

INCH POUND

MIL-DTL-18396E
15 April 2014

SUPERSEDING
MIL-S-18396D(SHIPS)
10 July 1973

DETAIL SPECIFICATION

SWITCHES, METER AND CONTROL, NAVAL SHIPBOARD

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 requirements for rotary type, class High-Impact (H.I.) shockproof switches used in meter and control circuits for Naval shipboard applications.

1.2 Classification. The switches covered by this specification will be of the following types, as specified (see 6.2.1):

Type MC – for use in both meter and control applications.

Type MO – for use in meter applications only.

1.2.1 Ratings. The switches will have the following ratings, as specified (see 6.2.1):

Type MC

Make and break:

20 amperes, 125 volt alternating current (a.c.) (60 or 400 hertz (Hz)).

10 amperes, 250 volt a.c. (60 or 400 Hz).

5 amperes, 500 volt a.c. (60 or 400 Hz).

0.4 amperes, 355 volt direct current (d.c.).

Carry – 20 amperes, all rated voltages.

Type MO

Make and break (inductive):

10 amperes, 120 volt a.c. (60 or 400 Hz).

3 amperes, 450 volt a.c. (60 or 400 Hz).

Carry – 10 amperes, all rated voltages.

1.2.2 Switch characteristics.

1.2.2.1 Switch actuation. Switch actuation will be of the following types, as specified (see 6.2.1):

- (a) Spring return (momentary action).
- (b) Detent action (nonspring return).
- (c) Push-pull.

1.2.2.2 Switch circuitry. The switch circuitry will be as follows and as specified (see 6.2.1). The information will be included in the drawings (see 3.10) and will include as a minimum:

- (a) Detailed circuit options.
- (b) Number of switch positions.
- (c) Number of poles.
- (d) Shorting or nonshorting contacts.
- (e) Location of switch stops; if required.

Comments, suggestions or questions on this document should be addressed to DLA Land and Maritime, 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/ .
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1.2.3 Switch handles. Operating handles will be of the following shapes, as specified (see 6.2.1):

- (a) Round (plain).
- (b) Round (knurled).
- (c) Oval.
- (d) Pistol grip or lever.

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 of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

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

DEPARTMENT OF DEFENSE SPECIFICATIONS

- [MIL-S-901](#) - Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
- [MIL-E-917](#) - Electrical Power Equipment, Basic Requirements for (Naval Shipboard Use).
- [MIL-P-15024/5](#) - Plates, Identification.

DEPARTMENT OF DEFENSE STANDARDS

- [MIL-STD-130](#) - Identification Marking of U.S. Military Property.
- [MIL-STD-167-1](#) - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)
- [MIL-STD-202](#) - Test Methods for Electronic and Electrical Component Parts.
- [MIL-STD-1285](#) - Marking of Electrical and Electronic Parts.
- [MIL-STD-31000](#) - Technical Data Packages

DEPARTMENT OF DEFENSE HANDBOOKS

- [MIL-HDBK-454](#) - General Guidelines for Electronic Equipment

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

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- [ASTM-B700](#) - Standard Specification for Electrodeposited Coatings of Silver for Engineering Use
- [ASTM-D5948](#) - Molding Compounds, Thermosetting, Standard Specification for.

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

3. REQUIREMENTS

3.1 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.3 and 6.4).

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3.2 Definitions.

3.2.1 Switch. A switch is a device for making, breaking, or changing the connections in an electric circuit.

3.2.2 Meter switch. The meter switch is used to connect or disconnect a meter in an electric circuit, or to transfer the meter from one circuit or phrase to another.

3.2.3 Control switch. The control switch is used to connect or disconnect electric power-operated devices in a circuit or to transfer the device from one circuit to another.

3.2.4 Contact rating.

3.2.4.1 Make and break. The rating of the switch which describes its ability to make or break an electric circuit for the rated life of the switch without damage. It is described both in amperes and volts.

3.2.4.2 Continuous current rating. The maximum d.c. or root mean square (rms) current in amperes, at rated frequency, which the switch will carry continuously without exceeding the specified limits of observable temperature rise in open air.

3.2.5 Shorting contacts (make before break). Contacts that close the circuit in the next switching position before opening the circuit in the present position.

3.2.6 Nonshorting contacts (break before make). Contacts that interrupt the circuit in the present switch position prior to completing the circuit in the next position.

