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DETAIL SPECIFICATION

SWITCH, TOGGLE, MOMENTARY, FOUR-POSITION ON, CENTER OFF, 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 four-position, momentary on, center off, positive action switch with free return to the off position.

1.2 Classification. Switches covered by this specification will be classified by type as indicated herein (see 3.1).

Type I - Snap action, positive break operation.
Type II - Nonpositive break operation.

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.

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

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. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil/.

AMSC N/A FSC 5930

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202	-	Test Methods for Electronics and Electrical Component Parts.
MIL-STD-202-101	-	Salt Atmosphere (corrosion)
MIL-STD-202-106	-	Moisture Resistance
MIL-STD-202-201	-	Vibration
MIL-STD-202-208	-	Solderability
MIL-STD-202-210	-	Resistance to Soldering Heat
MIL-STD-202-213	-	Shock (specified pulse)
MIL-STD-202-301	-	Dielectric Withstanding Voltage
MIL-STD-202-307	-	Contact Resistance
MIL-STD-202-310	-	Contact-chatter Monitoring
MIL-STD-810	-	Environmental Engineering Considerations and Laboratory Tests.

(Copies of these documents are available online at https://assist.dla.mil/.)

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.

INTERNATIONAL ORGINZATIONS FOR STANDARDS (ISO)

ISO 10012	-	Measurement management systems Requirements for measurement processes and measuring equipment

(Copies of these documents are available online at http://www.iso.org.)

NATIONAL CONFERENCE of STANDARDS LABORTORIES (NCSL)

NCSL Z540.3	-	Calibration of Measuring and Test Equipment, Requirements for.

(Copies of these documents are available online at http://www.ncsli.org/.)

SAE INTERNATIONAL

SAE-AS50881	-	Wiring, Aerospace Vehicle.

(Copies of these documents are available online at http://www.sae.org.)

UNDERWRITERS' LABORATORIES (UL), INCORPORATED

UL94	-	Test for Flammability of Plastic Materials for Parts in Devices and Appliances.

(Copies of these documents are available online at http://www.ul.com.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), 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 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. Switches furnished under this specification, shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (4.4 and 6.5).

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

3.3.1 Metals. All metal parts, other than current-carrying parts, shall be of corrosion-resistant material, or shall be suitably plated to resist corrosion.

3.3.1.1 Ferrous material. Ferrous material shall not be used for current carrying parts.

3.3.1.2 Dissimilar metals. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. The use of dissimilar metals which, in contact, tend toward active electrolytic corrosion (particularly brass, copper, or steel used in contact with aluminum or aluminum alloy) is not acceptable. However, metal plating or metal spraying of dissimilar base metals to provide similar or suitable abutting surfaces is permitted. The use of dissimilar metals separated by a suitable insulating materiel is also permitted. For further guidance on the selection and use of metals see 6.7.

3.3.2 Insulating material. Molded material shall be used. Cellulose-filled phenolic shall not be used.

3.3.2.1 Plastic. The plastic material used in all external switch parts and enclosures shall be tested in accordance with UL94 and classified as 94V-0; this requirement applies to all materials for external parts and enclosures regardless of whether the material used is acquired to a detail specification or not.

3.3.3 Protective treatment. Materials that are subject to deterioration when exposed to climatic and environmental conditions likely to occur during service usage shall be protected against such deterioration in a manner that will in no way prevent compliance with the performance requirements of this specification. The use of any protective coating that will crack, chip, or scale with age or extremes of climatic and environmental conditions shall be avoided.

3.4 Interface and physical dimensions. Switches shall be of sufficiently rugged construction to meet the requirements of this specification. Switches shall be direct acting, normally open type incorporating a positive action to assure good contact and snap feel with quick-make and quick-break circuits. Switches shall be designed to permit manual centering to the “off” position which shall permit breaking of welded contacts. Switches shall be constructed to assure free return of the movable contact member to the neutral “off” position when relieved of any external actuation forces. Switches shall not permit dual contact in any possible position of the lever. Movement of the actuating lever shall close the circuit between the common terminal and each other terminal in the direction of lever travel, as indicated in the circuit diagram of the MS sheet or detail specification sheets.

3.4.1 Dimensions. Switches shall conform to the dimensions shown on the MS sheet or detail specification sheets.

3.4.2 Mounting. Switch shall be operable when mounted in any attitude.

3.4.3 Stationary contact members and terminals. Stationary contact members and terminals shall be of such construction to meet the requirements of the specification. When terminals and contact members are separate pieces they shall be joined in a secure manner. All terminals shall be external and shall be treated to facilitate soldering. Silver plating shall not be used. Gold plating is allowable up to a thickness of .000030 inch to .000100 inch.

3.4.4 Cap. A cap of insulating material shall be fixed on the end of the actuating lever so that it cannot be readily removed and shall not rotate relative to the switch.

3.4.5 Electrical ratings. As specified (see 3.1).

3.4.6 Screw threads. Screw threads shall be as specified on the specification sheet.

3.4.7 Pure tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. Tin content of switch components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see 6.3.6)

3.5 Performance.

3.5.1 Actuating force. When switches are tested as specified in 4.6.3, the actuating force shall be within the limits specified (see 3.1)

3.5.2 Actuating lever travel. When switches are tested as specified in 4.6.4, the actuating lever travel shall be as specified.

3.5.3 Strength of actuating lever pivot, lever stop and cap. When switches are tested as specified in 4.6.5, there shall be no breakage of the cap or body, loosening or rotation of terminals or other damage to the switch.

