INCH-POUND
MIL-PRF-83530C
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SUPERSEDING
MIL-PRF-83530C
14 May 2008

PERFORMANCE SPECIFICATION

RESISTORS, VOLTAGE SENSITIVE (VARISTOR, METAL-OXIDE), GENERAL SPECIFICATION FOR

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

Inactive for new design after 30 March 2008

Parts manufactured prior to the above date may only be used for replacement purposes. See QPDSIS-83530 071212

Parts manufactured after above date shall not be supplied to this Specification.

1. SCOPE

1.1 Scope. This specification covers the general requirements for voltage sensitive resistors (varistors) to be used for suppressing transients in electronic circuitry.

1.2 Classification.

1.2.1 Part or Identifying Number (PIN). The resistors specified herein (see 3.1) are identified by a PIN which consists of the basic number of the specification and a coded number. The PIN appears in the following form:

M83530/1	-	2200		D
Specification number		Nominal voltage (see 1.2.1.1)		Voltage tolerance (see 1.2.1.2)

1.2.1.1 Nominal voltage. The nominal voltage value expressed in volts is identified by a four digit number; the first three digits represent significant figures and the last digit specifies the number of zeros to follow.

Examples:	1000	=	100 volts
	1001	=	1,000 volts
	1002	=	10,000 volts

Minimum and maximum voltage values are as specified (see 3.1). The standard values for every decade follow the sequence demonstrated for the "10 to 100" decade.

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/.

1.2.1.2 Voltage tolerance. The voltage tolerance is identified by a single letter in accordance with table I.

TABLE I. Voltage Tolerance.

Letter	Voltage tolerance (in percent)
A	±15
B	±10
C	±5

Letter	Voltage tolerance (in percent)
D	+10, -5
E	+5, -10
F	+10, -0

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

DEPARTMENT OF DEFENSE SPECIFICATION

MIL-PRF-83530/1 - Resistors, Voltage Sensitive (Varistor), Style RVS10

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202 - Test Methods Standard Electronics and Electrical Components Parts.
MIL-STD-750 - Test Methods for Semiconductor Devices.
MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests.

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

NCSL Z540.3 - Laboratories, Calibration, and Measuring and Test Equipment.

(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 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between requirements of this specification and the specification sheet, 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 products list prior to the award of a contract (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 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 6.4).

3.4 Interface and physical dimension requirements. Resistors shall meet the interface and physical dimension requirements as specified (see 3.1).

3.4.1 Terminal leads. Terminal leads shall be made of a solid conductor of the length and diameter specified. (see 3.1). They shall be treated to meet the requirements of solderability. (see 3.14). When a tin lead solder coating is used, the tin content shall be between 40 and 70 percent.

3.4.1.1 Solder dip (retinning) of leads. The manufacturer may solder dip/retin the leads of product supplied to this specification provided the solder dip/retin process (see appendix A) has been approved by the qualifying activity.

3.4.2 Solder Flux. When soldering fluxes are required during manufacturing processes, noncorrosive fluxes shall be used.

3.5 Voltage rating. Resistors shall have a rated direct-current (dc) continuous operating voltage, or a rated sine-wave root-mean-square (rms) alternating-current (ac) continuous operating voltage at commercial-line frequency and waveform as specified (See 3.1). This voltage is dependent on the ability of resistors to meet the operating life requirements specified in 3.28.

3.6 Power rating. Resistors shall have transient average power dissipation ratings (see 3.1) based on a group of pulses occurring within a specified isolated time period. This rating is based on the ability of resistors to meet the pulse life requirements specified in 3.11.

$$E = \sqrt{PR}$$

Where:

E = Continuous rated dc or rms working voltage in volts.
P = Rated power in watts.
R = Nominal resistance in ohms.

3.7 Nominal voltage. When resistors are tested as specified in 4.8.2, the dc voltage shall not exceed the specified tolerance of the nominal voltage (see 3.1).

3.8 Clamping voltage. When tested as specified in 4.8.3, the clamping voltage shall not exceed the specified maximum value (see 3.1).

3.9 Capacitance. When tested as specified in 4.8.4, the capacitance shall not exceed the specified maximum value (see 3.1).

