

MIL-S-81619B
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MILITARY SPECIFICATION
SWITCHES, SOLID STATE TRANSDUCER,
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 general requirements for the design and manufacture of solid state transducer switches (6.1 and 6.5).

1.2 Classification - Unless otherwise specified (3.1), switches shall be classified as Class 3 equipment in accordance with MIL-E-5400.

1.2.1 Enclosure Design - The enclosure design is identified by a single digit in accordance with Table I. In all types, the electronic package is a hermetically sealed unit.

TABLE I
ENCLOSURE DESIGN

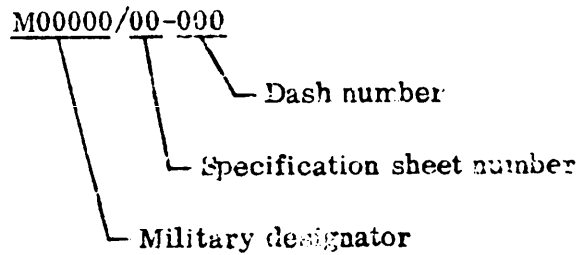
TYPE	ENCLOSURE
1	Unsealed
2	Dusttight
3	Watertight
4	Hermetic

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1.2.2 Military Part Number - The military part number shall consist of the letter "M", the basic number of the specification sheet, and an assigned dash number (3.1) as shown in the following:

Example:



2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

QQ-S-571	Solder, Tin Alloy, Lead-Tin Alloy and Lead Alloy
ZZ-R-765	Rubber, Silicone; Low and High Temperature and Tear Resistant

Military

MIL-I-10	Insulating Compound, Electrical, Ceramic, Class L
MIL-M-14	Molding Plastics and Molded Plastic Parts, Thermosetting
MIL-P-997	Plastic Material, Laminated, Thermosetting, Electrical Insulation: Sheets, Glass Cloth, Silicone Resin
MIL-D-1000	Drawings, Engineering and Associated Lists

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MIL-E-5400	Electronic Equipment, Aircraft, General Specification for
MIL-S-6872	Soldering Process; General Specification for
MIL-P-15037	Plastic Sheet, Laminated, Thermosetting, Glass-Cloth, Melamine-Resin
MIL-E-17555	Electronic and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of
MIL-G-45204	Gold Plating, Electrodeposited
MIL-I-45208	Inspection System Requirements
MIL-C-45662	Calibration System Requirements
MIL-P-81279	Power Supply, Miniature; General Specification for

STANDARDSMilitary

MIL-STD-143	Specification and Standards, Order of Precedence for the Selection of
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-456	Electronic Parts, Date and Source Coding for
MIL-STD-461	Electromagnetic Interference Characteristics Requirements for Equipment
MIL-STD-749	Preparation and Submission of Data for Approval of Nonstandard Electronic Parts
MIL-STD-810	Environmental Test Methods
MIL-STD-883	Test Methods and Procedures for Microelectronics

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MIL-STD-1285 Marking of Electrical and Electronic Parts

MS27726 Integrated Wire Termination System for Use on
Electrical Components

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

2.2 Other Publications - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS

Handbook H28 Screw-Thread Standards for Federal Service

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

3. REQUIREMENTS

3.1 Specification Sheets - Individual switch requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of conflict between requirements of this specification and the specification sheet, the latter shall govern.

3.2 Switch Categories - Switches furnished under this specification shall be Category I or II as defined herein.

3.2.1 Category I - Switches completely defined by a military specification sheet (3.1, 4.5, and 6.2.1).

3.2.2 Category II - Switches the same as Category I, except for minor differences such as terminations and mounting means, which do not change the basic design or construction of the qualified switch. Category II switches shall be procured from a source listed on the applicable qualified products list for the particular similar product in Category I. Category II switches are nonstandard (4.6, 6.2.2).

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3.3 Qualification - Category I switches furnished under this specification shall be products which are qualified for listing on the applicable qualified lists (6.4). This specification makes provisions for qualification inspection (4.5).

3.4 Materials - Materials shall be as specified herein. When a definite material is not specified, the selection of the material shall be at the discretion of the switch manufacturer. Wherever practicable, the manufacturer shall select material standards and specifications in accordance with MIL-STD-143. Materials selected will enable the switch to meet the performance requirements of this specification. Materials shall comply with requirements 3 and 4 of MIL-STD-454 and shall not give off gases which are harmful to humans, cause explosion of sealed enclosures, contaminate or damage any part, or form current carrying tracks when subjected to any of the test specified herein. Acceptance or approval of any constituent material shall not be construed as an endorsement or a guarantee of acceptance of the finished product.

3.4.1 Metals - Requirement 15 of MIL-STD-454 shall apply. The use of any protective coating that will crack, chip, or scale with age or when subjected to any of the inspection tests specified herein shall be avoided.

3.4.1.1 Dissimilar Metals - Unless otherwise specified (3.1), the use of dissimilar metals shall be as specified in Requirement 16 of MIL-STD-454 for Class 1 equipment.

3.4.2 Plastics - Plastic material shall conform to Specification MIL-M-14, MIL-P-15037 or MIL-P-997. Other types of plastic material may be used provided the manufacturer submits satisfactory evidence to the activity responsible for qualification that the materials are suitable for the purpose intended. Cotton-filled or wood-flour-filled materials shall not be used.

3.4.3 Ceramic - Ceramic insulating material shall conform to MIL-I-10, grade L422 or higher. Ceramic used for external surfaces shall be glazed.

3.4.4 Rubber - Rubber shall conform to ZZ-R-765.

3.4.5 Solder - Solder shall conform to QQ-S-571.

3.4.6 Adhesives - Adhesives used in the assembly of electronic parts shall conform to Requirement 23 of MIL-STD-454.

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3.5 Design and Construction - Switches shall be of the design, construction and physical dimensions specified (3.1). The use of materials, parts and processes other than those required by Specification MIL-E-5400 shall be investigated, and when it appears that a substantial reduction in size and weight, or improvement in simplicity of design, performance, and reliability can be realized by their use, a request for approval of a nonstandard part shall be submitted for consideration in accordance with MIL-STD-149. The construction of the switches shall preclude mechanical damage, flaking of the finish, loosening of terminals, or deterioration of marking when subjected to the test methods in section 4 of this specification.

3.5.1 BIT (Built-in-Test) Design Consideration - When specified (3.1), transducer switches shall incorporate a BIT scheme which will provide the necessary information to the data handling system for each of the following conditions:

- (a) Normal switch operation.
- (b) Abnormal switch operation.