3.3 Detail requirements (applicable to individual switches). The detail requirements shall be in conformance with this specification and as specified on the applicable drawing (see 3.10).

3.4 General requirements.

3.4.1 Materials. Materials shall be as specified herein. Any materials not specified shall be selected from those listed in [MIL-E-917](#). Even though constituent material is accepted, the finished switch shall comply with all requirements specified herein and perform its intended functions.

3.4.1.1 Plastics. All molded parts except handles (see 3.5.1.5) and position identification plates (see 3.5.5) shall be made of molded insulating material, type MAT 30, MAI 60, GDI 30F or MMI 30 of [ASTM-D5948](#). Laminated materials shall be of the type specified in [MIL-E-917](#), with a temperature index of 130°C (266°F) or higher.

3.4.1.2 Metals. Metals shall be of the corrosion-resistant type or shall be treated to resist corrosion as specified in [MIL-E-917](#).

3.4.1.2.1 Dissimilar metals. Dissimilar metals in contact with each other shall be selected to comply with the requirements of [MIL-E-917](#).

3.4.1.3 Current carrying parts. Nonferrous materials shall be used for current carrying parts. All contact surfaces of current carrying parts, including their connection surfaces, shall be faced with silver. Silver plating, when used, shall be in accordance with [ASTM-B700](#), minimum thickness of 0.0002 inch. If silver overlay, or similar construction is used, the silver material shall be not less than 0.003 inch thick.

3.4.2 Pure tin. The use of pure tin, as an underplate or final finish, is prohibited both internally and externally. Tin content of switch components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see 6.6).

3.5 Design and construction. The switches shall be of the design, construction and physical dimensions as specified (see 3.3).

3.5.1 Parts.

3.5.1.1 Threaded parts. Threaded parts shall be in accordance with [MIL-E-917](#). Current carrying threaded parts shall be silver plated in accordance with [ASTM-B700](#), minimum thickness of 0.0002 inch.

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3.5.1.2 Terminals. Nonferrous terminal posts or binderhead screws shall be furnished for all connections. Terminals shall conform to requirement 19 of [MIL-HDBK-454](#).

3.5.1.3 Contacts. Contacts shall be of simple and rugged construction. The contacts shall have wipe action and shall be of such type that no adjustments are required to complete the endurance test (see [4.7.7.1](#)). Contacts shall be shorting or nonshorting, as specified (see [6.2.1](#)).

3.5.1.4 Springs and hinges. Springs and hinges shall not be depended upon to carry current.

3.5.1.5 Operating handles (knobs). Operating handles shall be molded plastic, type CFI-5, in accordance with [ASTM-D5948](#). The handle finish shall be smooth and free of flash. The handle shape shall be as specified (see [1.2.3](#) and [6.2.1](#)). Metal fastening devices securing the handle to the operating shaft shall not come in contact with the operators hand.

3.5.2 Construction. Switches shall be of closed construction so that the switching mechanism and the switching contacts are fully enclosed (except terminals), to prevent foreign matter from entering the switch mechanism or interfering with the contacts. Covers may be used as a means of satisfying this requirement.

3.5.3 Creepage and clearance distances.

3.5.3.1 Type MC. Switches shall be in accordance with [MIL-E-917](#). External parts shall meet the requirements for set C spacings, "open creepage", and internal parts shall meet the requirements for set C spacings, "enclosed creepage". Mounting screws and operating shafts shall be considered ground.

3.5.3.2 Type MO. The same requirements apply as for the type MC switch, except that set B spacings shall be met.

3.5.4 Operational requirements.

3.5.4.1 Ambient temperature. Switches shall be designed for operation in a 65°C (A149°F) ambient.

3.5.4.2 Indexing. Switches shall have a positive detent or indexing mechanism, locating each switch position, except when a spring return action is specified (see [6.2.1](#)). The positive detent or indexing mechanism shall be designed to minimize the possibility of the movable elements coming to rest between positions. The spring return mechanism shall return to the specified fixed position when the operating force is removed and the movable element shall come to rest in a positive detent position (see [4.7.1](#)).

3.5.4.3 Rotational torque. When switches are tested as specified in [4.7.2](#), the torque required to rotate the shaft from each position to the next shall be within the specified limits (see [3.3](#)). Following the endurance test, and following the vibration and shock test, the values shall not vary by more than 20 percent from the original values.

