INCH-POUND
MIL-PRF-22E
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SUPERSEDING
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PERFORMANCE SPECIFICATION

RESISTOR, VARIABLE, WIREWOUND, POWER TYPE, GENERAL SPECIFICATION FOR

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

1. SCOPE.

1.1 Scope. This specification covers the general requirements for power type variable resistors having a resistance element of wire, wound linear on an insulating strip shaped in an arc, such that a contact bears uniformly on the resistance element when adjusted by a control shaft. The power ratings (see 3.1) cover a range from 6.25 watts to 1,000 watts, inclusive (see 6.2).

1.2 Classification.

1.2.1 Part or Identifying number (PIN). The PIN is in the following form, and as specified (see 3.1):

M22/01	-	0001	2	SB
Associated specification number		Resistance value designator (1.2.1.2)	Electrical off position (1.2.1.3)	Shaft and type of mounting (1.2.1.4)

1.2.1.1 Style. The style is identified by the two letter symbol “RP” followed by a two digit number. The letters identify power type, wire-wound variable resistors and the number identifies the size and power rating.

1.2.1.2 Resistance value designator. The resistance value designator is a coded value which identifies the resistance value and maximum current (see 3.1).

1.2.1.3 Electrical off position. The existence and location of an electrical off position at one end of the resistance element is indicated by a single digit, in accordance with table I.

1.2.1.4 Shaft and type of mounting. The shaft, type of mounting, and length of shaft is identified by a two letter symbol. The first letter indicates the style of shaft and type of mounting and the second letter indicates the length of the shaft, in accordance with tables II and III, respectively.

Comments, suggestions, or questions on this document should be addressed to: DLA Land and Maritime, ATTN: VAT, Post Office Box 3990, Columbus, Ohio 43218-3990 or by email Resistor@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 5905

TABLE I. Electrical off position.

Symbol	Electrical off position
1	No electrical off position.
2	Electrical off position at end of rotation of control knob in a counterclockwise direction.
3	Electrical off position at end of rotation of control knob in a clockwise direction.

TABLE II. Style of shaft and type of mounting.

Symbol	Style of shaft	Type of mounting				
		Bushing				Two hole
		.125 inch diameter shaft		.250 inch diameter shaft		.375 inch diameter shaft
		Standard	Locking	Standard	Locking	
F	Flatted			X		X
S	Slotted	X		X		
T	Flatted				X	
U	Slotted		X		X	

TABLE III. Length of operating shaft.

Symbol	Standard length of shaft measured for mounting surface of resistor						
	Flatted			Slotted			
	.250 inch diameter shaft		.375 inch diameter shaft	.125 inch diameter shaft		.250 inch diameter shaft	
	Standard bushing	Locking bushing	Two hole mounting	Standard bushing	Locking bushing	Standard bushing	Locking bushing
	Inches (±0.0469)						
A						0.500	
B				0.625	0.625		0.625
D	0.875	1.250	0.875		0.875	0.875	
G							1.250
H	1.500		1.500	1.500		1.500	
J	2.000		2.000	2.000		2.000	
K	2.500 1/		2.500 1/	2.500		2.500	
N	4.000		4.000				
R	6.000		6.000				
S				0.375			

1/ This shaft is to be flatted within 0.156 inch of the mounting bushing (or mounting surface if no bushing is present).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4 and 5 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, 4 and 5 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 (see 6.2).

DEPARTMENT OF DEFENSE SPECIFICATION

(See supplement 1 for list of specification sheets.)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202	-	Test Methods Standard Electronics and Electrical Components Parts
MIL-STD-810	-	Environmental Engineering Considerations and Laboratory Tests

DEPARTMENT OF DEFENSE HANDBOOKS

FED-STD-H28	-	Screw Thread Standards for Federal Services

(Copies of these documents are available online at http://quicksearch.dla.mil or from the DLA Document Services, 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 the documents cited in the solicitation or contract (see 6.2).

INTERNATIONAL ORGANIZATION for STANDARDS (ISO)

ISO 10012	-	Measurement Management Systems - Requirements for Measurement Processes and Measuring Equipment

(Copies of this document are available online at http://www.iso.org/ or should be addressed to the American National Standards Institute, 11 West 42nd Street New York, NY 10036.)

NATIONAL CONFERENCE OF STANDARDS LABORATORIES

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

(Copies of this document are available from http://www.ncsli.org/ or from the National Conference of Standards Laboratories (NCSL) International, 1800 30th Street, Suite 305, Boulder, CO 80301-1026.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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 unless otherwise noted. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS.

3.1 Associated specifications. The individual part requirements shall be as specified herein and in accordance with the applicable associated specifications. In the event of a conflict between requirements of this specification and the associated specifications, the latter shall govern (see 6.2).

3.2 Qualification. Resistors furnished under this specification shall be products which are qualified for listing on the applicable qualified product list (QPL) before contract award (see 4.4 and 6.3).

3.3 Materials. Materials shall be used which will enable the resistors to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.3.1 Fungus. All external materials shall be nonnutrient to fungus growth or shall be treated to retard fungus growth. The manufacturers shall certify that all external materials are fungus resistant or shall perform the test specified in 4.7.16. There shall be no evidence of fungus growth on the external surface as a result of the test.

3.3.2 Pure tin. The use of pure tin, as an underplate or final finish is prohibited both internally and externally. Tin content of resistor components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see 6.8).

3.4 Interface and physical dimensions. The resistors shall meet the interface and physical dimensions specified (see 3.1).