3.5.2 Screw Threads - Screw threads shall be in accordance with Handbook H28. Where practical, all threads shall be in conformity with the coarse-thread series. Threading of nonmetallic parts shall not be permitted.

3.5.2.1 Thread Engagement - Threads shall engage by a minimum of two full threads with all required hardware assembled.

3.5.2.2 Thread Length - The minimum thread length shall permit one and one-half threads to extend beyond the retaining nut with all parts assembled.

3.5.3 Actuator - Mechanical actuators shall be as specified (3.1). The number of movable members shall be kept to a minimum. In multiposition switches, mechanical stops or detent action, whichever is applicable, shall be provided for each actuator position.

3.5.3.1 Actuator Operation - When tested as specified in 4.8.2.1, the actuator shall operate smoothly with no indication of mechanical malfunctioning, nor evidence of electrical discontinuity or oscillations (6.5).

3.5.3.2 Operating Forces - The operating forces shall be as specified (3.1) when tested in accordance with 4.8.2.2.

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3.5.3.3 Pretravel (6.5) - The linear or angular pretravel distance shall be as specified (3.1) when tested in accordance with 4.8.2.3.

3.5.3.4 Movement Differential (6.5) - When tested in accordance with 4.8.2.4, the linear or angular distance shall not exceed the value specified (3.1).

3.5.3.5 Overtravel (6.5) - When tested in accordance with 4.8.2.5, the linear or angular overtravel distance shall not be less than the value specified (3.1).

3.5.4 Switch Action - Switches shall incorporate a threshold point at which a change of state (3.5) in the output circuit will be initiated during switch operation. The change of state will be completed prior to reaching the limit specified (3.1) for completion of switch action. Manually operated spring return devices may not be of the snap action type. For snap action switches, the switch action or change of state of the output circuit shall occur at or beyond the threshold point in the selected direction of actuator travel and before the next specified (3.1) switch position.

3.5.5 Mounting Means - Each switch shall be provided with the mounting hardware specified (3.1). For direct Government orders, the hardware shall be assembled in proper order.

3.5.5.1 Single Hole - The mounting bushing shall be as specified (3.1). When specified (3.1), a seal between the actuator and the bushing shall be provided. Should an elastomer seal be used, it shall not protrude above the top of the mounting bushing except for the tapered joint or meniscus where the seal joins the actuator. Single hole mounting means shall incorporate an anti-rotational device as specified (3.1).

3.5.5.2 Multihole - Multihole mounting shall be as specified (3.1).

3.5.6 Terminations (3.1) - Terminals shall not be provided when not functionally required.

3.5.6.1 Flexible Wire - Wire size and type shall be as specified (3.1). Each wire shall be identified by color as specified (3.1), or marked at 3.0 inch intervals with the specified (3.1) terminal designation.

3.5.6.2 Solder - Terminals shall be as specified and designed to accommodate two conductors. Terminals may be treated to facilitate soldering. Solder terminals shall not be gold plated unless so specified (3.1).

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3.5.6.3 Integrated - Quick disconnect terminals shall be of the integrated wire terminations system type defined by Military Standard MS87720.

3.5.6.4 Plug-In (Connector) - Contacts for plug-in headers shall conform to the dimensions and contact arrangements necessary for proper mating with the specified (3.1) receptacle. Pin contacts only shall be used. Unless otherwise specified (3.1), terminals shall be gold plated in accordance with MIL-G-45204, type II, class 1 over nickel plate 0.0001 to 0.0003 inch thick.

3.5.7 Weight - The weight shall be as specified (3.1).

3.5.8 Enclosure Finish - All exterior surfaces shall be lusterless.

3.5.8.1 Enclosure Ground - Unless otherwise specified (3.1), enclosure ground shall be isolated from all signal grounds by not less than 10 megohms.

3.6 Marking - Switches shall be permanently and legibly marked as specified (3.1). Marking shall be considered defective if it is illegible at the completion of any of the required tests.

3.6.1 Identification of Product - Switches shall be marked in accordance with MIL-STD-1285, with the following information:

- (a) Military part number (Category I only).
- (b) Manufacturer's part number.
- (c) Manufacturer's name, trademark, or code symbol in accordance with MIL-STD-456.
- (d) Date code in accordance with MIL-STD-456.
- (e) Switch position (when specified 3.1).
- (f) Terminal identification as specified (3.1).

3.6.1.1 Use of Military Part Number - Military part numbers shall not be applied to a product, except for qualification test samples, nor referred to in correspondence, until notice of approval has been received from the activity responsible for qualification.

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3.7 Interchangeability - All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. The drawing number requirement of Specification MIL-D-1000 shall govern changes in manufacturer's part numbers.

3.8 Attitude - Switches shall be constructed to ensure proper operation when mounted in any position.

3.9 Workmanship - Workmanship shall be in accordance with MIL-STD-454, Requirement 9.

3.9.1 Soldering - Soldering processes shall conform to MIL-S-8872. Soldering shall be so executed that both a positive electrical and strong mechanical connection is assured. However, connections shall not depend on solder alone for mechanical strength.

3.10 Mechanical Characteristics

3.10.1 Strength of Actuating Means - When tested as specified in 4.8.2.6, there shall be no evidence of bending, breaking, or loosening of parts and the mechanical and electrical characteristics of the switch shall remain as specified (3.1).

3.10.2 Strength of Mounting Means - When tested as specified in 4.8.2.7, there shall be no evidence of twisting, breaking, or loosening of parts and the mechanical and electrical characteristics of the switch shall remain as specified (3.1).

3.10.3 Terminal Strength - When tested as specified in 4.8.2.8, there shall be no short circuiting, breakage, loosening of terminals or damage to the switch body and the mechanical and electrical characteristics of the switch shall remain as specified (3.1).

3.10.4 Resistance to Soldering Heat - When tested as specified in 4.8.2.9, there shall be no evidence of loosening of parts. After test, the switch shall comply with the specified (3.1) electrical operating characteristics.

3.10.5 Solderability - Switches tested as specified in 4.8.2.10 shall meet the applicable requirements of Method 208 of MIL-STD-202.

3.10.6 Seal - Upon completion of the applicable test (4.8.2.11) and prior to any internal inspection, the switch shall comply with the specified (3.1) electrical operating characteristics.

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3.10.6.1 Dusttight (Type 2 Enclosure) - When tested as specified in 4.8.2.11.1, there shall be no evidence of mechanical or electrical malfunction and no dust shall be evident inside the switch.