3.5.4 Strength of terminals. When switches are tested as specified in 4.6.6, there shall be no short circuit, breakage, loosening, rotation of terminals or other damage to the switch.

3.5.5 Electrical overload. When switches are tested as specified in 4.6.7, there shall be no electrical or mechanical damage.

3.5.6 Electrical endurance. When switches are tested as specified in 4.6.8, switch contacts under test shall open and close the circuit in proper sequence during each cycle of the switch actuating member.

3.5.7 Temperature rise. When switches are tested as specified in 4.6.9, the temperature rise shall not exceed 30 degree Celsius (°C).

3.5.8 Dielectric withstanding voltage. When switches are tested as specified in 4.6.10, the switches shall withstand the application of the specified voltages without arcing, flashover, breakdown of insulation, or damage; there shall be no current leakage in excess of 1 milliampere.

3.5.9 Vibration. When switches are tested as specified in 4.6.11, there shall be no separation of closed contacts or closure of open contacts having a duration exceeding 10 microseconds. There shall be no evidence of damage.

3.5.10 Shock. When switches are tested as specified in 4.6.12, the opening or closing of contacts shall not exceed 10 microseconds.

3.5.11 Acceleration. When switches are tested as specified in 4.6.13, there shall be no closure of open contacts.

3.5.12 Moisture resistance. When switches are tested as specified in 4.6.14, there shall be no electrical or mechanical failures and the switches shall meet dielectric withstanding voltage test specified herein.

3.5.13 Thermal shock. When switches are tested as specified in 4.6.15, there shall be no electrical or mechanical damage.

3.5.14 Altitude. When switches are tested as specified in 4.6.16, there shall be no electrical or mechanical damage.

3.5.15 Salt spray. When switches are tested as specified in 4.6.17, there shall be no electrical failures, or breaking, spalling, cracking, or loosening of terminals.

3.5.16 Fungus. When switches are tested as specified in 4.6.18, there shall be no electrical or mechanical damage. This test may be waived by the preparing activity provided suitable evidence is provided that all materials used (such as fungus inert or treated) are non-nutrient.

3.5.17 Solderability (applicable to solderable terminations).

3.5.17.1 Small wire. When switches with solid wire terminations of .045 maximum diameter or stranded wire terminations of number 18 AWG or smaller are tested as specified in 4.6.19, the dipped surface of the termination:

a. Shall be at least 95 percent covered by a continuous new solder coating.

b. Shall not have pinholes or voids that are concentrated in one area or that exceed 5 percent of the total area.

3.5.17.2 Large wire. When switches with solder terminals, solid wire terminations greater than .045 diameter, and stranded wire terminations larger than number 18 AWG are tested as specified in 4.6.19, the dipped surface of the terminations:

a. Shall have 95 percent of the total length of the filet, which is between the standard wire wrap and the termination, tangent to the surface of the termination being tested and shall be free from pinholes and voids.

b. Shall not have a ragged or interrupted line at the point of tangency between the filet and the termination under test.

3.5.18 Resistance to soldering heat (applicable to switches with solderable terminals) (not applicable to switches with integral lead wire terminals). When switches are tested as specified in 4.6.20, switches shall meet the switch resistance requirement, and there shall be no deformation or other damage at the conclusion of the test sequence.

3.5.19 Switch resistance. When measured as specified in 4.6.21, the switch resistance shall not exceed 25 milliohms initially and 40 milliohms after the mechanical endurance test. After electrical endurance, the switch resistance shall not exceed 1 percent of the load impedance using the electrical parameters of the electrical endurance test load. For switches with integral lead wires, the switch resistance shall be as specified (see 3.1).

3.6 Marking. Switches shall be marked in accordance with the following:

a. MS part number or detail specification sheet part number.

b. Switch manufacturer's name, trademark or code symbol.

c. Switch manufacturer's part number.

d. Date of manufacture; such as day, month, or year.

3.7 Workmanship. Switches shall be processed in such a manner as to be uniform in quality and free from cracked or displaced parts or other defects which effect life, serviceability, or appearance. Switches shall have an all over smooth, high finish surface and shall be free from warpage, checks, blisters, projecting ridges or chips. Gate marks shall not be considered a defect.

3.8 Recycled, recovered, environmentally preferable or biobased materials. Recycled, recovered, environmentally preferable, or biobased 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.

4. VERIFICATION

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

a. Qualification inspection (see 4.4).

b. Conformance inspection (see 4.5).

4.2 Test equipment and inspection facilities. The contractor shall establish and maintain a calibration system in accordance with ANSI/NCSL Z540-1, ISO-10012-1, or equivalent system as approved by the qualifying activity

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.4) on sample units produced with equipment and procedures normally used in production.

4.4.1. Test routine. Sample units shall be subjected to the qualification inspection specified in table I, in the order shown.

4.4.2. Failure. Failure in any examinations or test shall be cause for refusal to grant qualification.

4.4.3. Retention of qualification. To retain qualification, the contractor shall forward after initial qualification, at the conclusion of each succeeding 12 month period, a summary of the results of group A test performed during that period, indicating as a minimum the number of lots which have passed and the number which failed, and a summary of the group B test performed during that period. The contractor shall forward for each 36 month interval the complete results of group C test which shall be performed during the last 12 months of the interval. If the test results indicate nonconformance with specification requirements, action shall be taken to remove the failing product from the qualified products list. Failure to submit a report within 30 days after the end of each period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity anytime during the applicable interval that the inspection data indicates failure of product to meet the requirements of this specification. In the event that no production occurred during the 12 month reporting interval, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the time. If the item has not been produced for 36 months, the product must be requalified.