3.4.1 Windings. The resistance element shall consist of a winding of resistance wire or ribbon (see 3.4.1.1) on a form which shall not char or break down at any combination of temperatures and loads specified herein. The resistance element shall be wound in such a manner to preclude the possibility of shorting the turns. Joints, welds and bonds shall be held to an absolute minimum, the wire shall be securely set on the form so as to avoid lateral displacement or bunching under action of the contact arm. The insulating coating between the wires shall be below the contact surface of the winding.

3.4.1.1 Resistance wire. The resistance wire shall possess a uniform cross sectional area of conductor. The cross sectional area of the wire shall be the maximum consistent with other requirements of this specification.

3.4.2 Contact arm assembly. Contact pressure on the resistance element shall be maintained by uniform positive pressure and shall permit smooth electrical and mechanical control of the resistor over the entire range of continuity travel (applicable to resistors with stops). The moving contact shall have continuous electrical contact with its terminal throughout the entire mechanical travel and shall be insulated from the operating shaft, bushing, and case.

3.4.3 Operating shaft. All operating shafts shall be of corrosion resistant metal.

3.4.3.1 Size. The diameter and length of the operating shaft shall be as specified (see 3.1 and table II and table III.)

3.4.3.2 Flatted shaft (when applicable). Flatted shafts shall have their flatted surface within $\pm 3^{\circ}$ of being diametrically opposite the contact arm. The flatted surface with the exception specified in footnote 1/ of table III shall have a minimum length of 0.625 inch for resistors with a high power rating of 150 watts or less and a minimum length of 1.5 inches for resistors of higher power ratings, or it shall be flatted to within 0.156 inch of the mounting bushing (or mounting surface if no bushing present), whichever length is shorter. Thickness of the flatted portion shall be as specified (see 3.1).

3.4.3.3 Slotted shaft (when applicable). The dimensions shall be as specified. In no case shall the slot be deep enough to interfere with shaft retainers. The slot shall be so positioned that the centerline is within $\pm 10^{\circ}$ of the centerline of the contact arm (see 3.1).

3.4.4 Stops. Stops employed to limit the mechanical travel of the contact arm assembly may be part of, but shall not complete, any electrical circuit. In no case shall the mechanical stop contact the electrical pick off portion of the contact assembly.

3.4.5 Terminals. Terminals shall be located as shown in the associated specifications, (see 3.1 and 6.2). The resistors shall be supplied either with soldering or screw terminals, as specified (see 3.1). Terminals shall permit secure electrical and mechanical connection of wire to carry adequately the maximum current of resistors (see 3.1). The terminals shall be treated to facilitate soldering.

3.4.5.1 Electrical off position (when applicable). The construction of the electrical off position shall be such that there will be no question as to when the contact is turned from the winding. There shall be no provision for a terminal at the off position. The number of terminals shall be as specified (see 3.1).

3.4.6 Mounting. Mounting of the resistors shall be as specified (see 3.1 and table II and table III).

3.4.6.1 Locking bushing. Locking bushings for applicable styles shall be as specified (see 3.1).

3.4.6.2 Nonturn device. A nonturn device shall be furnished on standard bushing and locking bushing type resistors which will prevent rotation of resistors with respect to the surface on which they are mounted. The location of the nonturn device and its widest dimension shall be as specified (see 3.1). If the nonturn device is not symmetrical about its vertical axis, it shall be so placed that a plane raised perpendicular to the widest dimension and through its center will pass through the axis of the operating shaft.

3.4.7 Mechanical rotation. The total mechanical rotation shall be as specified (see 3.1).

3.4.8 Enclosure. When specified (see 3.1), resistors shall have enclosures for protection against mechanical damage and shall be dustproof.

3.4.9 Hardware (for bushing mounted units). When specified (see 3.1), each resistor shall be furnished with a corrosion resistant, internal tooth lock washer and a hexagonal mounting nut (see 3.12). Unless otherwise specified, the hardware shall be assembled on the resistor.

3.4.9.1 Threaded parts. All external threaded parts shall be in accordance with FED-STD-H28, and as specified herein.

3.4.9.2 Locking of screw thread assemblies. All screw thread assemblies shall be rendered resistant to loosening under vibration.

3.5 Dielectric withstanding voltage. When resistors are tested as specified in 4.7.2, there shall be no damage, arcing, or breakdown.

3.6 DC resistance (see 4.7.3).

3.6.1 Total.

3.6.1.1 Total resistance. When measured are tested as specified in 4.7.3.1, as applicable, the total resistance value shall be within the specified nominal resistance tolerance for the nominal resistance.

3.6.2 Minimum resistance. When measured as specified in 4.7.3.2, the minimum resistance shall not exceed 0.2 percent of the nominal total resistance value or 0.2 ohms, whichever is greater, unless otherwise specified (see 3.1).

3.6.3 Resistance value deviations. All maximum deviations as specified in this section are to be considered absolute limits with the exception of the contact resistance adjustment.

3.7 Torque (see 4.7.4).

3.7.1 Operating. When resistors are tested as specified in 4.7.4.1, the torque required to rotate the contact arm shall be as specified (see 3.1).

3.7.2 Stops. When resistors are tested as specified in 4.7.4.2, there shall be no mechanical damage to the contact arm, stop, and nonturn device, as applicable.

3.7.3 Locking (when applicable). When resistors are tested as specified in 4.7.4.3, there shall be no damage to the bushing, threads, and nonturn device. The contact arm shall not move when subjected to the specified torque.

3.8 Low temperature exposure. When resistors are tested as specified in 4.7.5, the torque required to rotate the contact arm shall not exceed the value specified (see 3.1). There shall be no discontinuity, electrical connections shall not be affected, nor shall there be any loosening of rivets or evidence of any other mechanical damage.

3.9 Power rating. When resistors are tested as specified in 4.7.6, the hotspot temperature shall not exceed the temperature specified (see 3.1).

