

MILITARY SPECIFICATION

SWITCH, MOMENTARY, ACCELERATION-SENSITIVE

This specification is approved for use within the Army Missile Command, Department of the Army and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers one type of single pole, single throw, normally open, momentary, acceleration-sensitive switch.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

MIL-E-11991	Electronics, Electrical, and Electro-mechanical Equipment, Guided Missile and Associated Weapon Systems, General Specification For
MIL-W-16878/4	Wire, Electrical, Polytetrafluoroethylene (PTFE) Insulated, 200°C, 600 Volts, Extruded Insulation

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Missile Command, ATTN: AMSMI-RD-SE-TD-ST, Redstone Arsenal, AL 35898-5270 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MIL-S-47314(MI)

MIL-S-28786 Switches, Packaging of

STANDARDS

MILITARY

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-130	Identification Marking of US Military Property
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-1250	Corrosion Prevention and Deterioration Control in Electronic Components and Assemblies
MIL-STD-1285	Marking of Electrical and Electronic Parts
MIL-STD-2000	Standard Requirements for Soldered Electrical and Electronic Assemblies

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 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, specification sheets, or MS standards), 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 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.3) in accordance with 4.4.

3.2 Materials. Materials shall be defined by documentation selected in accordance with MIL-E-11991 (except group IV) and shall be in compliance with MIL-STD-1250.

.2.1 Nonmetals. Nonmetals, including protective finishes, shall be moisture resistant and shall not support combustion. Such materials shall be chemically inert in accordance with MIL-STD-454, requirement 4. Materials shall not be adversely affected by exposure to the environment specified herein.

.3 Design and construction. The configuration and dimensions of the switch shall be in accordance with figure 1 (see 4.6.1).

.3.1 Mounting. The switch shall be capable of being mounted through a 0.125 ± 0.004 inch diameter hole in 0.028 ± 0.007 inch thick material and secured by a removable cap (see 4.6.1).

.3.2 Weight. The weight of the switch shall be not greater than 4 grams (see 4.6.1).

.3.3 Wire leads. The wire leads shall be silver-coated copper wire in accordance with MIL-W-16878/4, except that solid copper wire shall be permitted (see 4.6.1).

.3.3.1 Solderability. The leads shall be solderable in accordance with MIL-STD-2000 (see 4.6.1).

