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INCH-POUND

MIL-PRF-83530A
6 July 1993
SUPERSEDING
MIL-R-83530
10 March 1996

PERFORMANCE SPECIFICATION

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

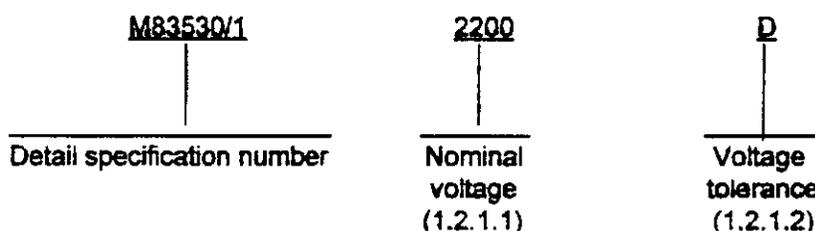
This specification is approved for use by all Departments and Agencies of the Department of Defense.

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) shall be identified by a PIN which shall consist of the basic number of the detail specification and a coded number. The PIN shall be in the following form:



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 shall be as specified (see 3.1). The standard values for every decade shall follow the sequence demonstrated for the "10 to 100" decade.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: DESC-ELDM, 1507 Wilmington Pike, Dayton, OH 45444-5765 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 5905

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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
	Percent (%)
A	±15
B	±10
C	±5
D	+10, -5
E	+5, -10
F	+10, -0

2. APPLICABLE DOCUMENTS

2.1 Government documents.

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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

MILITARY

MIL-R-39032 - Resistors, Packaging of.

STANDARDS

MILITARY

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.

MIL-STD-750 - Test Methods for Semiconductor Devices.

MIL-STD-1276 - Leads for Electronic Components.

MIL-STD-45662 - Calibration Systems Requirements.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, Robins Avenue, Philadelphia, PA 19111-5094.)

2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Associated detail specifications. The individual item requirements shall be as specified herein and in accordance with the applicable associated detail specifications. In the event of any conflict between requirements of this specification and the associated detail 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 products list at the time set for opening of bids (see 4.4 and 6.3).

3.3 Material. The material shall be as specified herein. Material used, exposed to the equipment, shall be non-nutrient to fungus. However, when a definite material is not specified, a material 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.

3.4 Design and construction. Resistors shall be of the design, construction, and physical dimensions specified in the associated detail specification (see 3.1). Each resistor shall consist of metal terminals connected to a ceramic resistor element. Resistor construction shall provide protection against exposure to humidity, temperature or other environmental conditions or contaminants by means of an enclosure or a coating of insulating material.

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 suitably 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) leads. The manufacturer may solder dip/retin the leads of product supplied to this specification provided the solder dip process has been approved by the qualifying activity. The manufacturer shall maintain a solder purity in accordance with table II, during the tinning process.

TABLE II. Contamination Limits.

Contamination	Tinning percent by weight ^{1/}
Copper	0.750
Gold	0.500
Cadmium	0.010
Zinc	0.008
Aluminum	0.008
Antimony	0.500
Iron	0.020
Arsenic	0.030
Bismuth	0.250
Silver	0.750
Nickel	0.250

^{1/} This is a fixed percentage by weight of the solder.

3.4.1.1.1 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 finish 52 of MIL-STD-1276 as prescribed in (a), 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 nominal voltage 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 soldering heat test followed by the moisture resistance test. No defects are allowed.

3.4.1.1.2 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 4.6.9.
- b. As a corrective action if the lot fails the group A solderability test.

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 4.6.2, 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 4.6.3, the clamping voltage shall not exceed the specified maximum value (see 3.1).

3.9 Capacitance. When tested as specified in 4.6.4, the capacitance shall not exceed the specified maximum value (see 3.1).

3.10 Peak current rating. When tested as specified in 4.6.5, 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 (3.8) - Change shall not exceed +20%.
- Nominal voltage (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 4.6.6, 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 (3.8) - Change shall not exceed +20%.
- Nominal voltage (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 4.6.7, 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 (3.8) - Change shall not exceed +20%.
- Nominal voltage (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 4.6.8, the resistors shall meet the following requirements:

- Leakage current - Shall not exceed 1 milliamperes at any time during test.
- Visual examination - There shall be no evidence of mechanical damage, arcing, or breakdown.