3.10 Peak current rating. When tested as specified in 4.8.5, the resistors shall have a peak single pulse transient current rating as specified (see 3.1) without exceeding the specified peak current clamping voltage (see 3.1). Upon completion, the resistors shall meet the following requirements:

Clamping voltage (see 3.8)	-	Change shall not exceed +20%.
Nominal voltage (see 3.7)	-	Change shall not exceed -10%.
Visual examination	-	There shall be no evidence of mechanical damage

3.11 Pulse life rating. When tested as specified in 4.8.6, the resistors shall have a pulse life rating as specified (see 3.1). Upon completion of the test, the resistors shall meet the following requirements:

Clamping voltage (see 3.8)	-	Change shall not exceed +20%.
Nominal voltage (see 3.7)	-	Change shall not exceed -10%.
Visual examination	-	There shall be no evidence of mechanical damage

3.12 Energy rating. When tested as specified in 4.8.7, the resistors shall have an energy rating as specified (see 3.1). Upon completion of the test, the resistors shall meet the following requirements:

Clamping voltage (see 3.8)	-	Change shall not exceed +20%.
Nominal voltage (see 3.7)	-	Change shall not exceed -10%.
Visual examination	-	There shall be no evidence of mechanical damage

3.13 Dielectric withstanding voltage. When tested as specified in 4.8.8, the resistors shall meet the following requirements:

Leakage current	-	Shall not exceed 1 milliampere at any time during test
Visual examination	-	There shall be no evidence of mechanical damage

3.14 Solderability. When tested as specified in 4.8.9, the resistors shall meet the criteria for wire-lead terminal evaluation in the test method.

3.15 Resistance to soldering heat. When tested as specified in 4.8.10, the resistors shall meet the following requirements:

Clamping voltage (see 3.8)	-	Change shall not exceed +20%.
Nominal voltage (see 3.7)	-	Change shall not exceed -10%.
Visual examination	-	There shall be no evidence of mechanical damage

3.16 Resistance to solvents. When tested as specified in 4.8.11, there shall be no evidence of mechanical damage to the body and the marking shall remain clear and legible.

3.17 Flammability (external flame). When tested as specified in 4.8.12, the time for flaming combustion of resistors to self-extinguish shall not exceed 7 seconds on any test. The average of all tests, the time to self-extinguish shall not exceed 5 seconds. The time of persistence of glowing combustion of resistors shall not exceed 30 seconds after removal of test flame. Resistors shall not drip flaming particles that ignite dry absorbent surgical cotton.

3.18 Terminal strength. When tested as specified in 4.8.13, there shall be no evidence of breaking or loosening of terminals from the resistor form, chipping of coating, or any other evidence of mechanical damage.

3.19 High temperature life (stabilization bake). When tested as specified in 4.8.14, the resistors shall show no evidence of mechanical damage.

3.20 Thermal shock. When tested as specified in 4.8.15, the resistors shall show no evidence of mechanical damage.

3.21 Power burn-in. When tested as specified in 4.8.16, the resistors shall show no evidence of mechanical damage.

3.22 Moisture resistance. When tested as specified in 4.8.17, the resistors shall meet the following requirements:

Dielectric withstanding voltage	-	As specified in 3.13
Nominal voltage (see 3.7)	-	Change shall not exceed -10%.

3.23 Vibration. When tested as specified in 4.8.18, the resistors shall meet the following requirements:

Clamping voltage (see 3.8)	-	Change shall not exceed +20%.
Nominal voltage (see 3.7)	-	Change shall not exceed -10%.
Visual examination	-	There shall be no evidence of mechanical damage

3.24 Shock. When tested as specified in 4.8.19, the resistors shall meet the following requirements:

Clamping voltage (see 3.8)	-	Change shall not exceed +20%.
Nominal voltage (see 3.7)	-	Change shall not exceed -10%.
Visual examination	-	There shall be no evidence of mechanical damage

3.25 Constant acceleration. When tested as specified in 4.8.20, the resistors shall meet the following requirements:

Clamping voltage (see 3.8)	-	Change shall not exceed +20%.
Nominal voltage (see 3.7)	-	Change shall not exceed -10%.
Visual examination	-	There shall be no evidence of mechanical damage

3.26 Low temperature storage. When tested as specified in 4.8.21, the resistors shall meet the following requirements:

Clamping voltage (see 3.8)	-	Change shall not exceed +20%.
Nominal voltage (see 3.7)	-	Change shall not exceed -10%.
Visual examination	-	There shall be no evidence of mechanical damage

3.27 High temperature storage. When tested as specified in 4.8.22, the resistors shall meet the following requirements:

Clamping voltage (see 3.8)	-	Change shall not exceed +20%.
Nominal voltage (see 3.7)	-	Change shall not exceed -10%.
Visual examination	-	There shall be no evidence of mechanical damage

3.28 Operating life. When tested as specified in 4.8.23, the resistors shall meet the following requirements:

Clamping voltage (see 3.8)	-	Change shall not exceed +20%.
Nominal voltage (see 3.7)	-	Change shall not exceed -10%.
Visual examination	-	There shall be no evidence of mechanical damage

3.29 Marking. The resistors shall be marked with the PIN, manufacturer's CAGE, date code and lot code. The part number may appear on two lines and in such case shall be divided between the / and the specification sheet number. The date code shall be the date of the final assembly operation for the production lot as defined in 4.6.1.1.2. The following is an example of the marking:

M83530/ 1-2200D	-	PIN
12345	-	Manufacturer's CAGE
8636XX	-	Date code and lot code

3.30 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.