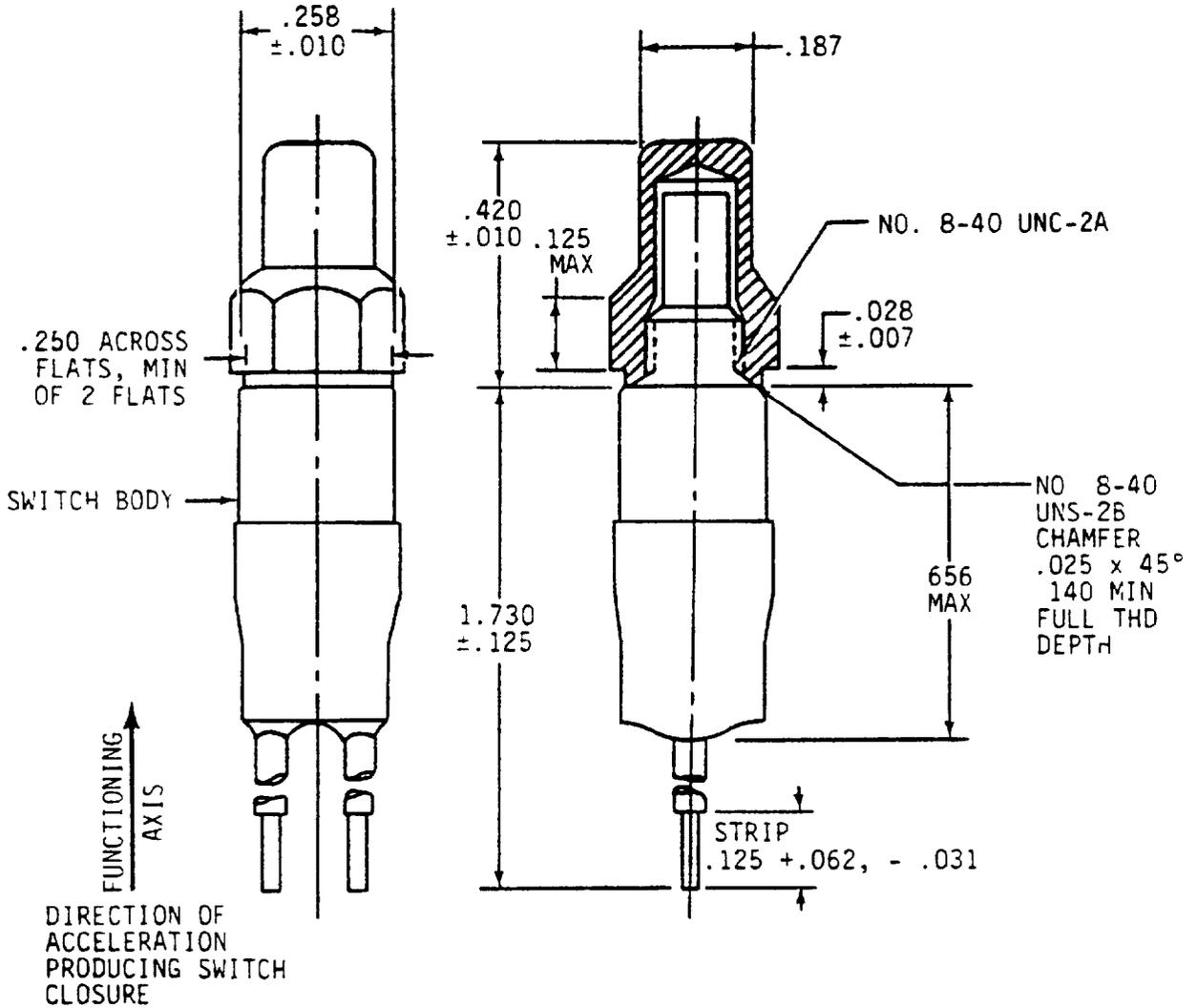
.4 Performance.

.4.1 Closure characteristics. The switch shall be sensitive to operation in the functioning axis specified in figure 1 in accordance with table I (see 4.6.2).

.4.2 Contact resistance. When measured as specified in 4.6.2, the contact resistance shall be as follows:

- a. Open: 5.0 megohms, minimum.
- b. Closed: 0.10 ohm, maximum.

.4.3 Contact current. The contacts, in closed position, shall be capable of carrying 4.0 amperes of current, minimum, for the closure duration.



NOTE: Unless otherwise specified, tolerances shall be $\pm .005$.

FIGURE 1. Switch envelope.

TABLE I. Closure characteristics.

Test Level		Requirement	
Shock level(g)	Shock duration(ms)	Close, min(ms)	Reopen, max(ms) <u>1/</u>
0-100-----	2.5 \pm 0.5	No	Remain open
300-600-----	2.5 \pm 0.5	0.08	1.0
475 <u>2/</u> -----	21.0 \pm 3.0	25% of pulse width	50.0

1/ The maximum reopen time shall be after the termination of shock pulse.

2/ Maximum rise time: 4 milliseconds

3.5 Insulation resistance. The insulation resistance between each contact and the case shall be not less than 5.0 megohms (see 4.6.3).

3.6 Environment.

3.6.1 Storage. Without evidence of physical damage the switches shall meet the requirements of 3.4.1 after exposure to the conditions of 4.6.4.

3.6.2 Temperature/altitude. Without evidence of physical damage the switches shall meet the requirements of 3.4.1 after exposure to the conditions of 4.6.5.

3.6.3 Temperature shock. Without evidence of physical damage the switches shall meet the requirements of 3.4.1 after exposure to the conditions of 4.6.6.

3.6.4 Vibration. Without evidence of physical damage the switches shall meet the requirements of 3.4.1 after testing in accordance with 4.6.7.

3.6.5 Handling shock. There shall be no contact closure when tested in accordance with 4.6.8. The switches shall meet the requirements of 3.4.1 after testing.

3.6.6 Humidity. The switches shall meet the requirements of 3.4.1 without evidence of corrosion after exposure to the conditions of 4.6.9.