3.14 Solderability. When tested as specified in 4.6.9, 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 4.6.10, the resistors shall meet the following requirements:

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

3.16 Resistance to solvents. When tested as specified in 4.6.11, 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 4.6.12, 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 (Lead fatigue). When tested as specified in 4.6.13, 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 4.6.14, the resistors shall show no evidence of mechanical damage.

3.20 Thermal shock. When tested as specified in 4.6.15, the resistors shall show no evidence of mechanical damage.

3.21 Power burn-in. When tested as specified in 4.6.16, the resistors shall show no evidence of mechanical damage.

3.22 Moisture resistance. When tested as specified in 4.6.17, the resistors shall meet the following requirements:

Dielectric withstanding voltage: As specified in 3.13.
Nominal voltage: Change shall not exceed -10 percent.

3.23 Vibration. When tested as specified in 4.6.18, the resistors shall meet the following requirements:

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

3.24 Shock. When tested as specified in 4.6.19, the resistors shall meet the following requirements:

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

3.25 Constant acceleration. When tested as specified in 4.6.20, the resistors shall meet the following requirements:

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

3.26 Low temperature storage. When tested as specified in 4.6.21, the resistors shall meet the following requirements:

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

3.27 High temperature storage. When tested as specified in 4.6.22, the resistors shall meet the following requirements:

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

3.28 Operating life. When tested as specified in 4.6.23, the resistors shall meet the following requirements:

Clamping voltage (see 3.8): Change shall not exceed +20 percent.
 Nominal voltage (see 3.7): Change shall not exceed -10 percent.
 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 PIN 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 4.5.1.1.2. The following is an example of the marking:

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

3.30 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. QUALITY ASSURANCE PROVISIONS

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

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

4.1.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-STD-45662.

4.2 Classification of inspection. The examination and testing of resistors shall be classified as follows:

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

4.3 Inspection conditions and precautions.

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

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 III, 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 III for groups II to VI inclusive, and subjected to the inspections for their particular group.

TABLE III. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units	Allowable failures group/cumulative	
<u>Group I</u>	3.1, 3.3 to 3.4.2 incl. and 3.29, 3.30	4.6.1	All units	0	0
Visual and mechanical inspection ^{1/}					
High temperature (stabilization bake)....	3.19	4.6.14		0	0
Thermal shock.....	3.20	4.6.15			
Power burn-in.....	3.21	4.6.16			
Clamping voltage ^{1/}	3.8	4.6.3			
Nominal voltage ^{1/}	3.7	4.6.2			
<u>Group II</u>			12	0	0
Solderability.....	3.14	4.6.9			
Resistance to soldering heat.....	3.15	4.6.10			
Resistance to solvents....	3.16	4.6.11			
Flammability (external flame).....	3.17	4.6.12			
<u>Group III</u>			10	1	1
Low temperature storage...	3.26	4.6.21			
High temperature storage..	3.27	4.6.22			
Capacitance ^{1/}	3.9	4.6.4			
Dielectric withstanding voltage ^{1/}	3.13	4.6.8			
<u>Group IV</u>			10	1	1
Terminal strength (lead fatigue).....	3.18	4.6.13			
Moisture resistance.....	3.22	4.6.17			
Pulse life.....	3.11	4.6.6			
<u>Group V</u>			10	1	2
Vibration.....	3.23	4.6.18			
Shock.....	3.24	4.6.19			
Constant acceleration....	3.25	4.6.20			
Energy.....	3.12	4.6.7			
<u>Group VI</u>			10	1	2
Peak current.....	3.10	4.6.5			
Operating life.....	3.28	4.6.23			

^{1/} Nondestructive

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

4.4.4 Retention of qualification. To retain qualification, the contractor shall forward a report at six-month intervals to the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall consist of:

- a. A summary of the results of the tests performed for inspection of product for delivery (groups A and B), indicating as a minimum the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.
- b. A summary of the results of tests performed for periodic inspection (group C), including the number and mode of failures. The summary shall include results of all periodic inspection tests performed and completed during the six-month period. If the summary of the test results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the Qualified Products List.