3.31 Workmanship. Resistors shall be processed in such a manner as to be uniform in quality and free from defects that may adversely affect operability, reliability or appearance. The wire leads or terminals shall be unbroken, and not crushed or nicked.

4. VERIFICATION

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

a. Qualification inspection (see 4.4).
b. Conformance inspection (see 4.6).
c. Periodic inspection (see 4.7).

4.2 Test equipment and inspection facilities. The supplier 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 Conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the GENERAL REQUIREMENTS of MIL-STD-202.

4.3.2 Precautions. Adequate precautions shall be taken during tests to prevent condensation of moisture on resistors, except during the moisture resistance tests.

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. The number of sample units comprising a sample of resistors to be submitted for qualification inspection shall be 52. The sample shall be taken at random from a production run, and shall be produced with equipment and procedures normally used in production. Each voltage rating of each resistor style shall be qualified separately.

4.4.2 Test routine. Sample units shall be subjected to the qualification inspection specified in table II, in the order shown. All sample units shall be subjected to the inspection of group I. The 52 sample units from group I shall then be divided as specified in table II for groups II to V inclusive, and subjected to the inspections for their particular group.

4.4.3 Failures. Failures in excess of those allowed in table II shall be cause for refusal to grant qualification.

TABLE II. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units	Allowable failures	
				group	cumulative
Group I					
Visual and mechanical Inspection 1/	3.1, 3.3 to 3.4.2 incl. and 3.29, 3.30	4.8.1	All Units	0	
High temperature	3.19	4.8.14			
Thermal shock	3.20	4.8.15			
Power burn-in	3.21	4.8.16			
Clamping voltage 1/	3.8	4.8.3			
Nominal voltage 1/	3.7	4.8.2			
Group II					
Solderability	3.14	4.8.9	12	0	
Resistance to soldering heat	3.15	4.8.10			
Resistance to solvents	3.16	4.8.11			
Flammability	3.17	4.8.12			
Group III					
Low temperature storage	3.26	4.8.21	10	1	1
High temperature storage	3.27	4.8.22			
Capacitance 1/	3.9	4.8.4			
Dielectric withstanding voltage 1/	3.13	4.8.8			
Group IV					
Terminal strength	3.18	4.8.13	10	1	1
Moisture resistance	3.22	4.8.17			
Pulse life	3.11	4.8.6			
Group V					
Vibration	3.23	4.8.18	10	1	2
Shock	3.24	4.8.19			
Constant acceleration	3.25	4.8.20			
Energy	3.12	4.8.7			
Group VI					
Peak current	3.10	4.8.5	10	1	2
Operating life	3.28	4.8.23			

1/ Nondestructive

4.5 Retention of qualification. Every 6 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 results indicate failure of the qualified product to meet the requirements of the 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.

4.6 Conformance inspection.

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

4.6.1.1 Inspection and production lot.

4.6.1.1.1 Inspection lot. An inspection lot shall consist of all resistors of the same part number, under essentially the same conditions and offered for inspection during a period of 1 month.

4.6.1.1.2 Production lot. A production lot consists of parts manufactured from the same basic raw materials, processed under the same specifications and procedures, and produced with the same equipment. Each production lot of parts should be a group identified by a common manufacturing record through all significant manufacturing operations, including the final assembly operation. The final assembly operation shall be considered the last major assembly operation, such as casing, hermetic sealing, or lead attachment, rather than painting or marking, for example.

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

4.6.1.2.1 Sampling plan.

4.6.1.2.1.1 Subgroup 1. Subgroup 1 tests shall be performed on 100 percent of the product supplied under this specification. Resistors which fail to meet the requirements of the tests of this subgroup shall be removed from the lot. Lots having more than 10 percent total rejects shall not be furnished on contracts.

4.6.1.2.1.2 Subgroup 2. A sample of parts from each inspection lot shall be randomly selected in accordance with table IV. If one or more defects are found, the lot shall be reworked or screened and defectives removed. After reworking or screening and removal of defectives, a new sample of parts shall be randomly selected in accordance with table IV. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

4.6.1.2.1.3 Subgroup 3 (solderability).

4.6.1.2.1.3.1 Sampling plan. A sample of parts from each inspection lot shall be randomly selected in accordance with table IV and subjected to the subgroup 3 solderability test. If there are one or more defects, the lot shall be considered to have failed.