4.5 Conformance inspections.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspection. Delivery of products which have passed group A shall not be delayed pending the results of group B inspection.

4.5.1.1 Group A inspection. Group A inspection shall consist of the inspections specified in table II. An inspection lot shall consist of all switches of the same design and construction, produced under essentially the same conditions, and offered for inspection at one time.

4.5.1.1.1 Sampling plan. Statistical sampling shall be in accordance with tables II and III. Separate, randomly selected groups of samples are required for subgroups 1 and 2. For acceptance of the lot there shall be zero occurrences of defects.

4.5.1.1.1.1 Subgroup 1. A sample of parts shall be randomly selected in accordance with table III, subgroup 1 sampling plan.

4.5.1.1.1.2 Subgroup 2. A sample of parts shall be randomly selected in accordance with table III, subgroup 2 sampling plan.

4.5.1.1.2 Rejected lots. If an inspection lot is rejected, the lot shall be 100 percent inspected for the defects noted. The contractor may correct all of the defects or remove all of the defective units from the lot. The lot shall then be sampled again in accordance with tables II and III. For acceptance, there shall be zero occurrences of defects. Such lots shall be separate from new lots and shall be clearly identified as reinspected lots.

4.5.1.2 Group B inspection. One switch shall be selected at random from each 1,000 switches produced and shall be subjected to the normal endurance test (see 4.6.8.1).

4.5.1.2.1 Disposition of sample units. Sample units which have been subjected to group B shall not be delivered on the contract or order.

4.5.1.2.2 Action in case of failure. The manufacturer shall immediately investigate the cause of failure and take corrective action to insure that subsequent switches do not contain the same defects.

4.5.2 Group C inspection. Group C inspection shall consist of the tests specified in table I in the order shown and shall be made on sample units produced with production tools and processes.

4.5.2.1 Disposition of sample units. Sample units which have been subjected to group C inspection shall not be delivered on a contract or order.

4.5.2.2 Noncompliance. If a sample fails to pass group C inspection, the manufacturer 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 with essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all tests and examinations, or the test which the original sample failed, at the option of the qualifying activity). Groups A and B inspections may be reinstituted; however, final acceptance and shipment shall be withheld until the group C inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.6 Methods of examination and test.

4.6.1 Visual and mechanical examination. Switches shall be examined to verify that the design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1).

4.6.2 Switching characteristics. Each switch shall be cycled by hand five times through all positions, while carrying the rated inductive load. The test fixture shall have suitable provisions to show that the proper circuit is being closed and opened. The switch shall return to the center off position upon removal of the external actuating force.

4.6.3 Actuating force (see 3.5.1). The switch shall be horizontally mounted by its normal mounting means with the actuating mast in the horizontal plane and with a stationary contact down. Weight shall be hung on the cap. For group A inspection a suitable spring loaded fixture may be used. Unless otherwise specified (see 3.1), the switch shall actuate between 21 and 36 ounces and there shall be no short circuiting, breakage or damage to the switch. All four switch positions shall be measured.

4.6.4 Actuating lever travel (see 3.5.2). Switches shall be tested in a suitable fixture with an accuracy of at least .25 degree. The actuating lever travel of 3 degrees to 7 degrees shall be required to make contact in each position and a minimum of 2 degrees overtravel shall be required beyond the point of contact make. On the return stroke there shall be a minimum of 2 degrees of lever travel between the point of breaking contact and the center off position. The differential between the point of make or break of the contacts and the snap feel shall not exceed .25 degree for any one of the four directions of travel

4.6.5 Strength of actuating lever pivot, lever stop and cap (see 3.5.3). Switches shall be electrically and mechanically operable after the following test and there shall be no breakage of the cap or body, loosening or rotation of terminals or other damage to the switch:

a. A minimum of 10 inch-pounds of torque shall be applied to the cap around the major axis of the switch.

b. A 90-pound load minimum shall be applied to the outer edge of the cap at an angle of 45 degrees to the major axis of the switch in each of the four directions of travel.

c. A 90-pound load minimum shall be applied to the top of the cap coaxial with the major axis of the switch toward the actuating lever pivot.

d. A 2-pound load minimum shall be dropped from a minimum height of 8 inches and shall strike the cap. The switch shall be mounted with its major axis at an angle of 30 degrees from vertical (see figure 1).

TABLE I Qualification inspection sequence.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be tested
Group I			
Visual and mechanical inspection	3.1, 3.3, 3.4, 3.6, 3.7	4.6.1	All
Resistance to soldering heat 1/	3.5.18	4.6.20	
Dielectric withstanding voltage	3.5.8	4.6.10	
Switch resistance	3.5.19	4.6.21	
Switching characteristics	3.1	4.6.2	
Actuating force	3.5.1	4.6.3	
Actuating lever travel	3.5.2	4.6.4	
Group II			
Solderability	3.5.17	4.6.19	4 samples
Strength of terminals	3.5.4	4.6.6	
Strength of actuating lever pivot and lever stop			
Thermal shock	3.5.3	4.6.5	
Shock	3.5.13	4.6.15	
Acceleration	3.5.10	4.6.12	
Vibration	3.5.11	4.6.13	
Moisture resistance	3.5.9	4.6.11	
Dielectric withstanding voltage	3.5.12	4.6.15	
Visual and mechanical examination	3.5.8	4.6.10	
Switching characteristics	3.1, 3.3, 3.4, 3.6, 3.7 3.1	4.6.1 4.6.2	
Group III			
Salt spray	3.5.15	4.6.17	2 samples
Visual and mechanical examination	3.1, 3.3, 3.4, 3.6, 3.7	4.6.1	
Switching characteristics	3.1	4.6.2	
Group IV			
Electrical overload	3.5.5	4.6.7	4 samples
Electrical endurance 2/	3.5.6	4.6.8	
Temperature rise	3.5.7	4.6.9	
Switch resistance	3.5.19	4.6.21	
Dielectric withstanding voltage	3.5.8	4.6.10	
Visual and mechanical examination	3.1, 3.3, 3.4, 3.6, 3.7	4.6.1	
Switching characteristics	3.1	4.6.2	
Group V			
Altitude	3.5.14	4.6.16	2 samples
Dielectric withstanding voltage	3.5.8	4.6.10	
Visual and mechanical examination	3.1, 3.3, 3.4, 3.6, 3.7	4.6.1	
Switching characteristics	3.1	4.6.2	