3.10 Load life. When resistors are tested as specified in 4.7.7, the change in total resistance measurement and each of the succeeding total resistance measurements shall not exceed 5 percent, nor shall there be any evidence of mechanical damage.

3.11 Vibration, low frequency. When resistors are tested as specified in 4.7.8, there shall be no evidence of intermittent contacts or electrical discontinuity. The total resistance shall not change in excess of 5 percent. The contact arm shall not move more than 2 degrees, nor shall there be a change in resistance between the contact arm terminal and either end terminal in excess of 5 percent. There shall be no evidence of mechanical damage.

3.12 Salt spray (corrosion). When resistors are tested as specified in 4.7.9, there shall be no appreciable corrosion. Resistors shall be mechanically operative and electrically continuous, and the mounting hardware (see 3.4.9) shall be readily removable.

3.13 Humidity (steady-state). When resistors are tested as specified in 4.7.10, the change in total resistance shall not exceed 10 percent between the initial total resistance measurement and each succeeding total resistance measurements.

3.14 Rotational load life. When resistors are tested as specified in 4.7.11, the change in total resistance shall not exceed 5 percent between total resistance measurement and the final total resistance measurement. During and after the tests, the resistors shall be mechanically operative, there shall be no evidence of intermittent contact between the contact arm and resistance element, and mechanical damage.

3.15 Terminal strength (when applicable). When resistors are tested as specified in 4.7.12, there shall be no evidence of mechanical damage and the change in total resistance shall not exceed 1 percent.

3.16 Shock (specified pulse). When resistors are tested as specified in 4.7.13, there shall be no open circuit or intermittent contact; movement of the contact arm shall not result in a resistance change greater than 10 percent; the total resistance shall not change in excess of 2 percent; and there shall be no evidence of mechanical damage (see 3.1 and 6.2).

3.17 Acceleration (when applicable). When resistors are tested as specified in 4.7.14, there shall be no open circuit or intermittent contact; movement of the contact arm shall not result in a resistance change greater than 10 percent; the total resistance shall not change in excess of 3 percent; and there shall be no evidence of mechanical damage (see 3.1).

3.18 Vibration, high frequency. When resistors are tested as specified in 4.7.15, there shall be no open circuit or intermittent contact; movement of the contact arm shall not result in a resistance change greater that 10 percent; total resistance shall not change greater in excess of 2 percent; and there shall be no evidence of mechanical damage.

3.19 Marking. Resistors shall be permanently marked with the PIN and manufacturer's name and or trademark. If space permits, the resistance value shall also be marked. The PIN shall be marked on either the rear or the periphery of the resistors. There shall be no space between symbols which comprise the PIN. If lack of space requires it, the PIN may be set in two lines. In this event, the PIN shall be divided between the document number and the dash number as shown in the following example:

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3.20 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.21 Workmanship. Resistors shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

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 4.6).

4.2 Test equipment and inspection facilities. The manufacturer shall establish and maintain a calibration system in accordance with NCSL Z540.3, ISO 10012, or equivalent system as approved by the qualifying activity.

4.3 Inspection conditions and precautions.

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

4.3.2 Precautions. Adequate precautions shall be taken during inspection to prevent condensation of moisture on resistors. Precautions shall also be taken to prevent damage by heat when soldering resistor leads to terminals.

4.4 Qualification. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample size. The number of sample units comprising a sample of resistors to be subjected for qualification inspection shall be as specified in the appendix to this specification.

4.4.2 Inspection routine. Sample units shall be subjected to the qualification inspection specified in table IV, in the order shown. Twenty units shall be subjected to the inspection of group I. The sample units shall then be divided as specified in table IV for groups II to VI, inclusive as applicable, and subjected to the inspection for their particular group, and as follows: For group II, three sample units of the highest nominal resistance value and one sample unit of the applicable lower nominal total resistance value (see table A-I), for group III, three sample units of the highest nominal resistance value and one sample unit of the applicable lower nominal total resistance value (see table A-I), for group IV, two sample units of the highest nominal resistance value and two sample units of the applicable lower nominal total resistance value (see table A-I), for group V, as applicable, four sample units of the highest nominal resistance value; and four sample units of any resistance value (see table A-I), for group VI four samples of any resistance value. For locking bushing type resistors submitted with standard bushing resistors, the four additional sample units will be subjected to the examinations and test of group I and II of table V.

4.4.3 Defective. Failure of a resistor in one or more tests of a group shall be charged as a single failure. One failure shall be allowed for groups I, II, III, and IV combined. No failures shall be allowed for groups V, and VI. Failures in excess of those allowed shall be cause for refusal to grant qualification.

4.5 Retention of qualification. Every 12 months, the manufacturer shall verify the retention of qualification to the qualifying activity. In addition, the manufacturer shall immediately notify the qualifying activity whenever the group B inspection results indicate failures of the qualified product to meet the requirements of this specification. Verification shall be based on meeting the following requirements:

a. The manufacturer has not modified the design of the item.

b. The specification requirements for the item have not been amended so far as to affect the character of the item.

c. Lot rejection for group A inspection does not exceed the group A sampling plan.

d. The requirements for group B inspection are met.

When group B requirements were not met and the manufacturer has taken corrective action satisfactory to the Government, group B inspection retesting shall be instituted. A summary of the retesting shall be forwarded to the qualifying activity within 30 days after completion of the retest. All reports are to be certified by a responsible company official and the government inspector.

TABLE IV. Qualification inspection for standard bushing models.