4.6.1.2.1.3.2 Rejected lots. In the event of one or more defects, the inspection lot is rejected. The manufacturer may use one of the following options to rework the lot:

a. Each production lot that was used to form the failed inspection lot shall be individually submitted to the solderability test as required in 4.8.9. Five samples shall be selected from each production lot that formed the failed inspection lot. Production lot samples that pass the solderability test are available for shipment. Production lots failing the solderability test can be reworked only if submitted to the solder dip procedure in 4.6.1.2.1.3.2b.

b. The manufacturer submits the failed lot to a 100 percent solder dip using an approved solder dip process per the appendix A. Following the solder dip, the electrical measurements required in group A, subgroup 1, tests shall be repeated on 100 percent of the lot. The PDA for the electrical measurements shall be as for the subgroup 1 tests. Thirteen additional samples shall then be selected and subjected to the solderability test with zero defects allowed. If the lot fails this solderability test the lot may be reworked a second time and retested. If the lot fails the second rework, the lot shall be considered rejected and shall not be furnished against the requirements of this specification.

TABLE III. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph	Sampling plan
Subgroup 1			
High temperature life	3.19	4.8.14	
Thermal shock	3.20	4.8.15	
Power burn-in	3.21	4.8.16	4.6.1.2.1.1
Clamping voltage	3.8	4.8.3	
Nominal voltage	3.7	4.8.2	
Subgroup 2			
Visual and mechanical examination	---	4.8.1	
Body dimensions	3.4	---	
Diameter and length of leads	3.4.1	---	4.6.1.2.1.2
Marking (where applicable) 1/	3.29	---	
Workmanship	3.31	---	
Subgroup 3 2/			
Solderability	3.14	4.8.9	4.6.1.2.1.3

1/ Marking defects shall be charged only for illegible, incorrect, or incomplete marking. Any subsequent electrical defects shall not be charged as marking defect.

2/ The manufacturer may request the deletion of the Subgroup 3 solderability test, provided an in-line or process control system for assessing and assuring the solderability of terminations can be validated and approved by the qualifying activity. Deletion of the test does not relieve the manufacturer from meeting this test requirement in case of dispute. If the design, material, construction, or processing of the part is changed or if there are any quality problems, the qualifying activity may require resumption of the test.

4.6.1.2.1.3.3 Disposition of samples. The solderability test is considered a destructive test and samples submitted to the solderability test shall not be supplied on the contract.

TABLE IV. Group A inspection sampling plan.

Lot size	Subgroup 2 sampling plan	Subgroup 3 sampling plan
1 to 13	100 percent	100 percent
14 to 150	13	5
151 to 280	20	5
281 to 500	29	5
501 to 1,200	34	5
1,201 to 3,200	42	5
3,201 to 10,000	50	8
10,001 to 35,000	60	13
35,001 to 150,000	74	20
150,001 to 500,000	90	20
500,001 and over	102	20

4.6.2 Group B inspection. Group B inspection shall consist of the tests specified in Table V in the order shown. They shall be performed on sample units that have been subjected to and have passed group A inspection.

4.6.2.1 Sampling plan.

4.6.2.1.1 Subgroup 1. A sample of parts shall be randomly selected in accordance with table VI. If one or more defects are found, the lot shall be reworked or screened and defectives removed. After reworking or screening and removal of defectives, a new sample of parts shall be randomly selected in accordance with table VI. If one or more defects are found in the second sample, the lot shall be not supplied to this specification.

TABLE V. Group B inspection.

Inspection	Requirement paragraph	Test method paragraph	Sampling plan
Subgroup 1			
Dielectric withstanding voltage	3.13	4.8.8	4.6.2.1.1
Subgroup 2 1/			
Resistance to solvents	3.16	4.8.11	4.6.2.1.2
Subgroup 3 1/			
Terminal strength (lead fatigue)	3.18	4.8.13	4.6.2.1.3
Moisture resistance	3.22	4.8.17	
Peak current	3.10	4.8.5	
Energy rating	3.12	4.8.7	

1/ If the manufacturer can demonstrate that this test has been performed five consecutive times with zero failures, this test, with the approval of the qualifying activity, can be deleted. The manufacturer, however, shall perform this test every three years after the deletion as part of long term design verification. If the design, material, construction, or processing of the part is changed or, if there are any quality problems, the qualifying activity may require resumption of the specified testing. Deletion of testing does not relieve the manufacturer from meeting the test requirement in case of dispute.