3.5.4.4 Operation. When switches are tested in accordance with [4.7.1](#), the electrical circuit configuration shall conform to the applicable drawing, including indication of shorting or nonshorting contacts. Momentary, detent, or push-pull operation should be as specified (see [6.2](#)).

3.5.4.5 Dielectric withstanding voltage. When switches are tested as specified in [4.7.3](#), there shall be no evidence of flashover, mechanical damage, arcing, or insulation breakdown.

3.5.4.6 Insulation resistance. When switches are tested as specified in [4.7.4](#), the insulation resistance shall be not less than 100 megohms.

3.5.4.7 Temperature rise. When switches are tested as specified in [4.7.5](#), the measured temperature rise shall not exceed 65°C (149°F).

3.5.4.8 Overload. When switches are tested as specified in [4.7.6](#), they shall remain electrically and mechanically operative.

3.5.4.9 Endurance (electrical and mechanical). When switches are tested as specified in [4.7.7.1](#) and [4.7.7.2](#), they shall remain electrically and mechanically operative during and after the test. After the test there shall be no evidence of broken, deformed, displaced, or loose parts.

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3.5.4.10 Contact resistance. When measured in accordance with 4.7.8, the contact resistance shall not exceed the following values:

- (a) Initial and after vibration and shock – 10 milliohms.
- (b) After endurance – 20 milliohms.

3.5.4.11 Vibration. When tested as specified in 4.7.9, there shall be no momentary opening of closed contacts or momentary closing of open contacts. There shall be no chance of rotor position nor evidence of electrical or mechanical damage.

3.5.4.12 High impact shock. The switches shall withstand the high impact shock test specified in 4.7.10 without electrical or mechanical damage. Momentary opening of the closed contacts or momentary closing of the open contacts shall not exceed 0.02 seconds. There shall be no change in rotor position. Mechanical shock mounts or devices by which the switch can be locked-in or locked-out shall not be used.

3.6 Safety. The safety requirements shall be as specified in [MIL-E-917](#) and in requirement 1 of [MIL-HDBK-454](#).

3.7 Position indication. The switch positions shall be indicated on a plastic plate of CFI-5 material in accordance with [ASTM-D5948](#). All characters shall be indented and easily discernible. The marking shall be black on a gray background and shall be as specified (see 6.2.1).

3.8 Identification and marking. Identification markings shall be provided on the switch, either engraved or stamped on a metal plate portion of the switch accessible from the rear, or on an identification plate in accordance with MIL-P-14024, type A, B or C, and [MIL-P-15024/5](#), furnished as part of the switch. The markings shall be in accordance with [MIL-STD-130](#). The data shall consist of the following:

- (a) Switch manufacturer's name, trademark, or code symbol, in accordance with [MIL-STD-1285](#).
- (b) Date code in accordance with [MIL-STD-1285](#).
- (c) Switch manufacturer's part number.
- (d) Switch current and voltage ratings.

3.9 Repair parts. When specified (see 6.2.1), repair parts shall be furnished. When the switch is considered not repairable, the repair part shall be a complete switch for each 25 switches or fraction thereof of exactly the same type installed. When the switch is considered repairable, the requirements specified in 3.9.1 and 3.9.2 shall govern.

3.9.1 Each repair part shall be equal to the original and suitable for replacement without special tools. Where parts, as specified, are not readily replaceable, a complete switch shall be furnished as a repair part. Special tools are defined as those tools not listed in the Federal Supply Catalog.

3.9.2 Quantity. When individual switches are purchased, repair parts shall be furnished on a per switch basis and shall consist of a complete replacement of all contacts and springs installed in the switch. When switches are being furnished as part of a switch board or other unit, the quantity of repair parts shall be not less than 10 percent of the parts installed, and shall be sufficient to replace all contacts and springs in any switch furnished with the switchboard unit. When repair parts are to be consolidated and furnished on a per ship basis, they shall be not less than 10 percent of the parts installed and shall be sufficient to replace all contacts and springs in any switch installed.

3.10 Drawings. Drawings shall be furnished in accordance with categories F, G, and H and type II of [MIL-STD-31000](#) in the quantities as specified (see 6.2.1). The following notation shall appear on the drawings: "For design variations used to fulfill a specific application, refer to the applicable certification data sheet, outline drawing or other document, as appropriate." The drawings shall contain, as a minimum, the following data:

- (a) Outline of the front and side views of the switch, giving dimensions and showing the outlines of all parts of the switch. The parts shall have piece numbers referenced to the bill of material. Additional views may be shown for clarity.
- (b) List of material which shall include all parts, the materials, manufacturer's identification, and specifications (where applicable).
- (c) The drawings shall delineate the possible variations in number of switch positions; the number of switching sections; momentary, push-pull and detent action; shorting and nonshorting contact types; the type of knobs available.