Examination or test	Requirement Paragraph	Method Paragraph	Number of samples	Number of failures allowed 1/
Group I 2/				
Visual and mechanical examination 3/	3.1, 3.3 to 3.4.5, 3.4.6 to 3.4.9.2 inclusive, 3.18 to 3.21 inclusive	4.7.1		
Dielectric withstanding voltage	3.5	4.7.2 to 4.7.2.2, inclusive	24	
DC resistance	3.6	4.7.3 to 4.7.3.2, inclusive		
Torque	3.7	4.7.4 to 4.7.4.3, inclusive		
Low temperature exposure	3.8	4.7.5		
Group II				1
Power rating (when applicable)	3.9	4.7.6 to 4.7.6.2 inclusive		
Load life	3.10	4.7.7	4	
Vibration (low frequency) 4/	3.11	4.7.8		
Salt spray (corrosion)	3.12	4.7.9		
Group III				
Humidity (steady state)	3.13	4.7.10	4	
Group IV				
Rotational load life	3.14	4.7.11		
Terminal strength	3.15	4.7.12	4	
Shock (specified pulse) 4/	3.16	4.7.13		
Group V 5/				
Acceleration	3.17	4.7.14 to 4.7.14.4 inclusive	4	
Shock (specified pulse)	3.16	4.7.13		0
Vibration (high frequency)	3.18	4.7.15		
Group VI				
Fungus	3.3.1	4.7.16	4	

1/ Failure of a resistor in one or more tests of a group shall be charged as a single defective.
2/ Nondestructive examination and tests.
3/ Marking shall be considered defective only if marking is illegible.
4/ Not applicable to styles RP05, RP06, and RP07 (see 3.1).
5/ Applicable only to RP05, RP06, and RP07 (see 3.1).

TABLE V. Qualification inspection for locking bushing models. 1/

Examination or test	Requirement Paragraph	Method Paragraph	Number of samples	Number of failures allowed 2/
Group I 3/				
Visual and mechanical examination 4/	3.1, 3.3 to 3.4.5, 3.4.6 to 3.4.9.2 inclusive, 3.18 to 3.21 inclusive	4.7.1		
Dielectric withstanding voltage	3.5	4.7.2 to 4.7.2.2	4	0
DC resistance	3.6	4.7.3 to 4.7.3.2		
Torque	3.7	4.7.4 to 4.7.4.3		
Low temperature exposure	3.8	4.7.5		
Group II				
Rotational load life	3.14	4.7.11		
Terminal strength	3.15	4.7.12	4	1
Shock (specified pulse)	3.16	4.7.13		

1/ This inspection is applicable only to four additional locking bushing type resistors when submitted with the same style of standard bushing type resistors..
2/ Failure of a resistor in one or more tests of a group shall be charged as a single defective.
3/ Nondestructive examination and tests.
4/ Marking shall be considered defective only if marking is illegible.

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of packaging shall consist of groups A and B.

4.6.1.1 Inspection lot. An inspection lot, as far as practicable, shall consist of all resistors of the same style produced in a period not to exceed 30 days, produced under essentially the same conditions, and offered for inspection at one time.

4.6.1.2 Group A inspection. Group A inspection shall consist of the examination and tests specified in table VI and shall be made on the same set of sample units, in the order shown.

TABLE VI. Group A inspection.

Inspection	Requirement paragraph	Method paragraph	Sampling plan
DC resistance	3.6	4.7.3	4.6.1.2.1
Visual and mechanical examination			
Material	3.3	4.7.1	
Overall body and mounting dimensions	3.4		
Other physical dimensions	3.4		
Shaft dimensions	3.4.3 to 3.4.3.3		
Mechanical rotation	3.4.7		
Marking 1/	3.19		
Workmanship	3.21		

1/ Marking defects shall be charged only for illegible, incomplete, or incorrect marking. Incorrect marking defects shall be charged only to examination for style and type of marking. Incorrect electrical off position, resistance, and resistance marking shall be determined by and shall be charged to the dc resistance test (4.7.3 to 4.7.3.2, inclusive).

4.6.1.2.1 Sampling plan. A sample of parts from each inspection lot shall be randomly selected in accordance with table VII. If one or more defects are found, the lot shall be screened and defectives removed. After screening and removal of defectives a new sample of parts shall be randomly selected in accordance with table VII. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification. Resistance values in the sample shall be representative, and where possible, in proportion to the resistance in the inspection lot.

TABLE VII. Group A sampling plan.

Lot size			Sample size
1	to	12	100 percent
13	to	150	13
151	to	280	20
281	to	500	29
501	to	1,200	34
1,201	to	3,200	42
3,201	to	10,00	50
10,001	to	35,000	60
35,001	to	50,000	74
150,001	to	500,000	90
500,001and over			102

4.6.1.3 Group B inspection. Group B inspection shall consist of the tests specified in table VIII, in the order shown, and the sample shall be selected from inspection lots that have passed group A inspection.

TABLE VIII. Group B inspection. 1/

Inspection 2/	Requirement Paragraph	Method paragraph	Sampling plan
Terminal strength	3.15	4.7.12	
Shock (specified pulse)	3.16	4.7.13	
Rotational load life	3.14	4.7.11	4.6.1.3.1
Dielectric withstanding voltage	3.5	4.7.2 to 4.7.2.2 inclusive	
Torque	3.7	4.7.4 to 4.7.4.3 inclusive	

1/ If the manufacturer can demonstrate that this test has been performed 5 consecutive times with zero failures, the frequency of this test, with approval of the qualifying activity, can be performed on an annual basis. If the design, material, construction or processing of the part is changed, or if there are any quality problems or failure, the qualifying activity may require resumption of the original test.

2/ Failure of a resistor in one or more tests shall be charged as a single defective.

4.6.1.3.1 Sampling plan. A sample of parts shall be randomly selected in accordance with table IX. If one or more defects are found, the lot shall be screened and defectives removed. After screening and removal of defectives, a new sample of parts shall be randomly selected in accordance with table IX. If one or more defects are found in the second sample, the lot shall not be supplied to this specification.