1/ Four samples units only.
2/ Two sample unit for normal electrical endurance and two sample units for high speed electrical endurance.

TABLE II. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph	Sampling plan
Subgroup 1 Visual and mechanical examination 1/	3.1, 3.3, 3.4,3.6, 3.7	4.6.1	See 4.5.1.1.1.1
Subgroup 2 Actuating force Actuating lever travel Dielectric withstanding voltage Switching resistance	 3.5.1 3.5.2 3.5.8 3.5.19	 4.6.3 4.6.4 4.6.10 4.6.21	See 4.5.1.1.1.2

1/ At the option of the contractor, documented in-process inspection may be used to satisfy the materials (see 3.3) and design and construction (see 3.4) requirements provided that all of the contractor's in-process control data on these tests are made available to the Government upon request.

TABLE III. Zero defect sampling plan.

Lot size	Number of switches to be tested	
	Subgroup 1	Subgroup 2
1 - 15	5	All
16 - 50	5	13
51 - 90	7	13
91 - 150	11	13
151 - 280	13	20
281 - 500	16	29
501 - 1,200	19	34
1,201 - 3,200	23	42
3,201 - 10,000	29	50
10,001 - 35,000	35	60

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4.6.6 Strength of terminals (see 3.5.4). A load of 30 pounds shall be applied to each terminal, perpendicular to each terminal, perpendicular to the mounting plane of the switch, for one minute. Upon completion of the test, switches shall be electrically and mechanically operable.

4.6.7 Electrical overload (see 3.5.5). Each switch to be tested for electrical endurance shall first be tested for overload cycling at room ambient conditions using the same voltage, electrical frequency, and the same pairs of contacts that will subsequently be used for the electrical endurance test. The switches shall close and open the overload current of a circuit equal to 150 percent of the load rating at the particular voltage and electrical frequency (see 3.1). The cycling rate shall be 5 to 6 cycles of operation per minute. 100 cycles of operation shall be performed. The duty cycle shall be approximately 50 percent on, and 50 percent off.

4.6.8 Electrical endurance (see 3.5.6). For dc inductive loads, Inductive dc loads shall use inductors which have response and stored energy values as indicated in figure 2 and figure 3. An alternate method of selecting DC inductors can be found in Appendix A.

4.6.8.1 Normal. The switches shall be operated to make and free break the inductive load specified, (see 3.1) for 250,000 cycles at a rate of between 28 and 32 operations per minute. The maximum ratio of the “time on” to “time off” shall be 1:3. Operating force following endurance testing shall be between 12 and 50 ounces. The actuation lever travel shall be within limits except that the .25 degree differential may not be measurable due to the degradation of the snap feel. The following conditions shall apply, switches shall be continuously monitored and recorded to determine whether any contact has failed to open or close its individual circuit in the proper sequence. The monitoring circuit shall not shunt inductive components of inductive loads or switch contacts.

4.6.8.2 High speed. Switches shall be operated to make and free break the inductive load specified herein for 1,000 cycles at a rate of between 60 and 80 operations per minute. At all times during and at completion of the endurance test, switches shall be capable of making and free breaking the inductive circuit and returning to center off by its own action. Following the test the operating force and the actuation lever travel shall be within limits except that the .25 degree differential may not be measurable due to the degradation of the snap feel.

4.6.9 Temperature rise (see 3.5.7). Switches shall be equipped with suitable thermocouples and leads which shall be in accordance with SAE-AS50881. While carrying the inductive current specified herein, the temperature shall not rise more than 30°C for one hour, thermocouples shall not be placed on the common terminal.