4.6.2.1.2 Subgroup 2. A sample of 12 parts shall be randomly selected. If one or more defects are found, the lot shall be reworked or screened and defectives removed. After reworking or screening and removal of defectives, a new sample of 12 parts shall be randomly selected. If one or more defects are found in the second sample, the lot shall be not supplied to this specification.

4.6.2.1.3 Subgroup 3. A sample of parts shall be randomly selected in accordance with table VI. If one or more defects are found, the lot shall be reworked or screened and defectives removed. After reworking or screening and removal of defectives, a new sample of parts shall be randomly selected in accordance with table VI. If one or more defects are found in the second sample, the lot shall be not supplied to this specification.

4.6.2.1.4 Disposition of sample units. Sample units which have been subjected to Group B subgroups II or III shall not be delivered on the contract or order.

TABLE VI. Group B sampling plan.

Lot size	Group B sampling plan
1 to 50	5
51 to 90	7
91 to 150	11
151 to 280	13
281 to 500	16
501 to 1,200	19
1,201 to 3,200	23
3,201 to 10,000	29
10,001 to 35,000	35
35,001 and over	40

4.7 Periodic inspection. Periodic inspection shall consist of group C inspection. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.7.1.3), delivery of products which have passed groups A and B inspections shall not be delayed pending the results of these periodic inspections.

4.7.1 Group C inspection. Group C inspection shall consist of the tests specified in table VII. They shall be performed on sample units of each style and characteristic selected from lots which have passed groups A and B inspections.

4.7.1.1 Sampling plan. Sample size and frequency of sampling shall be as specified in table VII.

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

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

TABLE VII. Group C inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units	Failures allowed
Every 6 months				
High temperature storage	3.27	4.8.22	10 for each test	0
Operating life (steady state)	3.28	4.8.23		
Pulse life rating	3.11	4.8.6		
Shock	3.24	4.8.19		
Vibration	3.23	4.8.18		
Constant acceleration	3.25	4.8.20		
Energy	3.12	4.8.7		

4.8 Methods of inspection.

4.8.1 Visual and mechanical examination. Resistors shall be examined to verify the materials, design, construction, physical dimensions, marking and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, 3.4, 3.4.1, 3.4.2, 3.29, and 3.31). Defects are classified as shown in table VIII.

4.8.2 Nominal voltage (see 3.7). Resistors shall be tested in accordance with method 4022 of MIL-STD-750. The following details and exceptions shall apply:

a. Test current - 1.0 ±0.1 mA dc.

b. Time of test current application prior to voltage reading - 5 milliseconds minimum, 5 seconds maximum.

c. Method of mounting - not specified.

d. Resistors shall be tested in both polarities.

TABLE VIII. Defects.

Defects
Cracks, voids, chips or holes in the resistor body which would expose the resistor element or could cause probable failure. Leads or terminals which are broken, crushed or nicked which would cause probable failure in use. Body or lead dimensions out of specification. Incorrect, illegible marking.

4.8.3 Clamping voltage (see 3.8). Resistors shall be tested in accordance with method 4011 of MIL-STD-750. The following details and exceptions shall apply:

a. Test current - An impulse with waveform of 8 x 20 μS (see 6.5.2) and peak value, ±5% as specified (see 3.1).

b. Pulse repetition rate - Shall not exceed one per second.

c. Resistors shall be tested in both polarities.

4.8.4 Capacitance (see 3.9). Resistors shall be tested in accordance with method 4001 of MIL-STD-750. The following details and exceptions shall apply:

a. DC bias voltage - Shall not be applied.

b. Test voltage - 1.0 ±0.1 V rms.

c. Test frequency - 1.0 MHz ±5%.

4.8.5 Peak current (see 3.10). Resistors shall be tested in accordance with method 4141 of MIL-STD-750. The following details and exceptions shall apply:

a. Pulse generator source impedance and pulse voltage - Shall be such as to supply the specified peak current value ±10% (see 3.1).

b. Pulse width - An impulse waveform of 8 x 20μs (see 6.5.2).

c. Pulse repetition rate - A single pulse only shall be applied.

d. Polarity of pulse - Not specified.

e. Procedure:

(1). Verify the test set-up and that the peak current is within tolerance.

(2). Test the inspection lot to verify their capability to withstand the peak current value.

(3). When peak current is applied, clamping voltage shall be measured as specified in 4.8.3 and herein.

(a). The measuring instrument shall employ voltage probes separate from the current conducting connections.