3.6.7 Shock. The switches must close during subjection to the shock pulse specified in 4.6.10.

3.7 Marking. Switches shall be marked in accordance with MIL-STD-130 to include date/lot code and vendor identification number in accordance with MIL-STD-1285.

3.8 Workmanship. Workmanship shall be in accordance with MIL-STD-454, requirement 9.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Test equipment and inspection facilities. The manufacturer shall insure that test and inspection facilities of sufficient accuracy, quality and quantity are established and maintained to permit performance of required inspections.

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

- a. First article inspection (see 4.4).
- b. Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be conducted under the following conditions at ambient temperature, humidity and barometric pressure:

- a. Temperature: $25 \pm 10^\circ$ Celsius (C) ($77 \pm 18^\circ$ Fahrenheit (F)).
- b. Relative humidity: 90 percent, maximum.
- c. Barometric pressure: 30 ± 2 inches of mercury (in. Hg.).

4.3.1 Environment test tolerances. Unless otherwise specified, during environmental tests the following tolerances shall apply:

- a. Temperature: at $25 \pm 10^\circ\text{C}$ ($77 \pm 18^\circ\text{F}$)
others: $\pm 2^\circ\text{C}$ ($\pm 4^\circ\text{F}$)
- b. Relative humidity: ± 5 percent
- c. Barometric pressure: ± 0.06 in. Hg.
- d. Rate of barometric pressure change: 5 in. Hg. maximum, per minute
- e. Vibration amplitude: ± 10 percent
- f. Vibration frequency: ± 10 percent
- g. Shock amplitude: ± 15 percent
- h. Time duration: ± 10 percent or ± 15 minutes
whichever is less

4.4 First article inspection. When specified by the procurement document, first article inspection shall be performed in accordance with table II.

4.4.1 First article sample. First article inspection sample shall consist of 40 units divided into three sublots consisting of 15 sample units for arctic testing, 10 sample units for temperate testing, and 15 sample units for desert testing (see table II). The first article sample shall be fabricated using the same processes, facilities, materials and tooling as are proposed for production. Quantity production shall be withheld until the recorded results of the first article inspection have been approved by the procuring activity (see 3.1 and 6.2). No failures shall be permitted.

Table II. First article inspection.

Inspection	Number sample units	Requirement paragraph	Method paragraph
Examination of product-----	all sample units	3.3, 3.3.1, 3.3.2, 3.3.3, 3.3.3.1, 3.6, 3.7	4.6.1
Performance-----		3.4.1, 3.4.2, 3.4.3	4.6.2
Insulation resistance-----		3.5	4.6.3
Storage-----	40 (15 arctic) (10 temperate) (15 desert)	3.6.1	4.6.4
Temperature/ altitude-----		3.6.2	4.6.5
Temperature shock-----		3.6.3	4.6.6
Vibration-----		3.6.4	4.6.7
Shock, handling-----		3.6.5	4.6.8
Humidity-----		3.6.6	4.6.9
Shock-----		3.6.7	4.6.10
Performance-----	all sample units	3.4.1, 3.4.2 3.4.3	4.6.2
Insulation resistance-----		3.5	4.6.3

4.5 Quality conformance inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of the examination and test specified in table III in the order shown.

4.5.1.1 Inspection lot. An inspection lot for quality conformance inspection shall consist of all switches produced under essentially the same conditions and offered for acceptance at the same time.

Table III. Quality conformance inspection.

Examination or list	Requirement paragraph	Examination test paragraph	Inspection
Group I-----			100%
Performance-----	3.4.1, 3.4.2, 3.4.3	4.6.2	
Insulation resistance----	3.5	4.6.3	
Group II-----	3.3, 3.3.1, 3.3.2, 3.3.3, 3.3.1, 3.7, 3.8		In accordance with Table IV
Examination of product--	3.3-3.3.3.1 3.13, 3.14	4.6.1	

Table IV. Sampling plans.