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- (d) The drawings shall include in chart form the weight of a switch, the weight of a set of repair parts, and torque, as well as length dimensions, for switching having different numbers of switching decks. The drawings shall also show the maximum number of switching decks that can be used and still meet the high impact shock and vibration requirements with and without rear support.
- (e) A list of repair parts and special tools with piece number for each item, the name of each item, the quantity of each item recommended for a set of repair parts (on a per switch basis), the manufacturer's ordering identification for the item.
- (f) Switch rating.
- (g) List of exceptions to this specification.

4. VERIFICATION

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

- (a) First article inspection (see 4.3).
- (b) Conformance inspection (see 4.4).
- (c) Comparison inspection (see 4.5).

4.3 First article inspection. First article inspection shall consist of the tests specified in [table I](#).

4.3.1 First article samples. Switches submitted for first article shall be representative of the manufacturer's normal production standards and methods, and shall be in accordance with the drawings (see 3.10). The samples shall permit evaluation of the significant variations of the switch as shown on the drawings for which first article approval is sought. The switch arrangements specified in 4.3.1.1 have been selected to provide for the known variations. First article approval of the switches submitted will include qualification of any variation of switch as shown on the drawings (see 3.10) and of the electrical safety (see 3.6).

4.3.1.1 Test samples. Test samples shall consist of the following listed switch samples. The electrical circuit arrangement shall provide for a sufficient number of contacts to comply with the monitoring requirements of the shock and vibration tests and the electrical loading requirements for the overload and endurance tests. If a sufficient number of contacts are not available in the required number of sample switches, additional switches shall be used so the total number of contacts required are provided.

Switch sample 1:

- (a) Maximum number of switching decks for which approval is sought. (If rear support is specified, switch sample 1A shall have the rear support. An additional switch 1B shall be provided having the maximum number of switching decks suitable for use without rear support.)
- (b) Detent action or push-pull. (If switch design provides for both options, sample 1A shall have detent operation and sample 1B shall have push-pull operation.)
- (c) Maximum number of switch positions (angular throw).
- (d) Oval handle (for detent action), level handle (for push-pull).
- (e) A minimum of 6 closed contacts and 4 open contacts, including shorting and nonshorting contacts.

Switch sample 2:

- (a) Maximum number of switching decks (see sample 1, item (a)).
- (b) Momentary action.
- (c) Maximum number of positions (for momentary action).
- (d) Pistol grip or level handle.
- (e) A minimum of 6 closed contacts and 4 open contacts, including both shorting and nonshorting contacts.

Switch samples 3, 7 and 8:

Same as switch sample 1, except contacts as required.

Switch sample 4:

Same as switch sample 1, except minimum number of positions and contacts as required.

Switch sample 5:

Same as switch sample 2.

Switch sample 6:

Same as switch sample 2, except minimum number of positions and contacts as required.

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TABLE I – First article inspection ^{1/}

Inspection	Requirement paragraph	Test paragraph	Sample units							
			1A 1B	2A 2B	3	4	5	6	7	8
Group I										
Visual and mechanical examination	3.5	4.6	1	1						
Weight	3.5	4.6.2	2	2						
Creepage and clearance	3.5.3	4.6.3	3	3						
Material certification	3.4.1 and 3.5.1	4.6.1	4	4						
Rotational torque	3.5.4.3	4.7.2	5	5	2	2	2	2	2	2
Operation	3.5.4.2 and 3.5.4.4	4.7.1	6	6	3	3	3	3	3	3
Contact resistance	3.5.4.10	4.7.8	7	7	4	4	4	4	4	4
Dielectric withstanding voltage	3.5.4.5	4.7.3	8	8	5	5	5	5	5	5
Insulation resistance	3.5.4.6	4.7.4	9	9	6	6	6	6	6	6
Group II										
Temperature rise	3.5.4.7	4.7.5			7	7	7	7		
Overload	3.5.4.8	4.7.6			8	8	8	8		
Endurance, electrical	3.5.4.9	4.7.7.1			9	9	9	9		
Endurance, mechanical	3.5.4.9	4.7.7.2							7	7
Temperature rise	3.5.4.7	4.7.5			10	10	10	10		
Contact resistance	3.5.4.10	4.7.8			11	11	11	11	8	8
Dielectric withstanding voltage	3.5.4.5	4.7.3			12	12	12	12	9	9
Insulation resistance	3.5.4.6	4.7.4			13	13	13	13	10	10
Rotational torque	3.5.4.3	4.7.2			14	14	14	14	11	11
Visual and mechanical examination	3.5	4.6			15	15	15	15	12	12
Group III										
Vibration	3.5.4.11	4.7.9	10	10 ^{2/}						
High impact shock	3.5.4.12	4.7.10	11	11 ^{2/}						
Contact resistance	3.5.4.10	4.7.8	12	12						
Dielectric withstanding voltage	3.5.4.5	4.7.3	13	13						
Insulation resistance	3.5.4.6	4.7.4	14	14						
Rotational torque	3.5.4.3	4.7.2	15	15						
Visual and mechanical examination	3.5	4.6	16	16						