3.10.6.2 Watertight (Type 3 Enclosure) - When tested as specified in 4.8.2.11.2, there shall be no leakage as evidenced by a continuous stream of bubbles.

3.10.6.3 Hermetic (Type 4 Enclosure) - When tested as specified in 4.8.2.11.3, the leakage rate shall not exceed 10^{-6} standard atmosphere cubic centimeter per second (atm cc/sec).

3.11 Electrical Characteristics

3.11.1 Input Power - When switches are tested as specified in 4.8.3.1, the input power shall not exceed the specified values (3.1).

3.11.2 Absolute Maximum Supply Voltage - When tested as specified in 4.8.3.2, there shall be no evidence of damage nor shall the output change state. For acceptance testing, the specified (3.1) absolute maximum supply current shall not be exceeded.

3.11.3 Output Voltage and Current - When tested as specified in 4.8.3.3, the output voltage and current shall be as specified (5.1).

3.11.4 Output Rise and Fall Time - When tested as specified in 4.8.3.4, the output rise and fall time (6.5) shall be as specified (3.1).

3.11.5 Output Voltage Waveform - When tested as specified in 4.8.3.5, the output voltage waveform shall show no evidence of oscillations (6.5), ringing, spikes, discontinuity, and overshoot during steady state and during transition between states.

3.11.6 Short Circuit - When tested as specified in 4.8.3.6, there shall be no evidence of damage and the switches shall be operational upon completion of the test.

3.11.7 Transient Voltage - When tested as specified in 4.8.3.7, there shall be no change of state during a transient. When pulses are applied between the input and ground terminal with the switch in the actuated (logical '1') condition, conduction of pulse shall not constitute a failure. The switch shall be operational upon completion of the test.

3.11.8 Insulation Resistance - When tested as specified in 4.8.3.8, the insulation resistance shall be greater than 100 megohms.

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3.11.9 Dielectric Withstanding Voltage - When tested as specified in 4.8.3.9, there shall be no leakage current in excess of 1.0 milliamperes (ma), nor evidence of damage due to arcing (air discharge), flashover (surface discharge), or insulation breakdown (puncture discharge). Upon completion of the test the switch shall be operational.

3.12 Environmental Characteristics - While being subjected to the following tests, switches shall show no evidence of physical, mechanical, or electrical malfunction. Upon completion of each test, switches shall comply with the requirements of 3.12.1.

Temperature Shock	4.8.4.1
Temperature-Altitude	4.8.4.2
Humidity	4.8.4.3
Salt Fog	4.8.4.4
Vibration	4.8.4.5
Acceleration	4.8.4.6
Shock	4.8.4.7
Electromagnetic Compatibility	4.8.4.8
Magnetic Compatibility	4.8.4.9
Life	4.8.4.10
Seal	4.8.2.11

3.12.1 Performance Criteria - Unless otherwise specified herein, switches shall comply with the following requirements:

- (a) Design and construction 3.5, 3.5.3, 3.5.4, 3.5.8
- (b) Output voltage and current 3.11.3
- (c) Output-voltage waveform 3.11.5
- (d) Insulation resistance 3.11.8
- (e) Dielectric withstanding voltage 3.11.9

3.13 Conditioning (Burn-In) - When tested as specified in 4.8.5, the switch shall perform satisfactorily (3.1).

4. QUALITY ASSURANCE PROVISIONS

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4.1 Inspection Responsibility - Inspection requirements shall comply with MIL-I-45208. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection and test requirements as specified herein. Except as otherwise specified, the supplier may use his own facilities or any commercial laboratory acceptable to the procuring agency. The procuring agency reserves the right to perform any of the inspections and tests set forth in the specification where such inspections and tests are deemed necessary to assure that the supplies and services conform to prescribed requirements.

4.1.1 Test Equipment and Facilities - Test equipment and facilities shall be of sufficient accuracy, quality and quantity to permit performance of the required inspection. The supplier shall establish calibration of inspection equipment to the satisfaction of the Government. Calibration of the standards which control the accuracy of the inspection equipment shall comply with the requirements of MIL-C-45662.

4.2 Classification of Inspections - The inspections specified herein are classified as follows:

- | | |
|-------------------------|-----|
| (a) Materials | 4.4 |
| (b) Qualification | 4.5 |
| (c) Category I Switches | 4.6 |
| (d) Quality Conformance | 4.7 |

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-810.

4.3.1 Power Supply - The power supply required for all electrical tests shall conform to Specification MIL-P-81279.

4.3.2 Stabilization of Test Temperature - Stabilization of the test temperature for both the operating and nonoperating condition shall be determined in accordance with the "General Requirements" of MIL-STD-810.

4.4 Materials Inspection - Materials inspection shall consist of certification supported by verifying data that the materials used in fabricating the switch are in accordance with the applicable specifications referenced herein (7.4).

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4.5 Qualification Inspection (Category I Switches, 3.2.1, 6.2.1) - Qualification inspection tests shall be conducted on production samples to determine the ability of the switches to meet the requirements of this specification prior to designation as a qualified product.

4.5.1 Sampling Instructions - The number of switches to be subjected to qualification inspection shall be as specified in Table II. Samples shall be submitted for each manufacturer's part number for which qualification is desired. Samples shall be identified by a securely attached tag marked with the manufacturer's part number and the military part number, and forwarded to the activity responsible (6.4) for qualification.

4.5.2 Test Data - Each submission shall be accompanied by test data for the tests listed in Table I which have been performed on representative samples.

TABLE I
QUALIFICATION INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	No. of Sample Units To be Tested	No. of Failures Allowed
<u>Group I</u>				
Visual and Dimensional Examination	3.1, 3.4, 3.4, 3.6 3.7, 3.9	4.8.1	All Units	0
Actuator Operation	3.5.3.1	4.8.2.1		
Insulation Resistance	3.11.8	4.8.3.8		
Dielectric Withstanding Voltage	3.11.9	4.8.3.9.1		
<u>Group II</u>				
Operating Forces	3.5.3.2	4.8.2.2		
Pretravel	3.5.3.3	4.8.2.3		
Movement Differential	3.5.3.4	4.8.2.4		
Overtravel	3.5.3.5	4.8.2.5		
Strength of Actuating Means	3.10.1	4.8.2.6		

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TABLE II (Contd)