Lot Size	Sample size
2 to 8	3
9 to 15	3
16 to 25	3
26 to 50	5
51 to 90	6
91 to 150	7
151 to 280	10
281 to 500	11
501 to 1200	15
1201 to 3200	18
3201 to 10,000	22
10,001 and over	29
The Acceptance Number in all cases is ZERO	

4.5.1.2 Sampling plan. Group I tests shall be performed on 100 percent of the product supplied under this specification. Switches which do not meet initial requirements shall be removed from the lot. Lots having more than 10 percent rejects shall not be furnished on the contract. Statistical sampling for group II shall be in accordance with Table IV. In all cases, the lot shall be rejected if the number of defectives equal or exceed one. Group II rejected lots may be reworked one time, and resubmitted for reinspection. Before reinspection, full particulars concerning the noncompliance and action taken to correct the defects and their causes shall be furnished to and approved by the procuring activity. In those cases where a Government approved Statistical Process Control program exists and the processes are demonstrated to be under statistical control with satisfactory process capabilities, the contractor may request that the procuring activity reduce sampling requirements.

4.5.2 Inspection of packaging. The sampling and inspection of the preservation, packing and container marking shall be in accordance with the requirements of MIL-S-28786.

4.6 Methods of inspection.

4.6.1 Examination of product. Switches shall be examined and weighed to verify conformance to all design and construction requirements of 3.3, 3.3.1, 3.3.2, 3.3.3, 3.3.3.1, 3.7, and 3.8.

4.6.2 Performance. Measure the unactivated contact resistance at the switch terminals with a standard ohmmeter to verify compliance with 3.4.2.a. The switch under test shall be rigidly mounted to a shock machine by normal mounting means so that maximum gravity units (g) levels are applied along the functioning axis as specified in figure 1. Place a recording voltmeter across the switch contacts. Connect a voltage source and load to the switch contacts sufficient to provide a 4.0 ± 0.4 , -0.0 ampere current for a period of 6 milliseconds (ms), minimum, through the switch contacts. The switch contacts shall also be instrumented to monitor and record simultaneously the switch operation and shock pulse waveform (reference figure 2). Apply shock pulses along the functioning axis as follows:

- a. Apply a half sine shock pulse of 100 ± 0 , -10 (g) having a pulse duration of 2.5 ± 0.5 ms. Switch operation shall be observed for not less than 3.5 ms after the beginning of the shock pulse. Closure of the switch shall constitute a failure. Retest is necessary if shock pulse exceeds 100 g. Verify compliance with table I.

- b. Apply a shock pulse of 300 ± 50 , -0.0 having a pulse duration of 2.5 ± 0.5 ms. Failure of the switch to close for at least 0.08 ms summed closure time shall be cause for rejection. The switch may or may not close in the range of 100 to 300 g. Switch shall open within 1 ms after pulse termination. A typical picture of the shock pulse waveform and switch operation shall be provided. The time elapsed during shock pulse shall be measured and recorded. Verify compliance with table I.
- c. Apply a 475 g, minimum, shock pulse having a maximum rise time of 4 ms and a duration of 21 ± 3 ms. Failure of the switch to close for at least 25 percent of the shock pulse duration shall be cause for rejection. Switch shall open within 50 ms after pulse termination (see table I). Switch operation shall be observed for not less than 90 ms after beginning of shock pulse. Measure closed contact resistance during switch closure duration (see 3.4.2.b). Verify compliance with table I.

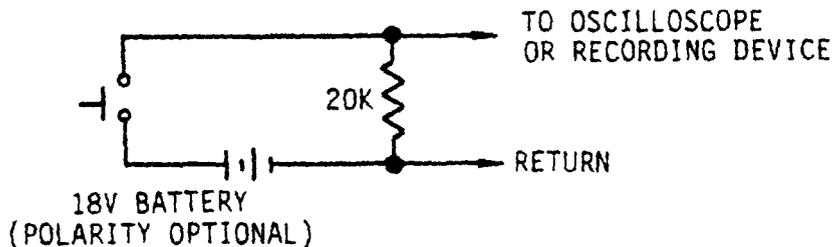


FIGURE 2. Test circuit.

4.6.3 Insulation resistance. Testing shall be performed in accordance with method 302 of MIL-STD-202, test condition B (500 ± 0 , -50 volts dc). Voltage shall be applied between each contact and the case with the contacts open. Application duration shall be 60 seconds minimum for first article inspection and 15 ± 6 , -0 seconds for quality conformance inspection (see 3.5).