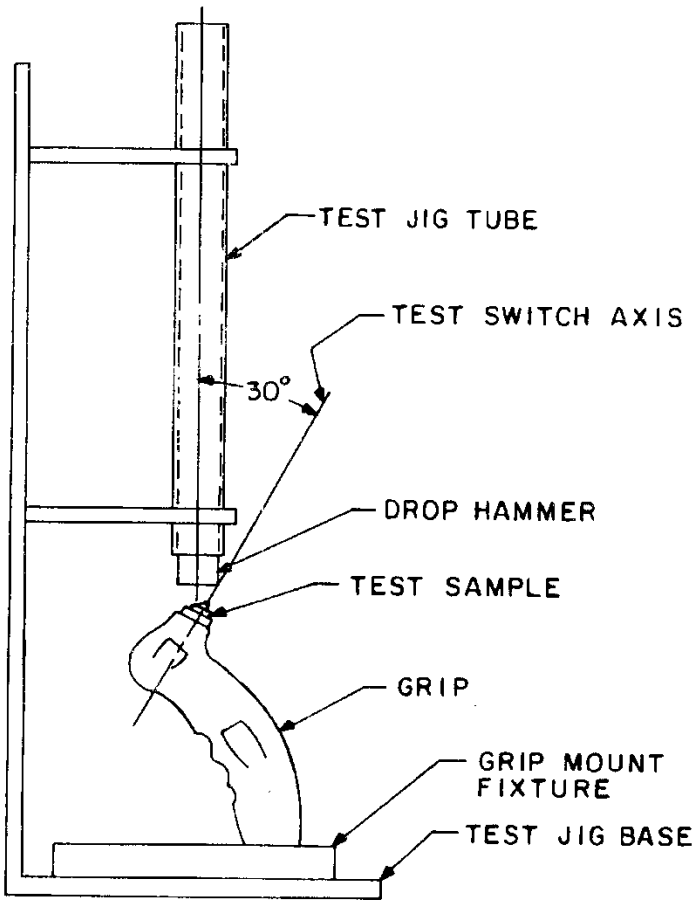

FIGURE 1. Suggested fixture, impact test.

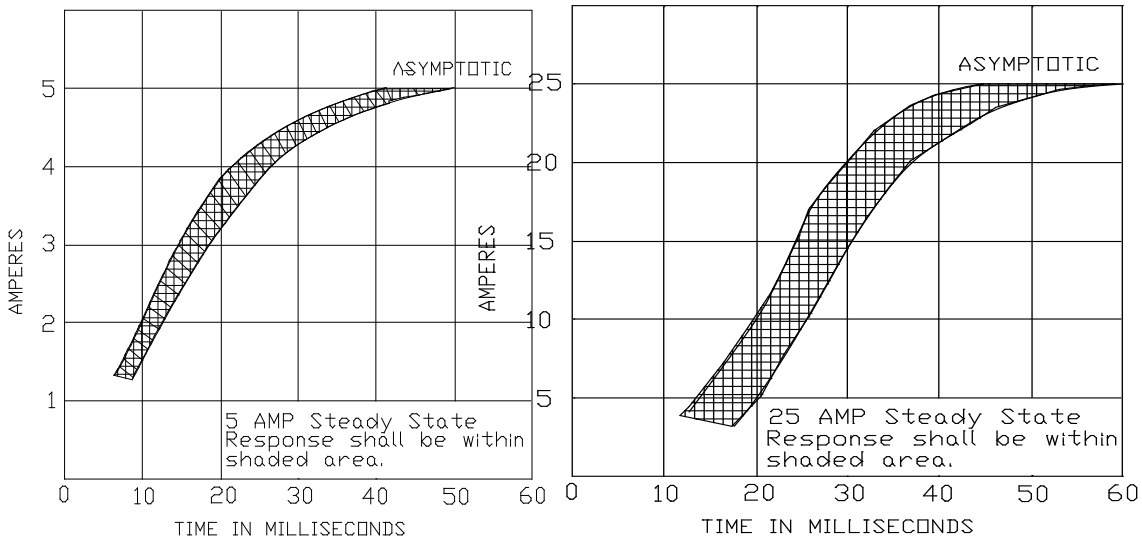

FIGURE 2. Response (current vs time) Type I inductors only.

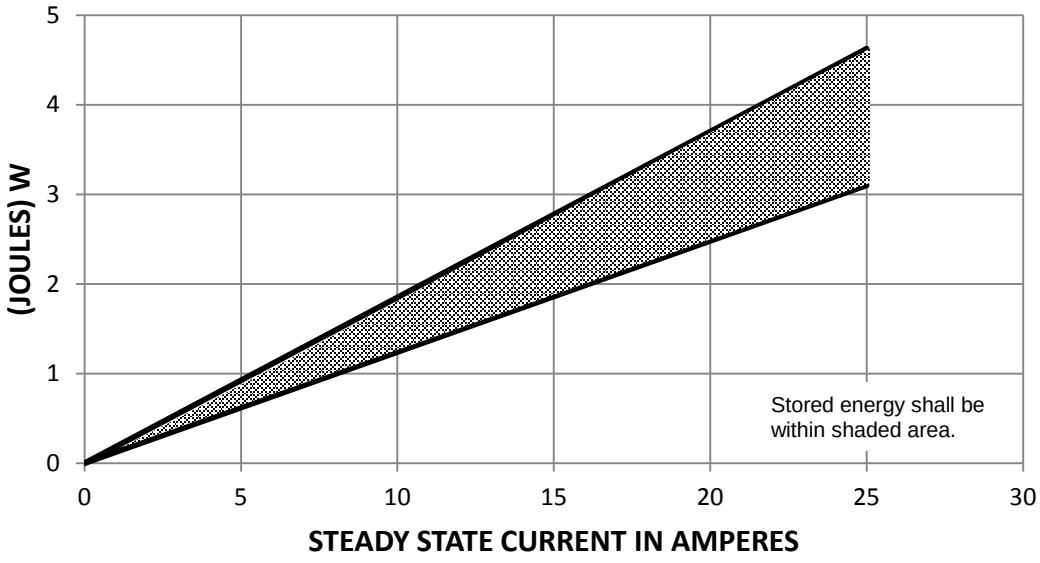

FIGURE 3. Stored energy (joules vs current) Type I inductors only.

4.6.10 Dielectric withstanding voltage (see 3.5.8). Switches shall be tested in accordance with MIL-STD-202-301. The following details and exceptions shall apply:

a. Magnitude of test voltage: 1,000 volts.

b. Nature of potential: AC root mean square (rms).

c. Duration of application of test voltage: For group A inspection, at the option of the contractor, the test voltage may be applied for period of 5 seconds.

d. Points of application of test voltage: Between all unconnected terminals and between all load terminals connected together and common with the switch in the off position.

e. Measurements during test: Leakage current.