QUALIFICATION INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	No. of Sample Units To be Tested	No. of Failures Allowed
Strength of Mounting Means	3.10.2	4.8.2.7	4	0
Terminal Strength	3.10.3	4.8.2.8		
Resistance to Soldering Heat	3.10.4	4.8.2.9		
Solderability	3.10.5	4.8.2.10		
Vibration	3.12	4.8.4.5		
Acceleration	3.12	4.8.4.6		
Shock	3.12	4.8.4.7		
Seal	3.10.6	4.8.2.11		
<u>Group III</u>				
Input Power	3.11.1	4.8.3.1	4	0
Absolute Maximum Supply Voltage	3.11.2	4.8.3.2		
Output Voltage and Current	3.11.	4.8.3.3		
Output Rise and Fall Time	3.11.	4.8.3.4		
Output Voltage Waveform	3.11.5	4.8.3.5	4	0
Short Circuit	3.11.	4.8.3.6		
Transient Voltage	3.11.	4.8.3.7		
Dielectric Withstanding Voltage	3.11.	4.8.3.9.2		
Temperature Shock	3.12	4.8.4.1		
Salt Fog	3.12	4.8.4.4		
<u>Group IV</u>				
Electromagnetic Compatibility	3.12	4.8.4.8	2	0
Magnetic Compatibility	3.12	4.8.4.9		
Humidity	3.12	4.8.4.3		

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TABLE II (Contd)

QUALIFICATION INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	No. of Sample Units To be Tested	No. of Failures Allowed
<u>Group V</u>				
Temperature-Altitude Life	3.12 3.12	4.5.4.2 4.8.4.10	2	0

1.5.3 Reduced Inspection - After a manufacturer has successfully qualified a basic switch type, other switches belonging to the same generic group (6.5) may be qualified with reduced inspection upon written consent of the qualifying agency (6.4). The reduced inspection schedule shall include those tests, selected from Table II, which validate the acceptability of any difference from the basic type.

1.5.4 Failures - Failures in excess of those allowed in Table II shall be cause for refusal to grant qualification.

1.5.5 Retention of Qualification - To retain qualification, the supplier shall forward to the qualifying activity at 24-month intervals, a summary of group A tests, indicating as a minimum the number of lots which passed and the number which failed, and the complete results of groups B and C tests, including the number and type of any part failures. The summary shall include those tests performed during that 24-month period. If the summary of the test results indicates nonconformance with specification requirements, action shall be taken to remove the failed product from the qualified products list. Failure to submit the summary shall result in loss of qualification for that product.

In addition to the periodic submission of inspection data, the supplier shall immediately notify the qualifying activity at any time during the 24-month period that the inspection data indicates failure of the qualified product to meet the requirements of the specification. In the event that no production occurred during the reporting period, a report to that effect shall be submitted.

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4.6 Inspection of Category II Switches (3.2.2) - Test to verify suitability of the variations from the Category I switches shall be performed as specified (6.2.2).

4.7 Quality Conformance Inspection -

4.7.1 Inspection of Product for Delivery - Inspection of product for delivery shall consist of group A inspection. Except as specified in 4.7.2.2.3, delivery of products which have passed group A inspection shall not be delayed pending the results of the groups B and C inspections.

4.7.1.1 Inspection Lot - An inspection lot shall consist of all switches designed and constructed to conform to a particular specification (3.1), and produced under essentially the same conditions and offered for inspection at one time.

4.7.1.2 Group A Inspection - Group A inspection shall consist of the examinations and tests specified in Table III, and shall be performed in the order shown.

4.7.1.2.1 Disposition of Sample Unit - Sample units which have been subjected to and have passed group A inspection shall be delivered in the contract or purchase order.

4.7.1.2.2 Rejected Lots - If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units and resubmit for inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.7.2 Periodic Inspection - Periodic inspection shall consist of groups B and C inspections.

4.7.2.1 Group B Inspection - Group B inspection shall consist of the test(s) specified in Table IV, and shall be performed in the order shown.

4.7.2.1.1 Sampling Plan - The number of sample units specified in Table IV shall be selected every six months from inspection lots which have passed group A inspection.

4.7.2.1.2 Rejected Lots - If an inspection lot is rejected, the supplier may rework it to correct the defects or screen out the defective units, and resubmit for inspection. Resubmitted lots shall be subjected to groups A and B inspection. Such lots shall be separate from new lots, and shall be clearly identified as reworked lots.

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4.7.2.1.3 Disposition of Sample Units - Sample units which have been subjected to a group B inspection shall not be delivered on the contract or purchase order.

4.7.2.2 Group C Inspection -

4.7.2.2.1 Sampling Plan - Every 24 months, switches shall be subjected to the inspections of Table II, performed in the order shown. The number of failures allowed shall be as specified in Table II.

4.7.2.2.2 Disposition of Sample Units - Unless otherwise specified, sample units which have been subjected to group C inspection shall not be delivered on the contract or purchase order.

4.7.2.2.3 Noncompliance - If a sample fails to pass group C inspection, the supplier shall take corrective action on the materials or processes, or both, as necessary, and on all units of the product which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., 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 C inspection shall be repeated on additional sample units. Groups A and B inspections may be reinstituted; however, final acceptance shall be withheld until the group C reinspection has shown that the corrective action was successful.

4.7.3 Inspection of Preparation for Delivery - Sample packages or packs and the inspection of the preservation, packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 or the documents specified therein.

TABLE III

GROUP A INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	No. of Sample Units To be Inspected
Conditioning (Burn In)	3.13	4.8.5	100%
Actuator Operation	3.5.3.1	4.8.2.1	
Marking	3.6	4.8.1	
Absolute Maximum Supply Voltage	3.11.2	4.8.3 2	

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TABLE III (Contd)

GROUP A INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	No. of Sample Units To be Inspected
Output Voltage and Current	3.11.3	4.8.3.3	
Output Voltage Waveform	3.11.5	4.8.3.5	
Insulation Resistance	3.11.8	4.8.3.8	

TABLE IV

GROUP B INSPECTION

Examination or Test	Requirement Paragraph	Method Paragraph	No. of Sample Units To be Tested	No. of Defectives Allowed
Operating Forces	3.5.3.1	4.8.2.2	5	0
Input Power	3.11.1	4.8.3.1		
Short Circuit	3.11.6	4.8.3.6		
Transient Voltage	3.11.7	4.8.3.7		
Dielectric Withstanding Voltage	3.11.9	4.8.3.9		
Temperature Shock	3.12	4.8.4.1		
Seal	3.10.6	4.8.2.11		

4.8 Methods of Examination and Inspection -

4.8.1 Visual and Dimensional Inspection - Switches shall be examined to verify that the dimension, materials, design and construction, marking and workmanship are in accordance with the applicable requirements (3.1, 3.4, 3.5, 3.6, 3.7 and 3.9).