TABLE IX. Group B sampling plan.

Lot size			Sample size
1	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	1,200	15
1,201	to	3,200	18
3,201	to	10,000	22
10,001	to	35,000	29
35,001 and over			29

4.6.1.4 Small quantity production. If no more than 75 resistors of the same style or group of styles, defined for lot formation (see 4.6.1.1), are produced during a continuous 3-month period, the entire 3-month production may be submitted as one lot. In case of failure, the entire lot shall be rejected and all units involved shall be subject to corrective action.

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

4.6.2 Noncompliance. If a sample fails to pass group B inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Group A inspections may be reinstituted; however, final acceptance shall be withheld until group B reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to cognizant inspection activity and the qualifying activity.

4.7 Methods of examination and test.

4.7.1 Visual and mechanical examination. Resistors shall be examined to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3 to 3.4.5, 3.4.6 to 3.4.9.2, 3.18 and 3.20, inclusive).

4.7.2 Dielectric withstanding voltage (see 3.5).

4.7.2.1 Atmospheric pressure. Resistors shall be tested in accordance with method 301 of MIL-STD-202. The following details and exceptions shall apply:

a. Magnitude of test voltage: 1000 volts root mean square (rms) for resistor styles except RP05, RP06, and RP07 (see 3.1), which shall be 500 volts rms.

b. Nature of potential: From alternating current (ac) supply at commercial line frequency and waveform.

c. Points of application of test voltage: Between the resistor terminals tied together and the bushing or shaft, as applicable. For product acceptance inspection, the duration of application of the voltage may be shortened to 1 second.

d. Examination after test: Resistors shall be examined for evidence of flashover, mechanical damage, arcing, and insulation breakdown.

4.7.2.2 Barometric pressure. Resistors shall be tested in accordance with method 105 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition B.

b. Test voltage during subjection to reduced pressure: 550 volts rms for all resistor styles except RP05, RP06, and RP07 (see 3.1), which shall be 250 volts rms.

c. Nature of potential: As specified in 4.7.2.1b.

d. Points of application: As specified in 4.7.2.1c.

e. Examination and measurement: As specified in 4.7.2.1d.

4.7.3 DC resistance. Resistors shall be tested in accordance with method 303 of MIL-STD-202. Measuring instruments used for initial and final readings of this test, can be of different styles or models provided performance is equivalent or better (see 3.6).

4.7.3.1 Initial resistance. The contact arm shall be rotated 25 cycles to remove any foreign material which may have accumulated on the resistance element of the resistor (see 3.6.1.1) .

4.7.3.1.1 Total resistance of a resistor with an electrical off position. The total resistance of a resistor with an electrical off position shall be the resistance between its terminals when the movable contact is located at the position introducing the total resistance element of the resistance (see 3.6.2).

4.7.3.1.2 Total resistance of a resistor without an electrical off position. The total resistance of a resistor without an electrical off position shall be the resistance between the end terminals when the movable contact is at the extreme counterclockwise end of the total resistance element.

4.7.3.2 Minimum resistance. The contact arm shall be rotated to its extreme counterclockwise limit of rotation. With the arm in this position, the resistance between the counterclockwise terminal and rotating contact terminal shall be measured. The contact arm shall then be rotated to its extreme clockwise limit of rotation. With the arm in this position, the resistance between the clockwise terminal and the rotating contact terminal shall be measured. If one terminal is an electrical off position, this test shall not apply (see 3.6.2).

4.7.4 Torque (see 3.7).

4.7.4.1 Operating. The torque required to rotate the contact arm on the resistance element shall be determined throughout the entire range of mechanical rotation by the torque wrench method or by any other method satisfactory to the Government.

4.7.4.2 Stop. The contact arm shall be rotated to each extreme limit of rotation, and the specified torque (see 3.1) shall be applied to the operating shaft. Resistors shall then be examined for damage to the contact arm, stop, and nonturn device, as applicable.

4.7.4.3 Locking (when applicable). Resistors shall be mounted on a metal panel by their normal mounting means and the locking device tightened with a torque wrench not greater than 8 inch-pounds. With the locking nut tightened, a 20 ounce-inch torque shall be applied to the operating shaft. Movement of the shaft shall be checked visually, and resistors shall be examined for damage to the bushing, threads, and nonturn device.

4.7.5 Low temperature exposure. Resistors shall be mounted on a panel in a refrigeration chamber. Low heat conducting extension shafts shall be placed through holes in the chamber such that rotation of the contact arm may be affected from outside the chamber. The chamber shall then be cooled to $-55^{O}C$ $+0^{O}C$, $-3^{O}C$ and held at this temperature for 1 hour. At the expiration of the hour, the amount of torque required to rotate the contact arm shall be determined by the method specified in 4.7.4.1. continuity, electrical connections, loosening of rivets, and effect of lubrication shall be checked. Resistors shall be examined for electrical and mechanical damage (see 3.8).

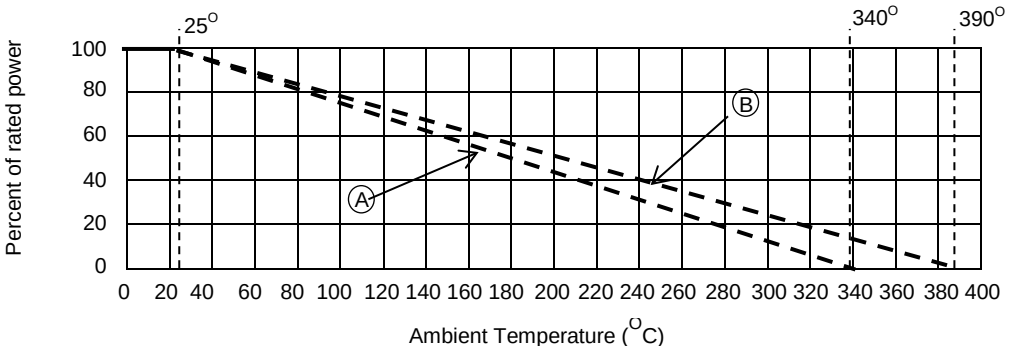
4.7.6 Power rating (when applicable) (see 3.1).