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4.6.4 Storage. Specified sample units in accordance with 4.4.1 and table II shall be exposed to 5 cycles of nonoperating storage. Verify conformance to 3.6.1 after test. Each cycle shall be as follows:

- a. Arctic sample: 10°C (50°F) for 8 hours followed by -54°C (-65°F) for 8 hours with return to 10°C (50°F).
- b. Temperate sample: No special exposure required.
- c. Desert sample: 18°C (65°F) for 8 hours followed by 68°C (155°F) for 8 hours with return to 18°C (65°F).

4.6.5 Temperature/altitude. Specified sample units in accordance 4.4.1 and table II shall be exposed to 4 hours at each condition of temperature and altitude in the sequence as follows:

- a. Arctic sample:
 - 54°C (-65°F) at 29.94 in. Hg.
 - 54°C (-65°F) at 5.56 in. Hg.
 - 40°C (-40°F) at 20.58 in. Hg.
 - 40°C (-40°F) at 29.94 in. Hg.
- b. Temperate sample:
 - 54°C (-65°F) at 5.56 in. Hg.
 - 25°C (77°F) at 20.58 in. Hg.
 - 25°C (77°F) at 29.94 in. Hg.
- c. Desert sample:
 - 68°C (155°F) at 29.94 in. Hg.
 - 54°C (-65°F) at 5.56 in. Hg.
 - 63°C (145°F) at 20.58 in. Hg.
 - 63°C (145°F) at 29.94 in. Hg.

Verify conformance to 3.6.2 after test

4.6.6 Temperature shock. All sample units shall be exposed to temperature shock conditions. A cycle shall consist of exposure for 4 hours at 68°C (155°F), exposure for 4 hours at -54°C (-65°F), and return to 68°C (155°F). Three cycles shall be performed. The transfer time from one temperature extreme to another shall be not greater than 5 minutes. Verify conformance to 3.6.3.

4.6.7 Vibration. Specified sample units in accordance with 4.4.1 and table II shall be vibration tested. The switch under test shall be rigidly mounted to a sinusoidal vibration machine as required for vibration to be applied for eleven 15-minute sweeps along each of 3 major mutually perpendicular axes. Vibration levels shall be 1.3 g from 5 to 26 Hertz (Hz), 0.036 in. double amplitude from 26 to 52 Hz and 5 g peak from 52 to 500 Hz. Switches shall be temperature stabilized as follows:

- a. Arctic sample: -40°C (-40°F)
- b. Temperate sample: 25°C (77°F)
- c. Desert sample: 63°C (145°F)

Verify conformance to 3.6.4 after test.

4.6.8 Handling shock. Specified sample units in accordance with 4.4.1 and table II shall be handling shock tested. The switch under test shall be rigidly mounted to a shock machine and monitored for closure. Switches shall be exposed to three 45 g half sine waveform, 10 ms shocks in each direction along each of 3 mutually perpendicular axes for a total of 18 shocks. Any closure of contacts shall be cause for rejection. Switches shall be temperature stabilized as follows:

- a. Arctic sample: -40°C (-40°F)
- b. Temperate sample: 25°C (77°F)
- c. Desert sample: 63°C (145°F)

Verify conformance to 3.6.5 after test.

4.6.9 Humidity. All sample units shall be exposed to the temperature and humidity conditions in accordance with figure 3. The conditions shown in figure 3 constitute one cycle of exposure; ten continuous cycles shall be performed for a total of not less than 240 hours. Verify conformance to 3.6.6 after test.

4.6.10 Shock. Specified sample units in accordance with 4.4.1 and table II shall be shock tested. The switch under test shall be rigidly mounted by normal mounting means such that shock pulse will be applied along positive functioning axes (see figure 1). Shock shall consist of one 600 g + 50 g shock with a duration of 10 ms. The rise time shall be 2 to 3 ms, dwell time of 8 to 9 ms and decay time of 13 to 15 ms. The switch contacts shall be monitored for closure. Failure to close shall constitute a failure (see 3.6.7). Switches shall be temperature stabilized during shock test and performance tested at temperature as follows:

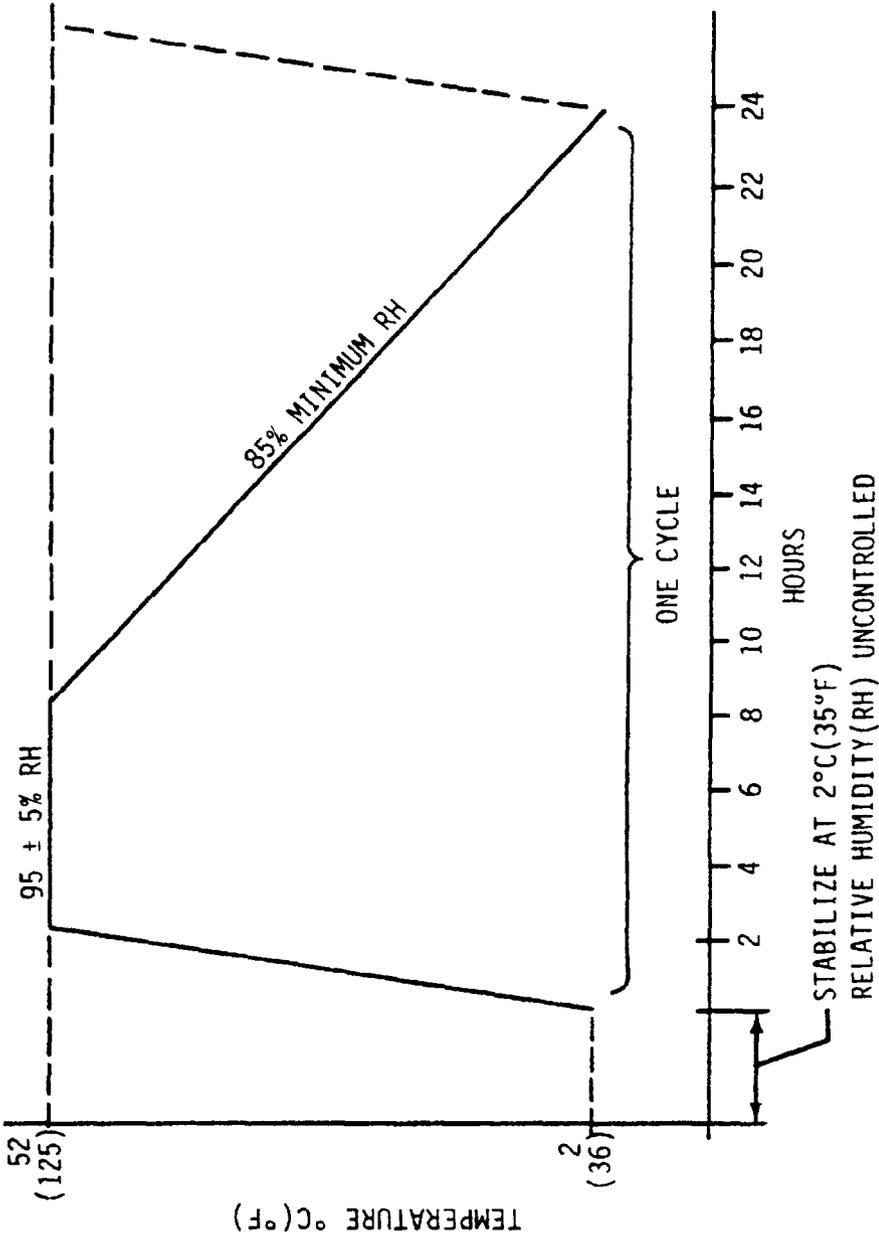


FIGURE 3. Relative humidity cycle.

- a. Arctic sample: -40°C (-40°F)
- b. Temperate sample: 25°C (77°F)
- c. Desert sample: 63°C (145°F)

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-S-28786.

6. NOTES

6.1 Intended use. The switches covered by this specification are intended to provide momentary completion of an electrical circuit during a specified magnitude of acceleration.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. Whether a first article inspection is required (see 3.1).
- c. Levels of preservation and packing (see section 5).

6.3 First article. When a first article inspection is required, the items should be a first article sample of 40 sample units. The contracting officer should include specific instructions in requisition documents regarding arrangements for examination, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Subject term (key word) listing.

Switch, acceleration-sensitive
Switch, momentary

6.5 Metriation. Wherever inch-pound units of measurement are expressed in this specification, metric equivalents in accordance with FED-STD-376 are acceptable.

Custodian:
Army - MI

Preparing activity:
Army - MI

(Project No. 5930-A629)