4.8.2 Mechanical and Physical Inspection

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4.8.2.1 Actuator Operation (3.5.3.1) - With the specified supply voltage (3.1) applied and the output circuit monitored, the switches shall be operated through all ranges of actuator motion.

4.8.2.2 Operating Forces (3.5.3.2) - The switch shall be mounted by its normal mounting means. The forces required to move the actuator between specified (3.1) positions in both direction of travel shall be measured. (For toggle switches, the force shall be measured 0.125 ± 0.030 inch from the top of actuator.)

4.8.2.3 Pretravel (3.5.3.3) - With the switch mounted by its normal mounting means, the specified supply voltage (3.1) applied and the output circuit monitored, the pretravel (6.5.4) shall be measured.

4.8.2.4 Movement Differential (3.5.3.4) - The switch shall be mounted by its normal mounting means. With the specified supply voltage (3.1) applied and the output circuit monitored, the movement differential (6.5.5) shall be measured.

4.8.2.5 Overtravel (3.5.3.5) - The switch shall be mounted by its normal mounting means. With the specified supply voltage (3.1) applied and the output circuit monitored, the overtravel distance (6.5.6) shall be measured.

4.8.2.6 Strength of Actuating Means (3.10.1) - With the switch mounted by its normal mounting means, the specified (3.1) static load shall be applied to the actuator and maintained for a period of 1 minute. The test shall be repeated for each direction in the line of actuator travel. For toggle type switches, the load shall be applied at a distance of 0.125 ± 0.030 inch from the top of the toggle.

4.8.2.7 Strength of Mounting Means (3.10.2) -

4.8.2.7.1 Single Hole - Bushing mounted switches shall be mounted on a metal panel by their normal mounting means with the hardware specified (3.1). A torque of 15 pound-inches shall be applied to the mounting nut for a period of 30 seconds. If the unit incorporates a nonturn device, the mounted switch bracket shall be subjected to a torque of 5 pound-inches for a period of 30 seconds.

4.8.2.7.2 Multihole - Switches shall be mounted on a metal panel by their normal mounting means with the hardware specified (3.1). Each mounting screw shall be subjected to a torque of 10 pound-inches for a period of 30 seconds.

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4.8.2.8 Terminal Strength (3.10.3) - Switches shall be tested in accordance with Method 211 of MIL-STD-202. Unless otherwise specified herein, two terminals of each discrete design, size, and configuration shall be tested. No terminal shall be tested in more than one direction. The following details and exceptions shall apply.

4.8.2.8.1 Pull Test (All Terminal Types) -

- (a) Test Condition - A
- (b) Applied Force - 5 pounds
- (c) Directions of Force - Parallel to the long axis of the terminal; perpendicular to the long axis of the terminal.

4.8.2.8.2 Bend Test (Not Applicable to Plug-In Terminals) -

- (a) Test Condition - B or C, as applicable.
- (b) Number of Bends - Two
- (c) Applied Force (Test Condition 'C' only) - 2.5 pounds.

4.8.2.8.3 Torque Test (Screw Terminals) -

- (a) Test Condition - E
- (b) Direction of Force - In the direction which will tighten screw.

4.8.2.9 Resistance to Soldering Heat (3.10.4) - Switches shall be tested in accordance with Method 210 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Depth of Immersion in Molten Solder - Within 0.060 ± 0.020 inch of the switch body.
- (b) Test Condition - B

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4.8.2.10 Solderability (3.10.5) - Switches shall be tested in accordance with Method 208 of MIL-STD-202. The following details shall apply:

- (a) Number of terminations of each part to be tested - All.
- (b) Depth of Immersion in Flux and Solder - Leads shall be immersed to within 1/16-inch of the seal or case.

4.8.2.11 Seal (3.10.6) -

4.8.2.11.1 Dusttight (3.10.6.1) - Switches shall be mounted on a metal panel by their normal mounting means and subjected to the dust test in accordance with Procedure I, Method 510 of MIL-STD-810. With the specified supply voltage applied to the input terminal and the output circuit monitored, mechanically actuated switches shall be operated during steps 1 and 3 at a rate of 6 cycles per minute.

4.8.2.11.2 Watertight (3.10.6.2) -

- (a) Switches shall be immersed in a container of water containing approximately one percent aerosol, and shall then be placed in a vacuum chamber. The absolute pressure shall be 1.3 inches of mercury and this pressure shall be maintained for a period of one minute or until air bubbles cease to be given off by the water, whichever is longer. The absolute pressure shall then be increased to 2.5 inches of mercury and this pressure maintained for two minutes. During the two-minute period, the switches shall be observed for evidence of a continuous stream of bubbles.
- (b) Measurement after test - As required in 3.10.6.

4.8.2.11.3 Hermetic (3.10.6.3) - Switches shall be tested in accordance with Method 112 of MIL-STD-202. The following details shall apply:

- (a) Test Condition - C (procedure III or IV at the option of the manufacturer). Test condition B shall be used to test for gross leaks.
- (b) Reduced pressure of chamber and duration of pressurization (procedure IV) - Below 5mm of mercury for 6 hours.

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(c) Measurements after test - Not applicable.

4.8.3 Electrical Inspections -

4.8.3.1 Input Power (3.11.1) - With the specified (3.1) supply voltage applied, the input power shall be measured by the volt-ammeter method for each of the following conditions:

- (a) Unactuated ('OFF').
- (b) Actuated and output connected to the specified (3.1) load impedance.
- (c) Actuated and output shorted to ground.

4.8.3.2 Absolute Maximum Supply Voltage (3.11.2) - With the specified (3.1) absolute maximum supply voltage applied to the input terminal and the output connected to the specified (3.1) load impedance, the switch shall operate in the actuated condition for 30 minutes. During this test the output voltage and current shall be monitored. The test shall be repeated with the switch in the deactuated (output in 'OFF' state) condition. For acceptance testing, the test time may be reduced to 5 seconds.

4.8.3.2.1 Reverse Polarity - The specified (3.1) absolute maximum supply voltage shall be applied in turn to each terminal with all other terminals connected to ground. The minimum test time shall be 1 minute for each voltage application. During this test the maximum supply current specified shall not be exceeded. The test shall be repeated for the actuated and deactuated condition.