^{1/} No failures shall be allowed.

^{2/} Switch shall be tested in a different actuation position than switch number 1.

TABLE II – Quality conformance inspection.

Inspection	Requirement paragraph	Test paragraph
Visual and mechanical examination	3.5	4.6
Marking	3.8	4.6
Operation	3.5.4.2 and 3.5.4.4	4.7.1
Dielectric withstanding voltage	3.5.4.5	4.7.3

4.4 Conformance inspection.

4.4.1 Inspection lot. An inspection lot, as far as practicable, shall consist of all the switches of the same type produced under essentially the same conditions and offered for inspection at one time. Switches meeting these requirements but having different circuit configurations or varying number of switch decks, may be combined to form a lot.

4.4.2 Sampling and inspection. Quality conformance inspection shall consist of the examinations and tests specified in [table II](#). The visual examination and dielectric withstanding voltage test shall be made on all sample units. The remaining examinations and tests will be performed on the same sample units in the order shown.

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4.5 Comparison inspection. Comparison inspection shall consist of the tests for samples 1 and 2 for test groups I and III specified in [table I](#), except that the vibration test may be waived. Sample units subjected to comparison inspection shall not be delivered on a contract or order. Comparison inspection shall be performed every three years.

4.6 Visual and mechanical examination. Switches shall be examined visually to verify that design, construction and workmanship are in accordance with this specification (see [3.5](#)). Weight, material certification, physical dimensions (including creepage and clearance), however are not required for more than two switches of the same type for comparison inspection.

4.6.1 Material certification. The materials and plating used in the construction of the switches shall be certified as to their conformance to this specification (see [3.4.1](#) and [3.5.1](#)).

4.6.2 Weight. The weight of the switch shall be measured and recorded. The weight shall not differ from the weight of the switch specified on the drawing (see [3.5](#)) by more than 10 percent.

4.6.3 Creepage and clearance. Creepage and clearance distances shall be demonstrated by actual measurement to be in accordance with [3.5.3](#).

4.7 Tests.

4.7.1 Operation. The operation test shall consist of the minimum number of electrical operations to ascertain that the electrical circuitry in each position of the switch is in accordance with the circuits specified on the detailed drawing. An audible or visual device shall be used to indicate the opening and closing of the circuits at each position and each deck. The indicating means shall permit observation as to whether the contacts are shorting or nonshorting. Momentary or positive positioning shall also be verified during this test (see [3.5.4.2](#) and [3.5.4.4](#)).

4.7.2 Rotational torque. The torque required to rotate the switch shaft with respect to the switch body shall be measured by a torque wrench or other suitable torque measuring position in both directions. The torque shall be taken as the average value of the measurements.

4.7.3 Dielectric withstanding voltage (see [3.5.4.5](#)). Switches shall be tested in accordance with [method 301 of MIL-STD-202](#). The following details shall apply:

- (a) Magnitude of test voltage – For switches rated at 125 volts, the test voltage shall be 1250 volts r.m.s. For switches rated above 125 volts, but not in excess of 500 volts, the test voltage shall be 2000 volts r.m.s.
- (b) Points of application of test voltage – The test voltage shall be successively applied between each electric circuit and grounded metal parts, and between each principal electric circuit and grounded metal parts, and between each principal electric circuit and all other principal circuits.
- (c) For qualification and comparison inspection the test voltage shall be applied for one minute. For quality conformance inspection, the test voltage may be applied for 1 second, at 1500 volts for 125 volt switches and 2400 volts for switches rated above 125 volts but not in excess of 500 volts.
- (d) Examination after test – Switches shall be examined for evidence of flashover, mechanical damage, arcing, and insulation breakdown.