4.7.6.1 Mounting. Resistors shall be centrally mounted with terminals pointing downward on a vertical steel panel of the dimensions specified in still air at an ambient temperature of $25^{O}C \pm 5^{O}C$ (see 3.1). No shielding shall be closer than 12 inches to the panel. Still air is surrounding air with no circulation other than that created by the heat of the resistor being operated.

4.7.6.2 Procedure. Rated power shall be applied with the contact arm in the position introducing total resistance. The hot spot shall be determined by the use of a thermocouple with 0.010030 inch diameter (No. 30 AWG) or smaller wire, after thermal stability has been reached. After determination of the hot spot, the thermocouple shall be cemented immediately adjacent to the exposed portion of the winding, using a minimum quantity of cement, and the hot spot temperature rise shall be measured. For the purpose of this test, thermal stability will have been reached when no further change in temperature is observed between to successive measurements taken at 5 minute intervals. The hot spot is the point or elemental area of maximum temperature on the exposed surface of the winding.

4.7.7 Load life. Load life shall be conducted at any ambient temperature from 20°C to 40°C. The total resistance shall be measured as specified in 4.7.3 to 4.7.3.1.2, as applicable. With the resistors mounted as specified in 4.7.6.1 and with the movable contact adjusted for total resistance, the applicable rated wattage, in accordance with figure 1, shall be applied intermittently, one and one-half hours "on" and one-half hour "off", for a total of 1,000 hours. Circuit connections shall be such that current flows through the movable contact. Total resistance measurements (see 4.7.3 to 4.7.3.1.2, as applicable) shall be made at the end of the one-half hour “off” period after 50 hours ±8 hours, 100 hours ±8 hours, 250 hours ±8 hours, 500 hours ±12 hours, 750 hours ±12 hours, and 1,000 hours ±12 hours have elapsed. Before the final resistance measurement is made, the contact arm shall be rotated 25 cycles. Resistors shall be examined for evidence of mechanical damage (see 3.10).

NOTE: Operation of these resistors at ambient temperatures greater than 125°C can damage the metal plating, shaft lubricant, etc. of the resistor.



(A) RESISTOR STYLE RP05, RP06, RP07, RP10, RP11, RP15, RP16, RP20, RP25

(B) RESISTOR STYLE RP30, RP35, RP40, RP45, RP50

FIGURE 1. Power rating curves for continuous duty.

4.7.8 Vibration, low frequency (when applicable). Resistors shall be tested in accordance with method 201 of MIL-STD-202 (see 3.11). The following details shall apply:

a. Method of mounting: With the contact arm set at approximately 50 percent of the effective rotation. Locking bushing type resistors shall have the locking nut tightened with a torque not greater than 8 pound-inches.

b. Measurement after vibration: Total resistance shall be measured as specified in 4.7.3 to 4.7.3.1.2, as applicable. The position of the contact arm shall be measured in degrees and the resistance between the contact arm terminal and either terminal.

c. Measurement during vibration: Each resistor shall be monitored to determine electrical discontinuity or movement of contact area.

d. Measurement after vibration: As specified in 4.7.8b. Resistors shall be examined for mechanical damage.

4.7.9 Salt spray (corrosion). Resistors shall be tested in accordance with method 101 of MIL-STD-202 (see 3.12). The following details and exceptions shall apply:

a. Mounting details: On aluminum panels by their normal mounting means.

b. Test condition: B.

c. Examination and test after exposure: Enclosures, if any, shall be removed and resistors washed, shaken, and air blasted and permitted to dry 24 hours at 40OC. The resistors shall then be examined for marked corrosion, and tested for electrical continuity and mechanical operation.

4.7.10 Humidity (steady state). Resistors shall be tested in accordance with method 103 of MIL-STD-202 (see 3.13). The following details shall apply:

a. Mounting: On an aluminum panel.

b. Measurement after conditioning: Total resistance (see 4.7.3 to 4.7.3.1.2, as applicable) shall be measured.

c. Test condition: B.

d. Length of time and points of application of polarizing voltage: A 120 volt dc potential shall be applied for 96 hours between the mounting panel and resistor winding through the contact arm set at extreme counterclockwise end of the total resistance. The positive terminal of the voltage source shall be applied to the resistor winding.

e. Measurement during test: Total resistance (see 4.7.3 to 4.7.3.1.2, as applicable) shall be measured at the end of the 96 hour period.

f. Measurement after the test: Total resistance (see 4.7.3 to 4.7.3.1.2, as applicable) shall be measured after the resistors have been removed from the humidity chamber and placed in a dry atmosphere at $40^{O}C \pm 5^{O}C$ for one hour and fifteen minutes.