(b). The probes shall contact the resistor leads no greater than 0.3 inch (7.6 mm) from the resistor body.

f. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.8.2 and 4.8.3 respectively.

g. Examination after test - Resistors shall be examined for evidence of mechanical damage.

4.8.6 Pulse life (see 3.11). Resistors shall be tested in accordance with method 4141 of MIL-STD-750. The following details and exceptions shall apply:

a. Pulse generator source impedance and pulse voltage - Shall be such as to supply the specified current value ±10% (see 3.1).

b. Pulse width - 8 x 20 μs (see 6.5.2).

c. Pulse repetition rate - Maximum pulse repetition rate shall be such that the theoretical pulse energy absorbed by the device is dissipated at 90% of the value of the transient average power dissipation, W_{tm} ±10% (see 3.1) and shall be computed by the following formula:

$$P_{RR} = .9\ W_{tm}/V_c \quad I_p \times 2 \times 10^{-5}$$

Where:

V_c is the specified clamping voltage (see 3.1)

I_p is the specified current of pulse life test (see 3.1).

d. Test duration - A minimum of 10,000 pulses shall be applied.

e. Pulse polarity - Shall alternate as a minimum after every 50 pulses.

f. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.8.2 and 4.8.3 respectively.

g. Examination after test - Resistors shall be examined for evidence of mechanical damage.

4.8.7 Energy (see 3.12). Resistors shall be tested in accordance with method 4141 of MIL-STD-750. The following details and exceptions shall apply:

a. Pulse generator source impedance and pulse voltage - Shall be such as to supply the specified peak current value ±10% (see 3.1).

b. Pulse width - 10 x 1,000 μs (see 6.5.2).

c. Pulse repetition rate - A single pulse only shall be applied.

d. Pulse polarity - Not specified.

e. Procedure:

(1) Verify that the peak current is within tolerance and that the pulse energy level is as specified (see 3.1).

(2) Pulse energy (E) can be estimated by the following:

$$E = 1.4\ V_c\ I_p\ \gamma$$

Where:

V_c = Clamping voltage

I_p = Peak current

γ = Impulse duration see figure 1

f. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.8.2 and 4.8.3 respectively.

g. Examination after test - Resistors shall be examined for evidence of mechanical damage.

4.8.8 Dielectric withstanding voltage (see 3.13). Resistors shall be tested in accordance with method 301 of MIL-STD-202. The following details and exceptions shall apply:

a. Test voltage - 2,500 V dc.

b. Duration - 60, -0, +5 seconds.

c. Point of application - The resistor body shall be immersed to the leads into a container of conductive shot. The shot diameter shall not exceed .032 inch (0.8 mm). One test terminal shall be applied to the conductive shot. The other test terminal shall be applied to the resistor leads which shall be connected together by a jumper wire.

d. Current - 1 mA ±20%.

e. Examination after test - Resistors shall be examined for evidence of flash-over, mechanical damage, arcing, and insulation breakdown.

4.8.9 Solderability (see 3.14). Resistors shall be tested in accordance with method 208 of MIL-STD-202. The following details and exceptions shall apply:

a. Number of terminations to be tested - Both leads of each resistor shall be tested.

4.8.10 Resistance to soldering heat (see 3.15). Resistors shall be tested in accordance with method 210 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition - C.

b. Cooling time prior to final measurements - one hour.

c. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.8.2 and 4.8.3 respectively.

d. Examination after test - Resistors shall be examined for evidence of mechanical damage.

e. Method of internal examination - Not applicable.

4.8.11 Resistance to solvents (see 3.16). Resistors shall be tested in accordance with method 215 of MIL-STD-202. The following detail and exception shall apply:

a. Examination after test - Resistors shall be examined for evidence of mechanical damage and legibility of marking.

4.8.12 Flammability (see 3.17). Resistors shall be tested in accordance with method 111 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting - Resistors shall be mounted with the leads horizontal and the body vertical.

b. Point of impingement - The resistor body shall be centered, 1.5 inch, -0.0, +0.25 inch (38 mm, -0,+6.35 mm) above the nozzle rim.

c. Duration of flame application - The flame shall be applied until flaming combustion of the resistor is visible or, for a maximum of 15 seconds in any case.

d. Dry absorbent surgical cotton shall be placed 12 inches (305 mm) below the resistor.

e. Examinations during and after test - The time for flaming combustion of resistors to self-extinguish and the time of persistence of glowing combustion of resistors shall be recorded. The dry absorbent surgical cotton shall be observed for ignition.