4.6.11 Vibration (see 3.5.9). Switches shall be tested in accordance with MIL-STD-202-201. The following details and exceptions shall apply:

a. Test and measurements prior to vibration: Not applicable.

b. Method of mounting: Switches shall be mounted in the normal manner on a rigid metal panel. The mounting fixture shall be free from resonance over the frequency range.

c. Electrical load conditions: The test circuit shall be in accordance with MIL-STD-202-310 and all contact positions shall be monitored.

d. Test and measurements during vibration: Switch-contact stability shall be continuously monitored during vibration by means of a test circuit in accordance with MIL-STD-202-310.

e. Measurements after vibration: After the test, switches shall be examined for change in shaft position, and evidence of broken, deformed, displaced, or loose parts, and switches shall be electrically and mechanically operative.

4.6.12 Shock (see 3.5.10). Switches shall be tested in accordance with MIL-STD-202-213. The following details and exceptions shall apply:

a. Mounting means: Switches shall be mounted in the normal manner.

b. Test condition A.

c. Electrical load conditions: Monitor circuit only.

d. Measurements during shock: Switch-contact stability shall be continuously monitored during shock by means of a test circuit in accordance with MIL-STD-202-310, and all contacts shall be monitored.

4.6.13 Acceleration (see 3.5.11). Switches shall be subjected to an acceleration force of 10g attained within 2 minutes and shall be maintained for 1 minute in the plane most likely to cause malfunction. Switch contacts shall be monitored for closing with a circuit such as a pilot lamp.

4.6.14 Moisture resistance (see 3.5.12). Switches shall be tested in accordance with MIL-STD-202-106. The following details and exceptions shall apply:

a. Mounting: By normal mounting means on a corrosion-resistant metal panel extending beyond the switch, positioned 15 degree from vertical and uninsulated. Half of the units shall be tested with the actuator in the upper side of the panel and the other half of the units shall be tested with the actuator on the under side of the panel.

b. Polarization: During steps 1 to 6 inclusive, a polarizing voltage of 100 volts dc shall be applied between all terminals tied together and the metal panel. The negative polarity shall be applied to the metal panel. Steps 7a and 7b are not applicable.

c. Load voltage: Not applicable.

d. Final measurements: At the end of the drying period, dielectric withstanding voltage shall be measured as specified herein.

e. Examinations during final measurement and after test: Switches shall be examined for evidence of corrosion, breaking, cracking, or spalling. Hardware shall be removable at the end of the test.

f. Water: Steam, distilled or de-ionized water shall be used for this test.

g. Switches shall make and free break the rated inductive load for 500 cycles after completion of this test.

4.6.15 Thermal shock (see 3.5.13). Switches shall be subjected to a temperature of -65°C ± 2°C for 12 hours after which the temperature shall be raised to -55°C ± 2°C and maintained for 2 hours. While at -55°C switches shall be mechanically cycled for 10 cycles. The temperature shall then be raised to +85°C ± 2°C for 36 hours. While at +85°C, the switches shall be subjected to the overload test specified herein.

4.6.16 Altitude (see 3.5.14). Switches shall be operated to make and free-break the inductive load specified (see 3.1) for 20,000 cycles at a rate of not less than 12 operations per minute at a pressure altitude of 60,000 feet. There shall be no mechanical or electrical failure or damage which would affect proper operation. The duty cycle shall be approximately 50 percent on and 50 percent off for resistive, inductive and motor loads. The duty cycle shall be approximately 30 percent on and 70 percent off for lamp loads.

4.6.17 Salt spray (corrosion) (see 3.5.15). Switches shall be tested in accordance with MIL-STD-202-101. The following details shall apply:

a. Test condition A.

b. Measurements after exposure: Not applicable.

c. Switches shall make and free-break rated inductive load for 500 cycles after the completion of this test.

4.6.18 Fungus (see 3.5.16). Switches shall be subjected to procedure 1 of MIL-STD-810. At the conclusion of the test, after allowing a 24 hour drying period, switches shall be subjected to the dielectric withstanding voltage and then examined for electrical and mechanical damage and electrical continuity.

4.6.19 Solderability (see 3.5.17). Solder type terminations shall be tested in accordance with MIL-STD-202-208. Minimum of two terminals per unit shall be tested.

4.6.20 Resistance to soldering heat (see 3.5.18) (applicable to switches with solderable terminals) (not applicable to switches with integral lead wire terminals). Switches shall be tested in accordance with MIL-STD-202-210. The following details shall apply:

a. Depth of immersion: Terminals shall be immersed to within .05 inch of the switch body.

b. Test condition B.

c. Cooling time: Not applicable.

d. Inspections and measurements:

(1) Before: None.
(2) After: Subsequent to all applicable test of group I of table I, the switches shall be opened and inspected for deformation or other damage.

4.6.21 Switch resistance (see 3.5.19). Switch contacts shall be tested in accordance with MIL-STD-202-307. The following details shall apply:

a. Measurements shall be made between the terminals, forming a switching circuit. Measurements shall be made for all poles in a switch at each of the actuators extreme positions.

b. Test current: 0.1 amperes. After electrical endurance, use the electrical parameters of electrical endurance test load (this also applies to 4.6.21c).

c. Open-circuit test voltage: 6 ±1 V dc.

d. Number of actuations prior to measurement: Three.

e. Number of test actuations: Threes.

f. Number of measurements per actuation: One.