4.7.11 Rotational load life. Resistors shall be tested in accordance with method 206 of MIL-STD-202 (see 3.14). The following details and exceptions shall apply:

a. Mounting: Resistors shall be connected, such that a substantially constant current of nominal rating (see 3.1) flows through the resistors irrespective of the contact arm position during oscillation of the contact arm. Resistors shall be mounted with the shafts extending in a horizontal plane and with the terminals pointing downward. Locking bushing type resistors shall have their locking nuts removed.

b. Test potential: A dc potential equivalent to that required to dissipate rated wattage and limited in current to rated wattage shall be applied across the resistive element. If desired, an ac potential may be applied to resistors not having an electrical off position.

c. Cycle rate in cycles per minute (cpm): 5 - 20 cpm through 90 percent of total mechanical rotation. For resistors having an electrical off position, the moving contact shall pass through the electrical off position.

d. Test condition:

(1) A, for locking bushing type resistors.

(2) C, for standard bushing type and two hole mounting resistors.

e. Measurements prior to rotation: Total resistance (see 4.7.3 to 4.7.3.1.2, as applicable) shall be measured.

f. Measurement during rotation: Resistors shall be monitored for evidence for intermittent contact between the contact arm and the resistance element.

g. Measurement and examination after rotation: Total resistance (see 4.7.3 to 4.7.3.1.2, as applicable) shall be measured and examined for evidence of mechanical damage.

4.7.12 Terminal strength (when applicable). Total resistance (see 4.7.3 to 4.7.3.1.2, as applicable) shall be measured. A 20 pound tensile load, in a direction normal to the mounting plane of the resistor, shall be applied in turn to each terminal for one minute. Total resistance (see 4.7.3 to 4.7.3.1.2, as applicable) shall be measured. Resistors shall be examined for evidence of mechanical damage (see 3.15).

4.7.13 Shock (specified pulse). Resistors shall be tested in accordance with method 213 of MIL-STD-202 (see 3.16). The following details and exceptions shall apply:

a. Mounting method and accessories: Resistors shall be mounted by their normal mounting means on an appropriate fixture. The mounting fixture shall be constructed in such a manner as to insure that the points of theresistor mounting supports will remain in a static condition with reference to the shock table. Test leads used during this test shall be no larger thatn AWG 22 stranded wire, so that the influence of the test lead on the resistor will be held to a minimum. The test lead length shall be no longer than necessary. In all cases, the resistors shall be mounted in relation to the equipment in such a manner that the stress applied is in the direction which would be considered most detrimental. Locking bushing type resistors shall have the locking nut tightened with a torque wrench not greater than 8 inch-pounds.

b. Measurements before shock: Total resistance (see 4.7.3 to 4.7.3.1.2, as applicable) shall be measured between the contact arm terminal and one end terminal, with the contact arm positioned at the approximate midpoint of the resistance element.

c. Acceleration: 50 gravity units (g's).

d. Number and direction of blows: Resistors shall be subjected to a total of 30 blows, as follows:

(1) Ten blows applied with the resistors in a horizontal plane and with the shafts extended upward.

(2) Ten blows after the fixture has been rotated 180 degrees so that the shafts extend downward.

(3) Ten blows after the fixture is rotated 90 degrees so that the resistors are in a vertical plane with the removable contact arm in a horizontal position.

e. Measurement during shock: Each resistor shall be monitored to determine electrical discontinuity. A measurement of transient resistance change between the contact arm terminal and left terminal shall also be made.

f. Measurement and examination after shock: Total resistance (see 4.7.3 to 4.7.3.1.2, as applicable) shall be measured and examined for evidence of mechanical damage.

4.7.14 Acceleration (when applicable) (see 3.17).

4.7.14.1 Mounting of resistors. As specified in 4.7.13a.

4.7.14.2 Procedure. Total resistance (see 4.7.3 to 4.7.3.1.2, as applicable) shall be measured between the contact arm terminal and one end terminal. The resistors shall be subjected to a constant acceleration of 50 g's for a period of five seconds in each of the positions specified in 4.7.13d.

4.7.14.3 Measurements during acceleration. As specified in 4.7.13e.

4.7.14.4 Measurement and examination after acceleration test. As specified in 4.7.13f.

4.7.15 Vibration, high frequency (when applicable).Resistors shall be tested in accordance with method 204 of MIL-STD-202 (see 3.18). The following details and exceptions shall apply:

a. Mounting of resistors: As specified in 4.7.13a.

b. Measurements prior to vibration: As specified in 4.7.13b.

c. Test condition: B.

d. Measurement during vibration: As specified in 4.7.13e.

e. Direction of motion: As specified in 4.7.13d.

f. Measurements and examination after vibration: As specified in 4.7.13d.

4.7.16 Fungus. Resistors shall be tested in accordance with method 508 of MIL-STD-810. Resistors shall be examined for evidence of mechanical damage (see 3.3.1).

5. PACKAGING

5.1 Packaging. For acquisition purpose, 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 services 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

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory).

6.1 Intended use. The resistors covered by this specification are military unique due to the fact that these devices must be able to operate satisfactorily in military systems under the following demanding conditions: 15 g's of high frequency vibration, 50 g's of shock (specified pulse), 50 g's of acceleration and resistant to salt corrosion. In addition, these military requirements are verified under a qualification system. Commercial components are not designed to withstand these military environmental conditions.

6.2 Acquisition documents. Acquisition documents should specify the following:

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

b. Title, number, and date of the applicable detail specification, and complete PIN (see 1.2.1 and 3.1).

c. Unless otherwise specified (see 2.1), the versions of the individual documents referenced will be those in effect on the date of release of the solicitation.

d. Hardware, whether assembled on resistor (see 3.4.9).

e. Packaging requirements (see 5.1)

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Product List 22 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 purchase orders for the products covered by this specification. The activity responsible for the QPL and, information pertaining to qualification of products may be obtained from the DLA Land and Maritime, ATTN: VQP, Post Office Box 3990, Columbus, OH 43218-3990. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil or http://www.landandmaritime.dla.mil/Programs/QmlQpl/.