4.8.13 Terminal strength (see 3.18). Resistors shall be tested in accordance with method 211 of MIL-STD-202. The following details and exceptions shall apply:

a. Test conditions - A and C (pull test and bend test, respectively).

b. Applied force - Test condition A; 5 pounds. Test condition C; 1 pound.

c. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.8.14 High temperature life (stabilization bake) (see 3.19). Resistors shall be tested in accordance with method 1032 of MIL-STD-750. The following details and exception shall apply:

a. Test temperature - Maximum rated temperature (see 3.1).

b. Duration - 24 hours ± 1 hour.

c. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.8.15 Thermal shock (see 3.20). Resistors shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition - A, except that step 3 shall be the applicable maximum rated temperature (see 3.1).

b. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.8.16 Power burn-in (see 3.21). Resistors shall be tested in accordance with method 1038 of MIL-STD-750. The following details shall apply:

a. Test condition - B.

b. Test temperature - 85°C.

c. Voltage applied - Maximum rated ac voltage (see 3.1).

d. Duration - 72 hours +4 hours, -0 hours.

e. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.8.17 Moisture resistance (see 3.22). Resistors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

a. Load and polarization voltages - Not applied.

b. Measurements after test - Nominal voltage and dielectric withstanding voltage shall be measured as specified in 4.8.2 and 4.8.8 respectively.

c. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.8.18 Vibration (see 3.23). Resistors shall be tested in accordance with method 204 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting - Resistors shall be rigidly fastened to the test platform and the leads secured.

b. Voltage applied - Resistors shall not be energized.

c. Test condition - D (20 G; 10 - 2,000 Hz).

d. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.8.2 and 4.8.3 respectively.

e. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.8.19 Shock (see 3.24). Resistors shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting - Resistors shall be rigidly fastened to the test platform and the leads secured.

b. Voltage applied - Resistors shall not be energized.

c. Test condition - E, except 1 ms duration.

d. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.8.2 and 4.8.3 respectively.

e. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.8.20 Constant acceleration (see 3.25). Resistors shall be tested in accordance with method 212 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting - Resistors shall be rigidly fastened to the test platform and the leads secured.

b. Voltage applied - Resistors shall not be energized.

c. Test condition - B; 20,000 g in the y2 orientation.

d. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.8.2 and 4.8.3 respectively.

e. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

4.8.21 Low temperature storage (see 3.26).

4.8.21.1 Mounting. Resistors shall be mounted in a manner such that there is at least one inch of free air space around each resistor, and in such a position with respect to the air stream that the mounting offers substantially no obstruction to the flow of air across and around the resistors.

4.8.21.2 Procedure. Resistors shall be placed in a cold chamber which is at -65°C +0°, -3°C for a period of 24 hours ±4 hours. The resistors shall then be removed from the chamber and maintained at a temperature of 25°C ±5°C for a period of 6 hours ±2 hours. The nominal voltage and clamping voltage shall then be measured as specified in 4.8.2 and 4.8.3 respectively. The resistors shall be visually examined for evidence of mechanical damage.

4.8.22 High temperature storage (see 3.27).

4.8.22.1 Mounting. Resistors shall be mounted as specified in 4.8.21.1.

4.8.22.2 Procedure. Resistors shall be placed in a chamber which is at 125°C +3°, -0°C for a period of 340 hours ±8 hours. The resistors shall then be removed from the chamber and maintained at a temperature of 25°C ±5°C for a period of 6 hours ±2 hours. The nominal voltage and clamping voltage shall then be measured as specified in 4.8.2 and 4.8.3 respectively. The resistors shall then be visually examined for evidence of mechanical damage.

4.8.23 Operating life (see 3.28). Resistors shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

a. If forced-air circulation is employed, there shall be no direct impingement of the forced-air supply upon the parts.

b. Resistors shall be mounted by their normal mounting means and shall be so spaced to minimize the temperature of one specimen affecting the temperature of another.

c. Temperature - 85°C ±2^{O}C.

d. Operating conditions - The rated ac input voltage and frequency shall be applied (see 3.1).

e. Test condition - D.

f. Measurements after test - Nominal voltage and clamping voltage shall be measured as specified in 4.8.2 and 4.8.3 respectively.

g. Examination after test - Resistors shall be visually examined for evidence of mechanical damage.

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 activity 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: 20 G's of high frequency vibration, 100 G's of shock (specified pulse), thermal shock (with no more than 1 percent deviation in initial resistance), and a low temperature coefficient of resistance. In addition, these military requirements are verified under a qualification system. Commercial components are not designed to withstand these military environmental conditions.