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 material 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 Department or Defense Agency, or within the 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 not mandatory)

6.1 Intended use. The switches covered by this specification are intended for mounting in aircraft control wheels and grips and serves as the electrical trim tab control. However, it may be used in other applications, provided the parameters set forth herein are not exceeded.

6.2 Ordering data. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Detail specification sheet part number.

6.3 Definitions.

6.3.1 Operation. An operation consists of a mechanical actuation of the toggle lever from the “center off” to one “on” position and free return of toggle lever to “center off”.

6.3.2 Cycle. A cycle consists of mechanical actuation of the toggle lever from the “center off” after each “on” position in consecutive rotation, in order that contact is made in each of the four positions during each cycle.

6.3.3 Free break. After mechanical actuation to make the circuit, the toggle lever will return to “center off” position by its own action, thus breaking the circuit.

NOTE: Any sticking of the lever in “on” position constitutes failure.

6.3.4 Direct acting and positive action. The use of these terms in this specification will mean the direct attachment to the actuator lever or direct manual control of the common contact rather than dependence upon an intermediate spring or toggling member between the actuator and moving contact to effect opening or closing of the circuit.

6.3.5 Snap/tactile feel force characteristic. The switch assembly will incorporate an actuator travel dependent-actuation restraining force characteristic which provides both a positive tactile feedback to the user when electrical activation of the switch has been achieved and a restraining force threshold to prevent unintentional activation.

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

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List (QPL) 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 vqp.chief@dla.mil or from the DLA Land and Maritime, Attn: DLA Land and Maritime-VQP, 3990 East Broad Street, Columbus, OH 43213-1199.

6.5 Subject term (key word) listing.

Positive action
Positive break
Snap action

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. Environmentally 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 Dissimilar Metals. For further guidance on the selection or use of dissimilar metals are defined in MIL-HDBK-454, guideline 16.

6.8 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.

DC INDUCTOR CALIBRATION PROCESS

A.1 SCOPE.

A.1.1 Scope. This appendix details the alternate method of selecting inductors to meet the inductive load test (4.6.8). This appendix is not a mandatory part of this specification. The information contained herein is intended for compliance.

A.2 INDUCTIVE LOAD, DC

A.2.1 Inductor Classification. Inductors shall be classified into the following two groups based on the nominal steady state current.

A.2.1.1 Group 1. Inductors for use with military switches with inductive ratings of up to 2 Amps will use an inductor that has been qualified per A.3.1

A.2.1.2 Group 2. Inductors for use with military switches with inductive ratings from 2 to 25 Amps will use an inductor that has been qualified per A.3.2

A.3 INDUCTOR CALIBRATION PROCESS

A.3.1 Group 1 - Inductive Load Ratings up to 2 Amps –

a. Qualifying inductors for use in testing switches rated up to 2 Amps will be placed into a test circuit where the nominal rise time is 11.035 ±2.18 milliseconds measured at 63.2% of steady state current, or 1 L/R time constant as shown in Response Curve Figure A-1

b. Due to the decreasing tolerance zone of energy storage below 2 Amps, the inductors for this group shall be qualified at 1 Amp. Once qualified with a rise time that falls within the limits specified, it is acceptable to use the inductor for any test state current up to 2 Amps.

A.3.1.1 Calibration Process.

a. Place an inductor, variable resistor, and switching device in series with a 28±0.5VDC power supply.

b. Select a resistance to achieve a circuit current of 1±0.1Amps.

c. Power shall be applied using a knife switch or other switching device where contact bounce shall be less than 1 millisecond.

d. Insure the power supply will not be limiting the current at or below the specified steady state current.

e. Apply power to the circuit by closing the switch.

f. Monitor current using an oscilloscope.

g. Verify the rise time is between 8.8 and 13.2 milliseconds and steady state current is 1±0.1Amps. See Response Curve Figure A-1

A.3.1.2 Inductive Load Testing.

a. Test switches in series with a qualified inductor.

b. If the rise time of the inductor falls within 8.8 and 13.2 milliseconds at 1 Amp, it is qualified to use for any test current up to 2 Amps.

c. Set the current by adjusting the variable resistance to achieve the desired steady state current. Do not alter the inductance. The power supply shall remain at 28 +/- 0.5VDC.

A.3.2 Group 2. Inductive Load Ratings From 2 to 25 Amps –

a. Qualifying inductors for use in testing switches rated from 2 to 25 Amps will be placed into a test circuit where the nominal rise time is 11.035 ±2.18 milliseconds measured at 63.2% of desired steady state current, or 1 L/R time constant. as shown in Response Curve Figure A-1.

A.3.2.1 Calibration Process.

a. Place an inductor, variable resistor, and switching device in series with a 28±0.5VDC power supply.

b. Select a nominal resistance to achieve the desired test current.

c. Select an inductor to achieve a rise time of 11.035 ±2.18 milliseconds measured at 63.2%, or 1 L/R of the desired steady state current.

d. Power shall be applied using a knife switch or other switching device where contact bounce shall be less than 1 millisecond.

e. Insure the power supply will not be limiting the current at or below the desired steady state current.

f. Apply power to the circuit by closing the switch.

g. Monitor current using an oscilloscope.

h. Verify the circuit has achieved the desired steady state current.

i. If the rise time of the inductor falls within 8.8 and 13.2 milliseconds, it is qualified to use for this test current. See Response Curve Figure A-1

k. Tests to be completed at different current levels require the qualification process be repeated in order to determine an acceptable inductor for the desired test current. A single inductor will not be capable of achieving the proper rise time requirement over the entire 2 to 25 Amp range.