4.8.3.3 Output Voltage and Current (3.11.3) - With a suitable load impedance connected to the output terminal, the voltage and current shall be measured for each of the following conditions:

- (a) With the load impedance connected to ground and the specified (3.1) minimum supply voltage applied to the input terminal, the load impedance shall be adjusted for the specified (3.1) minimum output current flow for the switch in the actuated condition (logical '1' output). The voltage at the output terminal shall be measured. Deactuate the switch (logical '0' output) and repeat voltage measurement.

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- (b) With the switch in the deactuated condition, the specified (3.1) maximum supply voltage shall be applied to the load impedance. The load impedance shall be adjusted for the specified (3.1) minimum (sinking) current flow and the voltage at the output terminal shall be measured.

4.8.3.4 Output Rise and Fall Time (3.11.4) - With the specified (3.1) supply voltage applied to the input terminal and the output connected to a suitable impedance adjusted for the specified (3.1) minimum output current for the actuated condition (logical '1' output), the switch shall be actuated and deactuated. The voltage waveform at the output terminal shall be recorded and the rise and fall time measured (6.5).

4.8.3.5 Output Voltage Waveform (3.11.5) - The switch shall be operated as in 4.8.3.4 and the output voltage waveform noted.

4.8.3.6 Short Circuit (3.11.6) - With the specified (3.1) supply voltage applied to the input terminal and all output terminals shorted to ground operate the switch for 30 minutes. For quality conformance inspections, the test time may be reduced to 5 seconds.

4.8.3.7 Transient Voltage (3.11.7) - A train of positive pulses of 10 KHZ frequency and 100 volts maximum amplitude shall be applied between the input and ground terminals for a period of 1.0 millisecond. The duty cycle of each pulse in the train shall be 10 percent. Unless otherwise specified (3.1), the transient voltage source impedance shall be 250 ohms. The pulse train shall be repeated 5 times at three-second interval. The test shall be repeated across the output and ground terminals. The tests shall be performed for both the actuated (logical '1') and unactuated (logical '0') condition.

4.8.3.8 Insulation Resistance (3.11.8) - Switches shall be tested in accordance with Method 302 of MIL-STD-202. The following details shall apply.

(a) Test Condition - A

(b) Points of Measurement - The terminals shall be shorted together and measurements taken between enclosure and terminals.

4.8.3.9 Dielectric Withstanding Voltage (3.11.9) - Switches shall be tested as specified in 4.8.3.9.1 and 4.8.3.9.2.

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4.8.3.9.1 At Atmospheric Pressure - Switches shall be tested in accordance with Method 301 of MIL-STD-202. The following details shall apply:

- (a) Test Voltage - 120 volts RMS
- (b) Points of Application - The terminals shall be shorted together and the test voltage applied between the enclosure and terminals. Repeat test for each actuator position.

4.8.3.9.2 At Reduced Barometric Pressure - Switches specified for operation above 10,000 feet shall be tested in accordance with Method 105 of MIL-STD-202. The following details shall apply:

- (a) Method of Mounting - Normal mounting means.
- (b) Test Condition - D
- (c) Tests during subjection to reduced pressure - As specified in 4.8.3.9.1 except test voltage shall be 60 volts RMS.

4.8.4 Environmental Characteristics (3.12) -

4.8.4.1 Temperature Shock - Switches shall be tested in accordance with Method 503 of MIL-STD-810. The following details and exceptions shall apply:

- (a) Mounting - Switches shall be suspended in the test chamber by twine or other nonheat conducting material in a place parallel to the normal air flow.
- (b) Exposure Time - In steps 1, 3 and 5, the chamber temperature shall be maintained for a period of not less than 1 hour.
- (c) Temperature levels - As specified.
- (d) Inspection during test - None. Switches shall not be energized nor mechanically operated during this test.
- (e) Inspection after test - As specified in 3.12.1

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4.8.4.2 Temperature-Altitude - Switches shall be tested in accordance with Procedure I, Method 504 of MIL-STD- 10. The following details and exceptions shall apply:

- (a) Equipment class - 3
- (b) Test Conditions - In step 7 change 125° C to the maximum operating temperature specified (3.1). Omit step 8.
- (c) Inspection during test - Where specified, switch operation shall conform to 3.11.3 and 3.11.5.
- (d) Inspection after test - As specified in 3.12.1

4.8.4.3 Humidity - Switches shall be tested in accordance with Procedure I, Method 507 of MIL-STD-810. Switches shall be mounted on a corrosion-resistant panel by normal mounting means.

4.8.4.4 Salt Fog - Switches shall be tested in accordance with Procedure I, Method 508 of MIL-STD-810. The following details shall apply:

- (a) Inspection after exposure - Switches shall be examined for evidence of corrosion, peeling and blistering of the finish and exposure of base metal.
- (b) Inspection after test - As specified in 3.12.1.

4.8.4.5 Vibration - Switches shall be tested in accordance with Procedure II, Method 514 of MIL-STD-810. The following details and exceptions shall apply:

- (a) In part 1, the sinusoidal vibration test curve shown in Figure 1 of this specification shall be used.
- (b) Delete part 2.
- (c) In part 3, curve AH shall be used.
- (d) The time schedule of Table 514-IV shall be used.

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- (e) Inspection during test - During the entire vibration schedule, the specified (3.1) supply voltage shall be applied to the input terminal and the output circuit shall be monitored. The switch shall be cycled 15 minutes in the actuated condition (logical '1' output) and 15 minutes in the unactuated condition (logical '0' output). The output circuit shall show no evidence of oscillation (6.5) or change in state (6.5).

- (f) Inspection after test - As specified in 3.12.1.

4.8.4.6 Acceleration - Switches shall be tested in accordance with Procedure II, Method 513 of MIL-STD-883C. The following details and exceptions shall apply:

- (a) Acceleration level - As specified (3.1).
- (b) Inspection during Test - The specified (3.1) supply voltage shall be applied to the input terminal, and the output circuit shall be monitored. In each of the 6 directions the switch shall be in the actuated condition (logical '1' output) for 2 minutes and in the unactuated condition (logical '0' output) for an additional 2 minutes. The output shall show no evidence of oscillations (6.5) or change in state (6.5).
- (c) Inspection after test - As specified in 3.12.1.

4.8.4.7 Shock - Switches shall be tested in accordance with Procedure IV, Method 516 of MIL-STD-883C. The following details and exceptions shall apply:

- (a) Pulse configuration - Half sine wave with level and duration as specified (3.1).
- (b) Inspection during test - The specified (3.1) supply voltage shall be applied to the input terminal and output circuit shall be monitored. In each of the 6 directions the switch shall be in the actuated condition (logical '1' output) for the first shock pulse and in the unactuated condition (logical '0' output) for the second. The output shall show no evidence of oscillation (6.5) or change in state (6.5).

