to 55 Hz and return to 10 Hz, shall be traversed in approximately 1 minute. This motion shall be applied for not less than 1 hour in line with each of the three major axes of the switch (a total of three hours of vibration). A suitable device shall be used to detect spurious opening and closing of contacts during the test.

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4.8.15 Endurance. To determine conformance to [3.5.8](#), switches shall be connected to an energy source and to loads in the manner specified in [4.8.3](#), except that one switch shall be connected to the rated resistive load(s) specified on the applicable MS standard or drawing, and the other switch shall be connected to the rated inductive load(s) specified therein. Each switch shall be operated for 10,000 cycles, as defined in [4.2](#). During the test, each switch shall be periodically observed for evidence of malfunction.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see [6.2](#)). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. 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. The switches covered by this specification are used in direct current electrical circuits in military vehicles.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type, class, and grade of switch (see [1.2](#)).
- c. The specific issue of individual documents referenced (see [2.2.1](#) and [2.3](#)).
- d. Applicable MS standard or drawing (see [3.3](#)).
- e. Packaging requirements (see [5.1](#)).

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 13735, 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 via email to [yqp.chief@dla.mil](mailto:yqp.chief@dla.mil) or from the Defense Supply Center Columbus, Attn: DSCC-VQP, 3990 East Broad Street, Columbus, OH 43213-1199.

6.3.1 Extension of qualification. At the discretion of the qualifying activity, qualification of a switch of one type, class, and grade may establish qualification of any other switch of the same type but of a different class, except that qualification of a grade 2 switch will not establish qualification of a grade 1 switch.

6.4 Definitions.

6.4.1 Recovered materials. "Recovered materials" means materials that have been collected or recovered from solid waste (see [6.4.2](#)).

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6.4.2 Solid waste. "Solid waste means (a) any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; and (b) other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. It does not include solid or dissolved material in domestic sewage, or solid or dissolved material in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Clean Water Act, (33 U.S.C, 1342 et seq.), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 U.S.C, 2011 et seq.) (Source: Federal Acquisition Regulations, section 23.402).

6.4.3 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) (see [3.2.4](#)).

6.5 Subject term (key word) listing.

Electrical circuit  
Endurance  
Extreme low temperature  
Extreme high temperature  
Fungus resistance  
Qualification  
Recycled material  
Shock  
Vehicle  
Vibration

6.6 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 is available on their website at <http://www.epa.gov/epaoswer/hazwaste/minimize/chemlist.htm>. Further information is available at the following EPA site: <http://www.epa.gov/epaoswer/hazwaste/minimize/>. Included in the EPA list of 31 priority chemicals are cadmium, lead, and mercury. Use of the materials on the list should be minimized or eliminated unless needed to meet the requirements specified herein (see Section 3).

6.7 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where modifications 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.

Custodian:  
Army - AT  
DLA - CC

Preparing activity:  
DLA - CC

(Project 5930-2007-048)

Review activity:  
Army - AR, EA, MI

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