4.7.4 Insulation resistance (see [3.5.4.6](#)). Switches shall be tested in accordance with [method 302 of MIL-STD-202](#). The following details shall apply:

- (a) Test condition B (test potential 500 volts).
- (b) Points of measurement – In each switch position with test voltage applied between each principal circuit and grounded metal parts and between each principal circuit and all other principal circuits.
- (c) The test voltage shall be applied for 15 seconds.

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4.7.5 Temperature rise (see 3.5.4.7). The temperature rise of the switch stationary contacts, bolted connections and terminal studs energized during the electrical endurance tests shall be determined by means of thermocouples of small wire gage (28-32 AWG). The temperature sensitive elements shall be placed on the current carrying parts where they first emerge from the switch body. Temperature measurements shall be taken prior to, during, and immediately following the electrical endurance test. The temperature rise measurements during the electrical endurance test shall be taken after the first 50,000 cycles of operation, while the switches are in the 65°C (149°F) ambient temperature. The contacts shall be the same as those that were used for the overload and endurance tests, and shall be energized at the "carry" rating at any convenient voltage within the switch rating. Temperature measurements shall be taken at half hour intervals until three successive measurements are within plus or minus 1°C. Switch wiring shall be size 16 for 5 amperes or less and size 14 in excess of 5 amperes (20 amperes maximum). The cable length from load on sup-ply to the switch shall be 3 feet plus 1 inch, minus 0 inch. If enclosures or covers are provided as part of the switch, the test shall be made with the enclosures or covers properly mounted to the switch.

4.7.6 Overload. The switches shall be operated for 50 operations to interrupt 150 percent of the maximum rated current at the voltage for that rating. The circuit shall provide for "on-off" switching and one operation shall consist of throwing the switch from the "off" position to the "on" position and returning to the "off" position. "Two pairs of contacts shall be used for each electrical rating subsequently tested in the electrical endurance test and shall be the same ones used for the endurance and overload tests. The test rate shall be two operations per minute and the duty cycle shall be 50 percent on and 50 percent off. The wiring for the test shall be the same as for the endurance test.

4.7.7 Endurance (see 3.5.4.9).

4.7.7.1 Electrical. The contacts tested shall be used to determine the suitability of the switch to make, break, and carry each of the current/voltage ratings specified for the switch. The a.c. tests shall be conducted at a 0.75 to 0.80 lagging power factor (p.f.). The contacts shall be distributed uniformly over the entire length of the switch. Nonshorting contacts shall be used for interrupting ratings and shorting contacts shall be used for the maximum carrying rating. The switch shall be subjected to 100,000 cycles of operation. The first 50,000 cycles of operation shall be performed with the switches exposed to an ambient temperature of $65 \pm 3^\circ\text{C}$. The last 50,000 cycles of operation shall be performed at room ambient conditions. A cycle of operation is defined as one electrical make and break of each contact. The cycling rate shall be a minimum of 6 cycles of operation per minute, with a minimum of a 50 percent duty cycle. Switches shall be monitored to determine when any loaded contacts fail to open or close in proper sequence.

4.7.7.2 Mechanical. The switch shall be operated without electrical load for 10,000 cycles of operation. A cycle of operation is defined as a complete rotation of the switch shaft through all switch positions. Where the switch has removable stops, the stops shall be removed and a cycle of operation shall be the full 360 degrees. Where the switch has nonremovable stops, the rotation of the shaft from the fully counterclockwise position to the fully clockwise position and return shall constitute two cycles of operation. The cycling rate shall be at any convenient speed.

4.7.8 Contact resistance (see 3.5.4.10). Contact resistance of each pole subjected to the electrical endurance test and each pole subjected to the mechanical endurance test shall be determined in accordance with [method 307 of MIL-STD-202](#). The following details shall apply:

- (a) Test leads shall be connected by a method suitable for the switch terminals.
- (b) Contact resistance as indicated by the millivolt drop shall be measured after the electrical endurance tests using the load applied during the test.
- (c) Contact resistance as indicated by the millivolt drop shall be measured after the mechanical endurance test, using a 100 milliamper test current and an open circuit test voltage of 2 to 4 volts.
- (d) Ten separate measurements shall be taken for (b) and ten for (c) with one operation of the switch between measurements. The average value of the measurements shall be calculated.