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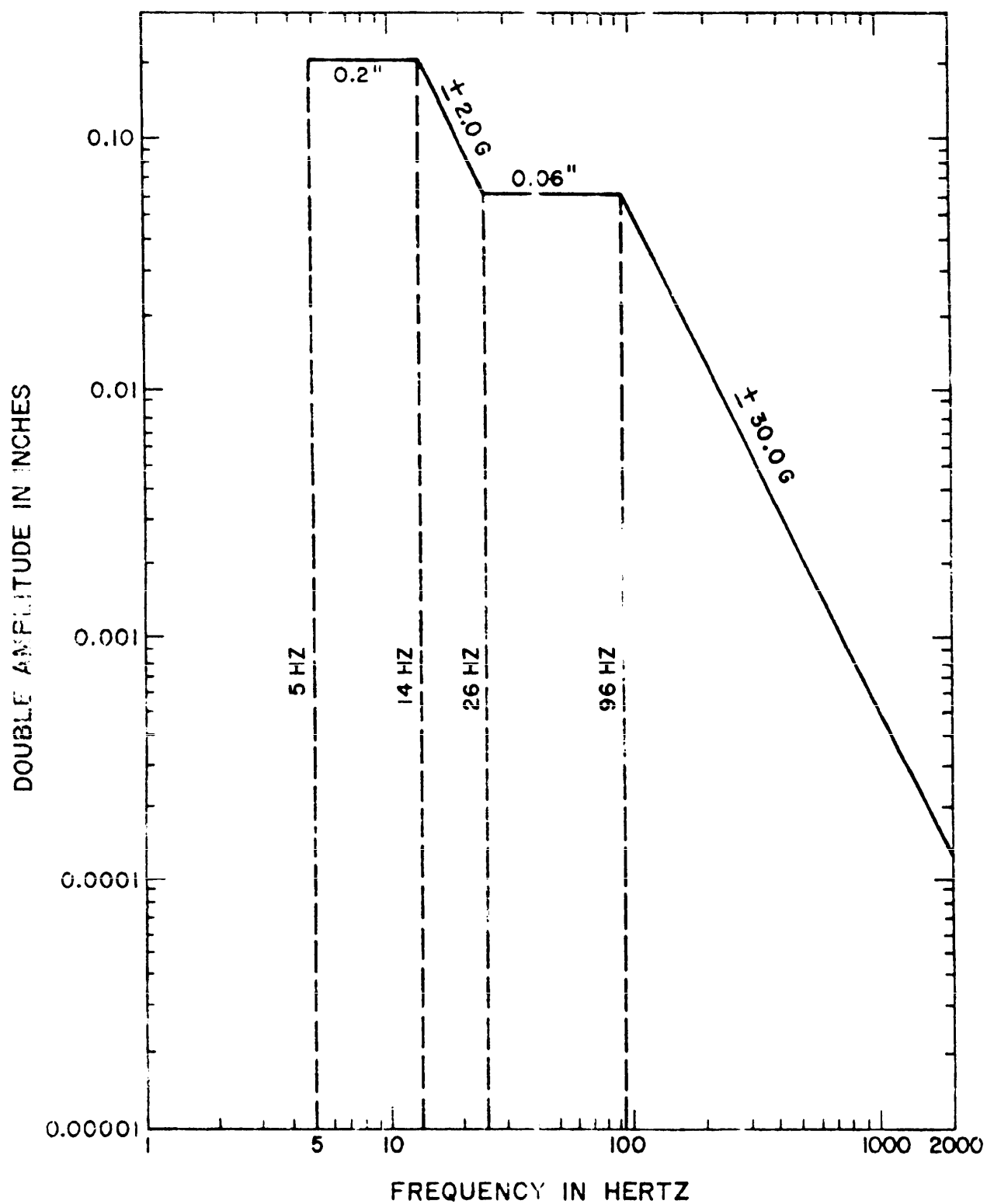


Figure 1. Vibration Level Curve

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(c) Inspection after test - as specified in 3.12.1.

4.8.4.8 Electromagnetic Compatibility - Switches shall be tested in accordance with MIL-STD-461. The following details and exceptions shall apply:

(a) Equipment class - 1D.

(b) Operating instructions - All tests shall be performed with the switch in the actuated condition (logical '1' output) and repeated with the switch in the unactuated condition (logical '0' output). Switch operation for each of these conditions shall be as specified in 4.8.3.3. During these tests, the effects of switching action shall be noted.

(c) Inspection after test - Not applicable.

4.8.4.9 Magnetic Compatibility - The switch operating in the actuated (6.5) condition as specified in 4.8.3.3, shall be rotated in a vertical plane about a short-bar magnet compass having a horizontal magnetic field intensity of 0.17 to 0.19 oersted. The nearest part of the switch shall be five inches from and magnetically east of the center of the compass. At this starting point and at each 45 degree angle interval, the switch shall be rotated 360 degrees on its own horizontal axis. With the switch at any specified position, the compass deflection shall not exceed 1 degree nor shall the switch output change state as a result of the magnetic field. The test shall be repeated with the switch operating in the unactuated condition as specified in 4.8.3.3. Inspection after test is not required.

4.8.4.10 Life - With the specified (3.1) supply voltage connected to the input terminal and the output connected to the specified (3.1) load impedance, the switch shall be cycled "ON" and "OFF" at a rate of not less than 10 to 18 cycles per minute for the minimum number of cycles specified (3.1). At the option of the manufacturer, a faster rate of cycling up to 60 cycles per minute may be used. The duty cycle shall be 50-percent.

Eighty percent of the operating cycles shall be evenly divided between operation at the specified (3.1) maximum and minimum operating temperatures. The remaining cycles shall be performed at room ambient. Switches with momentary actuator positions shall be returned from their momentary position solely by their internal mechanism. During this test the output voltage shall be monitored for proper operation. Inspection after test shall be as specified in 3.12.1.

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4.8.5 Conditioning (Burn-In) (3.1.3) - Conditioning (burn-in) shall be performed on all electronic components and subassemblies prior to assembly or on the completed electronic packages at the option of the vendor. Tests shall be performed in accordance with test condition 3 of Method 1015 of MIL-STD-883. The test duration shall be a minimum of 168 hours at the maximum operating temperature specified (3.1). On completed electronic packages the rated electrical parameters may be used. In addition to the above test, all completed switches shall be operated for a minimum of 500 cycles at the maximum operating temperature specified (3.1) and 500 cycles at room ambient prior to being subjected to the electrical characteristics tests (3.11).