6.2 Ordering data. Acquisition documents must specify the following:

a. Title, number, and date of this specification, and the complete PIN (see 1.2).

b. 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.

c. Packaging instructions (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 83530 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 http://assist.dla.mil or http://www.landandmaritime.dla.mil/Programs/QmlQpl/.

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 Application notes.

6.5.1 Caution note. Should the varistor be subjected to surge currents and energy levels in excess of maximum ratings, it may physically fail by package rupture or expulsion of material. It is recommended that protective fusing be used. If not fused, the resistor should be located away from other components or be physically shielded from them.

6.5.2 Current test waveform. All tests requiring an impulse of current uses the waveform of figure 1. The waveform is specified by its peak current value and by its time dimensions; for example, 8 x 20 μS, where 8 is the virtual front duration and 20 is the impulse duration in μS. The applied test waves are accurate to a tolerance of ±10% for virtual front duration, and to a tolerance of ±20% for impulse duration.

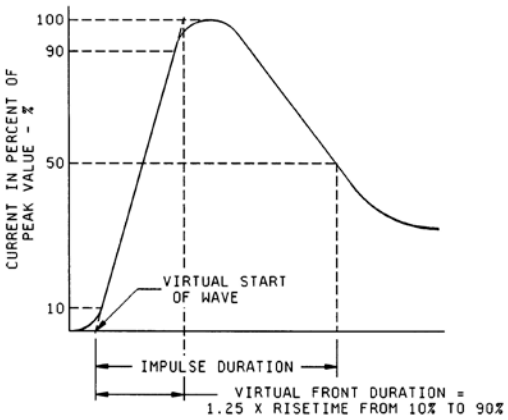

FIGURE 1. Pulse current waveform.

6.6 Subject term (key word) listing.

Suppressing transients
Varistor
Nominal voltage
Voltage tolerance

6.7 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).

6.8 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 samples, with related data, for qualification inspection of resistors covered by this specification. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

A.2 APPLICABLE DOCUMENTS

A.2.1 Government documents.

A.2.1.1 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 STANDARDS

MIL-STD-1276 - Leads for Electronic Component Parts

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

A.2.2 Order of precedence. In event of a conflict between the text of this document and the references cited herein (except for related associated specifications, specification sheets, or MS 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.

A.3. SUBMISSION

A.3.1 Sample. A sample consisting of 52 sample units of each part number for which qualification is sought shall be submitted and subjected to the inspections of table II.

A.3.2 Test results. Each submission shall be accompanied by test results covering the nondestructive tests listed in table II which have been performed on the submitted sample units. The performance of the destructive tests by the supplier on a duplicate set of sample units is encouraged, although not required. All test results shall be submitted in duplicate.

A.3.3 Description of items. The manufacturer shall submit a detailed description of the resistors being submitted for inspection, including materials used for the resistor element and the protective enclosure or coating.

A.4. SOLDER DIP (RETINNING) LEADS

A.4.1 Solder dip (retinning) leads. The manufacturer may solder dip/retin the leads of product supplied to this specification provided the solder dip process (see A.4.2 of appendix A) or an equivalent process has been approved by the qualifying activity.

APPENDIX A

A.4.2 Qualifying activity approval. Approval of the solder dip process will be based on one of the following options:

a. When the original lead finish qualified was hot solder dip lead finish 52 of MIL-STD-1276 (Note: The 200 microinch maximum thickness is not applicable). The manufacturer shall use the same solder dip process for retinning as is used in the original manufacture of the product.

b. When the lead originally qualified was not hot solder dip lead finish 52 of MIL-STD-1276 as prescribed in A.4.2a, approval for the process to be used for solder dip shall be based on the following test procedure:

(1) Thirty samples of any resistance value for each style and lead finish are subjected to the manufacturer's solder dip process. Following the solder dip process, the resistors are subjected to the dc resistance test and other group A electricals. No defects are allowed.

(2) Ten of the 30 samples are then subjected to the solderability test. No defects are allowed.

(3) The remaining 20 samples are subjected to the resistance to solder heat test followed by the moisture resistance test. No defects are allowed.

A.4.3 Solder dip retinning options. The manufacturer may solder dip/retin as follows:

a. After group A tests. Following the solder dip/retinning process, the electrical measurements required in group A, subgroup 1, tests shall be repeated on the lot. The group A, subgroup 1, lot rejection criteria shall be used. Following these tests, the manufacturer shall submit the lot to the group A solderability test as specified in 4.8.9.

b. As a corrective action if the lot fails the group A solderability test.

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

Preparing activity:
DLA - CC

Review activities:
Army - AR, MI
Navy - AS, CG, MC, OS
Air Force - 19, 99

(Project 5905-2012-032)

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.