4.7.9 Vibration (see 3.5.4.11). Switches shall be tested in accordance with type I requirements of [MIL-STD-167-1](#). The following shall apply:

- (a) Method of mounting – Switches shall be mounted to a rigid metal panel in a normal manner using associated mounting hardware. Switches having means for rear support shall be so supported during the test.
- (b) Switch positions – One sample switch shall be tested in one switch position, and a second sample switch in any other switch position. For momentary action (spring return) switches, the switch shall be tested in the "rest" position.

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- (c) Contact monitoring – All contacts of the switch shall be monitored during the exploratory vibration and endurance tests except when the number of closed contacts exceeds 6, or when the number of open contacts exceeds 4, only 6 closed and 4 open contacts need to be monitored. In such instances the contacts monitored shall be equally distributed (approximately) from the front to the rear of the switch. Oscillographs shall be taken during the last minute of the final tests along each principal axis to determine conformance with [3.5.4.11](#).
- (d) Electrical load conditions – Closed contacts to be tested shall be carrying maximum rated continuous current at rated voltage.
- (e) Examination – After test, the switches shall be examined for evidence of mechanical damage or loosening of parts.

4.7.10 High impact shock (see [3.5.4.12](#)). High impact shock tests shall be conducted in accordance with [MIL-S-901](#) for grade A, class I, type C equipment. The following shall apply:

- (a) Method of mounting – Fixture 6D-1 of [MIL-S-901](#).
- (b) Switch position – (See [4.7.9\(b\)](#)).
- (c) Contact monitoring – The number of contacts to be monitored shall be in accordance with [4.7.9\(c\)](#). The coil of a relay calibrated for the test voltage, and having a dropout time of 0.02 seconds shall be connected in series with the closed contacts. In lieu of the relay coil, a recording oscillograph or other means may be utilized to monitor the closed contacts. In addition, the oscillograph or other means shall be used to monitor the open contacts. The monitoring means shall be sufficiently sensitive to detect momentary opening of the closed contacts or momentary closing of the open contacts, in excess of 0.02 seconds.
- (d) Electrical load conditions – The current and voltage on the contacts shall be sufficient to detect momentary opening or closing of the contacts through the monitoring device.
- (e) Examination – After test, the switches shall be examined for evidence of mechanical damage or loosening of parts.

4.8 Inspection of preparation for delivery. The packaging, packing, and marking shall be inspected for compliance with section 5 of this document.

5. PACKAGING

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

6. NOTES

6.1 Intended use. The switches covered by this specification are intended for use in power, control and metering circuits where reliability and ruggedness are required for Naval shipboard applications.

6.2 Ordering data.

6.2.1 Procurement requirements. Procurement documents should specify the following:

- (a) Title, number and date of this specification.
- (b) Type of switch required (see [1.2](#)).
- (c) Switch rating, characteristics and circuitry (see [1.2.1](#), [1.2.2.1](#) and [1.2.2.2](#)).
- (d) Shape of operating handle (see [1.2.3](#) and [3.5.1.5](#)).
- (e) Whether shorting or nonshorting contacts are required (see [3.5.1.3](#)).
- (f) When a spring return action is specified (see [3.5.4.2](#)).
- (g) Whether momentary, detent, or push-pull operation is required (see [3.5.4.4](#)).
- (h) Position indication and marking (see [3.7](#)).
- (i) Repair parts required (see [3.9](#)).
- (j) Quantity of drawings required (see [3.10](#)).
- (k) Quality assurance requirements (see [4.1.1](#)).
- (l) Level of preservation, packaging, packing and marking required (see [5.1](#)).

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6.2.2 Contract data requirements. Data generated by this document are not deliverable unless specified on the Contract Data Requirements List (DD Form 1423) or the contract schedule. The data required by this specification include, but are not restricted to the following:

- (a) Drawings (see [3.10](#) and [3.10.1](#)).
- (b) Test reports (see [4.5.1](#)).

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

6.4 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).

6.5 Subject term (key word) listing.

- rotary
- high impact
- push-pull
- detent
- spring return

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:
Navy - SH
DLA - CC

Preparing activity:
DLA - CC

(Project 5930-2011-124)

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/>