5. PREPARATION FOR DELIVERY

5.1 Preservation, Packaging, Packing and Marking - Switches shall be preserved and packaged in accordance with Level A or C of Specification MIL-E-17555 as specified (6.2). They shall be packed in accordance with Level A, B or C as specified (6.2), and marked in accordance with Specification MIL-E-17555.

6. NOTES

6.1 Intended Use - Switches covered by this specification are intended for use in SOSTEL (Solid State Electric Logic) type systems.

6.2 Ordering Data - Procurement documents should specify the following.

6.2.1 Category I (Switches Covered by Specification Sheets (3.2.1)) -

- (a) Title, number, and date of this specification.
- (b) Title, number, and date of the applicable specification sheet, and the military part number.
- (c) The packaging and packing level required (5.1).

6.2.2 Category II (Qualified Switches with Modification) (3.2.2) -

- (a) Title, number, and date of this specification.
- (b) Title, number, and date of applicable specification sheet for similar switches.

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- (c) Military part number of similar qualified power switch.
- (d) Manufacturer's part number of modified switch.
- (e) Details of the variations from the specification sheet.
- (f) Inspection requirements (to verify variations from Category I switches) (4.6):
 - (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.
- (g) The packaging and packing level specified (5.1).
- (h) Test reports shall be prepared in accordance with MIL-STD-149.

6.3 Indirect Shipments - The preservation and packaging, packing, and marking specified in section 5 apply only to direct purchases by or direct shipments to the Government and are not intended to apply to contractor or orders between the supplier and prime contractor.

6.4 Qualification - With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening bids, been tested and approved for inclusion in the applicable Qualified Products Lists whether or not such products have actually been so listed by this date. The attention of the suppliers is called to this requirement and manufacturers are urged to arrange to have the products 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. The activity responsible for the Qualified Products List is the NAVAIRSYSCOM (Naval Air Systems Command), Washington, D. C. 20360, and information pertaining to qualification of products may be obtained from that activity.

6.4.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to the Commanding Officer, Naval Publications and Forms Center, 5809 Tabor Avenue, Philadelphia, Pennsylvania 19120.

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6.5 Definitions - The definitions listed below are not a complete glossary of solid state switch terminology, but rather are intended as definitions of the technical terms as applied within this specification.

6.5.1 Solid State Transducer Switch - A solid state transducer switch is defined as a device used to translate a natural phenomenon to an electric digital reference.

6.5.2 Oscillation - Oscillation is defined as any reversal of direction in the output voltage waveform.

6.5.3 Actuate - The action of changing the electrical output of the transducer from the low (0) state to the high (1) state.

6.5.4 Pretravel - The linear or angular distance the actuator moves from the set position to the operating position.

6.5.5 Movement Differential - The linear or angular distance the actuator travels between the actuate point and the deactuate point of a given output circuit.

6.5.6 Overtravel - The linear or angular distance the actuator travels from the position at which a change of state occurs in the output circuit to the next set position in the line of actuator travel.

6.5.7 Snap Action Switch - Snap action switches such as toggle, rotary, or push button shall incorporate an overcenter or detent type action as the threshold point between switch positions.

6.5.8 Change in State - A change in state is a change in the output voltage levels from a logical '0' to a logical '1' or vice versa.

6.5.9 Rise and Fall Time - See Figure 2.

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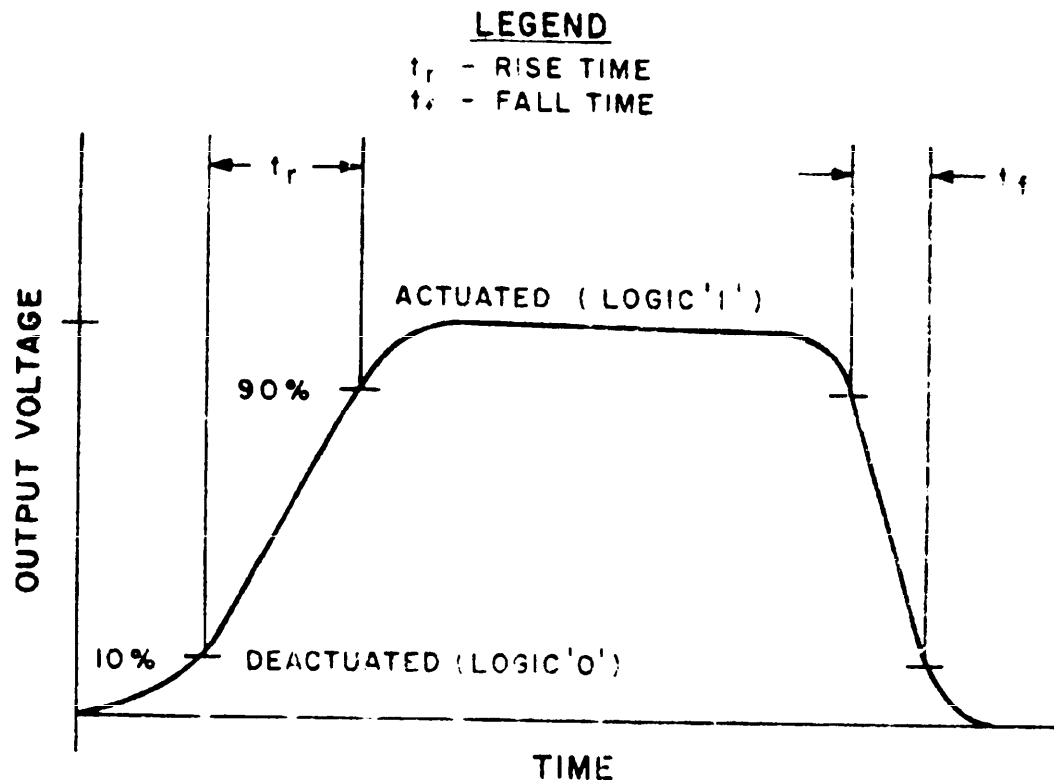


Figure 2. Illustration of Timing Characteristics

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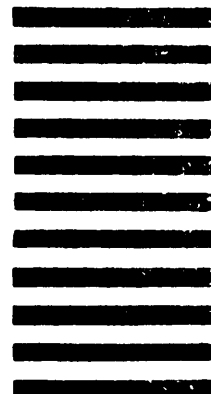
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