6.4 Derating. It is the intention of this specification to cover resistors capable of full load operation at an ambient temperature of 25°C. However, if it is desired to operate these resistors at an ambient temperature greater than 25°C, the resistors should be derated in accordance with figure 1.

6.5 Supplementary insulation. Resistors should not be used at potentials above ground greater than 500 volts (250 volts for RP05, RP06, and RP07) (see 3.1), unless supplementary insulation is used.

6.6 Dissimilar metals. Unless protected, metals such as brass, copper, or steel should not be used in intimate contact with aluminum or aluminum alloys.

6.7 Electrical off positions. Care should be exercised in specifying an electrical off position when resistors are required to break dc circuit having potentials in excess of 40 volts.

6.8 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).

6.9 Interchangeability. Resistors in this specification are mutually interchangeable with resistors of the same type designation acquired under MIL-PRF-22.

6.10 Subject term (key word) listing.

Potentiometer
Electrical off
Rotating contact
Locking bushing

6.11 PIN. This specification requires a PIN that describes technology and appropriate references to associated documents (see 1.2.1 and 3.1).

6.11.1 Type designation. The type designation system for identifying these parts are as follows:

RP06	2	SB	252	KK
Style (1.2.1.1)	Electrical off position (1.2.1.3)	Shaft and type of mounting (1.2.1.4)	Resistance (6.11.1.1)	Resistance tolerance (6.11.1.2)

6.11.1.1 Resistance. The total nominal resistance value expressed in ohms is identified by a three-digit number; the first two digits represent significant figures and the last digit specifies the number of zeros to follow. When fractional value of an ohm, and values of less than 10 ohms are required, the letter “R” is substituted for one of the significant digits to represent the decimal point. When the letter “R” is used, the succeeding digit becomes significant. The following is an example:

3R0 signifies 3.0 ohms.

6.11.1.2 Resistance tolerance. The resistance tolerance is in percent and is identified by two letters (KK) and is rated at ±10 percent.

6.12 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 http://www.epa.gov/osw/hazard/wastemin/priority.htm. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see Section 3).

6.13 Amendment notification. The margins of this specification are marked with vertical lines to indicate modification generated by this amendment. 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 and relationship.

APPENDIX A

PROCEDURE FOR QUALIFICATION INSPECTION

A.1. SCOPE.

A.1.1 Scope. This appendix details the procedure for submission of sample, with related test results, for qualification inspection of resistors covered by this specification. The procedure for extending qualification required sample to other resistors covered by this specification is also outlined herein. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2. APPLICABLE DOCUMENTS. This section is not applicable to this document.

A.3. SUBMISSION

A.3.1 Sample. A sample shall be submitted with shafts 2.5 inches long except for locking bushing type resistors which shall be submitted with their longest shaft length (see table III).

A.3.1.1 Qualification sample when qualification is sought for resistors with and without electrical off position. For qualification of standard bushing, or two hole mounting types, eight sample units without an electrical off position and with the highest nominal total resistance value for which qualification is sought, and four sample units in the same style with electrical off position symbol 2 (see 1.2.1.1) and with the applicable nominal total resistance value specified in table A-I shall be submitted. When resistor style RP05, RP06, and RP07 (see 3.1) are submitted, four additional sample units without an electrical off position with the highest nominal total resistance value for which qualification is sought shall also be submitted. To receive qualification of the locking bushing type resistors when standard bushing type resistors are submitted, four additional sample units of locking bushing type resistors in the same style and without electrical off position shall be submitted. These sample units shall consist of two with the highest nominal total resistance value for which qualification is sought and two with the applicable nominal total resistance value specified in table A-I. One additional sample unit of each style shall be submitted to permit substitution for the permissible defect in group 1 of table IV or table V, as applicable.

TABLE A-I. Nominal total resistance values to be submitted.

Style	Resistance (in ohms)
RP05	75
RP06	75
RP07	75
RP10	75
RP11	75
RP15	35
RP16	35
RP20	25

Style	Resistance (in ohms)
RP25	15
RP30	10
RP35	7.5
RP40	5.0
RP45	3.0
RP50	2.0
RP55	2.0

A.3.1.2 Qualification sample when qualification is sought for resistors without an electrical off position. For qualification of standard bushing, or two hole mounting types, eight sample units without an electrical off position and with the highest nominal total resistance value for which qualification is sought, and four sample units in the same style with electrical off position with the applicable nominal total resistance value specified in table A-I shall be submitted. When resistor style RP05, RP06, and RP07 (see 3.1) are submitted, four additional sample units without an electrical off position with the highest nominal total resistance value for which qualification is sought shall also be submitted. To receive qualification of the locking bushing type resistors when standard bushing type resistors are submitted, four additional sample units of locking bushing type resistors in the same style and without electrical off position shall be submitted. These sample units shall consist of two with the highest nominal total resistance value for which qualification is sought and two with the applicable nominal total resistance value specified in table A-I. One additional sample unit of each style shall be submitted to permit substitution for the permissible defect in group 1 of table IV or table V, as applicable.

A.4. EXTENT OF QUALIFICATION

A.4.1 Extent of qualification. Qualification of the style submitted shall extend qualification to the resistance range, which consist of the minimum nominal total resistance value specified (see 3.1) through the highest nominal resistance value submitted. Qualification shall also extend to all shaft designs covered by this specification. Qualification of electrical off position symbol 2 shall also qualify electrical off position symbol 3.

Custodians:
Army - CR
Navy - EC
Air Force - 85
DLA - CC

Preparing activity:
DLA - CC

Review activities:
Army - AR, AT, AV, CR4, MI
Navy - AS, CG, MC, OS
Air Force - 19

(Project 5905-2013-007)

NOTE: The activities listed above were interested in this document as of the date of the 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.