A.3.2.2 Inductive Load Testing.

a. Test switches in series with a qualified inductor.

A.4 Inductor Temperature Rise. The temperature rise of the test inductors should be limited to 55°C in order to maintain stable test currents which will minimize changes to inductor resistance as temperature increases.

A.5 FORMULAS

A.5.1 Stored Energy. Figure A-2 was derived from the following formulas.

a. V = IR (R @ 5A, 28V = 5.6Ω)
b. $(\text{Joules})\ W = \frac{1}{2}LI^2$
c. (Rise Time) τ = L/R
d. Stored Energy – Upper & (Proposed) Lower Limits

Upper Limit $(\text{Joules})\ W = 0.185 * I$

Lower Limit $(\text{Joules})\ W = 0.124 * I$

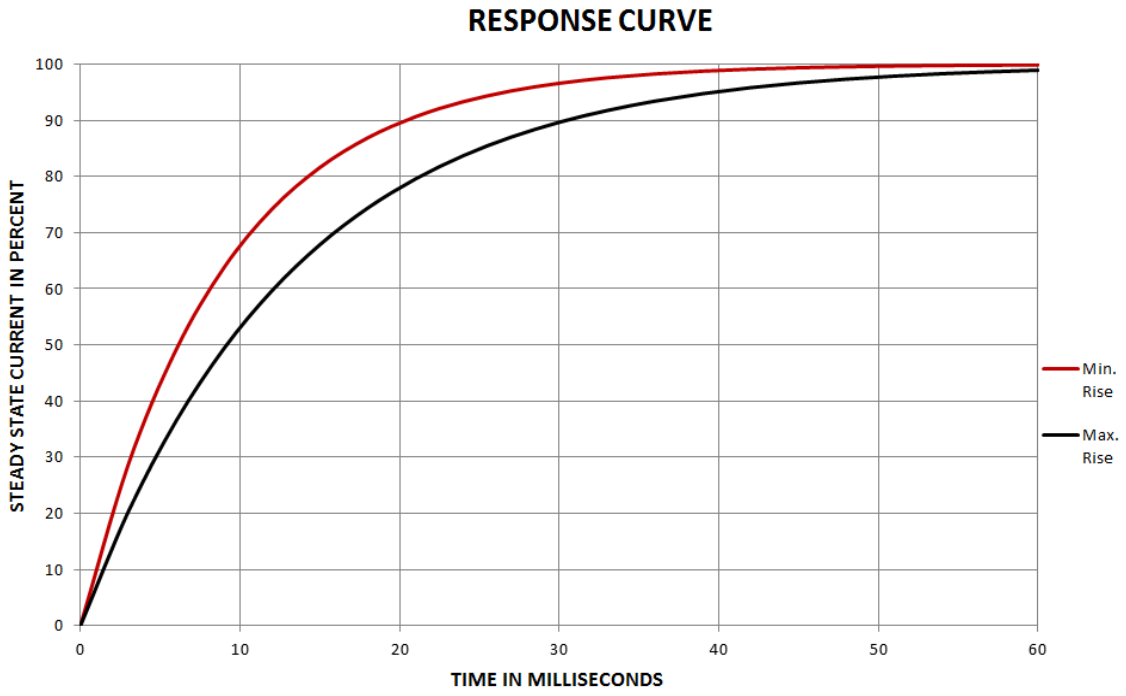

FIGURE A-1 - Response (Current Versus Time)

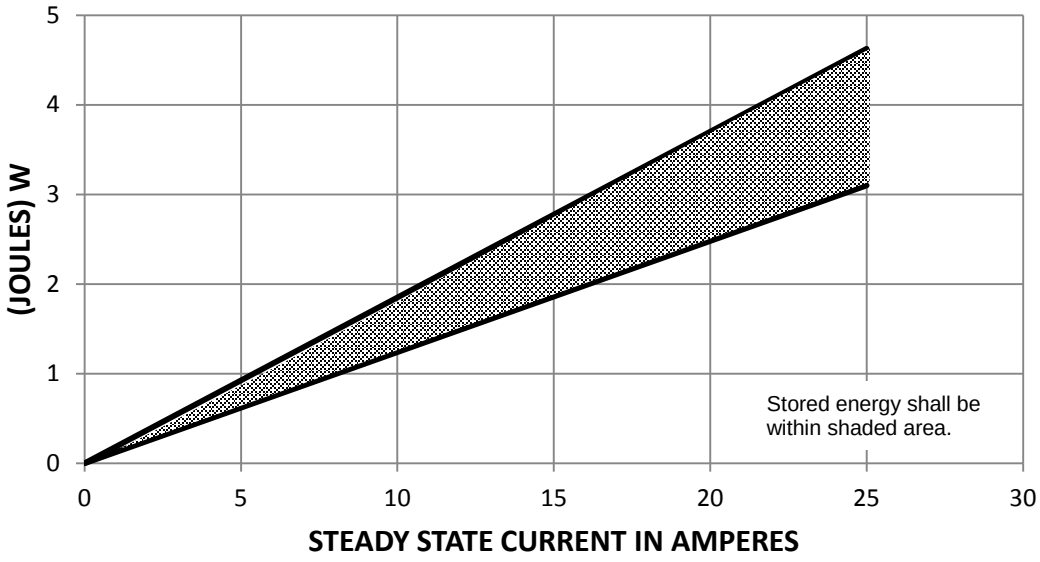

FIGURE A-2. Stored energy (joules versus current) type I inductors only.

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

Preparing activity:
DLA - CC

(Project 5930-2015-010)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil/.