Failure to submit the report within 30 days after the end of each six-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity at any time during the six-month period that the inspection data indicates failure of the qualified product to meet the requirements of this specification.

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If during two consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit his qualified products to testing in accordance with the qualification inspection requirements and the reason for no production.

4.5 Quality conformance inspection.

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

4.5.1.1 Inspection and production lot.

4.5.1.1.1 Inspection lot. An inspection lot shall consist of all resistors of the same PIN, under essentially the same conditions and offered for inspection during a period of one month.

4.5.1.1.2 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 equipments. 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.

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

4.5.1.2.1 Sampling plan.

4.5.1.2.1.1 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.

4.5.1.2.1.2 Subgroup 2. A sample of parts from each inspection lot shall be randomly selected in accordance with table V. 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 V. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

Inspection	Requirement paragraph	Test method paragraph	Sampling plan
<u>Subgroup 1</u>			
High temperature life (stabilization bake).....	3.19	4.6.14	See 4.5.1.2.1.1
Thermal shock.....	3.20	4.6.15	
Power burn-in.....	3.21	4.6.16	
Clamping voltage.....	3.8	4.6.3	
Nominal voltage.....	3.7	4.6.2	
<u>Subgroup 2</u>			
Visual and mechanical examination...	---	4.6.1	See 4.5.1.2.1.2
Body dimensions.....	3.4	---	
Diameter and length of leads.....	3.4.1	---	
Marking (where applicable) 1/.....	3.29	---	
Workmanship.....	3.30	---	
<u>Subgroup 3</u>			
Solderability.....	3.14	4.6.9	See 4.5.1.2.1.3

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

4.5.1.2.1.3 Subgroup 3 (solderability).

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

4.5.1.2.1.3.2 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 4.6.9. Five samples shall be selected from each production lot that formed the failed inspection lot. Production lots 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 (b).
- b. The manufacturer submits the failed lot to a 100 percent solder dip using an approved solder dip process per 3.4.1.1. 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. An additional sample shall then be selected in accordance with table V 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.

4.5.1.2.1.3.3 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 V. Group A inspection sampling plan.

Lot size	Subgroup 2 sampling plan	Subgroup 3 sampling plan
1 to 8	100 percent	5
9 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

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

4.5.1.3.1 Sampling plan.

4.5.1.3.1.1 Subgroup 1. A sample of parts shall be randomly selected in accordance with table VII. 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 VII. If one or more defects are found in the second sample, the lot shall be not supplied to this specification.

TABLE VI. Group B inspection.

Inspection	Requirement paragraph	Test method paragraph	Sampling plan
<u>Subgroup 1</u> Dielectric withstanding voltage	3.13	4.6.8	See 4.5.1.3.1.1
<u>Subgroup 2</u> Resistance to solvents	3.16	4.6.11	See 4.5.1.3.1.2
<u>Subgroup 3</u> Terminal strength (lead fatigue)	3.18	4.6.13	See
Moisture resistance	3.22	4.6.17	4.5.1.3.1.3
Peak current rating	3.10	4.6.5	
Energy rating	3.12	4.6.7	

4.5.1.3.1.2 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.

4.5.1.3.1.3 Subgroup 3. A sample of parts shall be randomly selected in accordance with table VII. 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 VII. If one or more defects are found in the second sample, the lot shall be not supplied to this specification.

4.5.1.3.2 Disposition of sample units. Sample units which have been subjected to group B, subgroups 2 or 3, shall not be delivered on the contract or order.

TABLE VII. 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

4.5.1.4 Periodic inspection. Periodic inspection shall consist of group C inspection. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.1.4.4), delivery of products which have passed groups A and B inspections shall not be delayed pending the results of these periodic inspections.

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

4.5.1.4.2 Sampling plan. Sample size and frequency of sampling shall be as specified in table VIII.

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

4.5.1.4.4 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 reinstated; 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.

4.5.2 Inspection of packaging. Sample packages or packs and the inspection of the preservation, packaging, packing, and marking for shipment and storage shall be in accordance with the requirements of MIL-R-39032.

TABLE VIII. Group C inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units	Failures allowed
<u>Every 3 months</u>				
High temperature storage...	3.27	4.6.22	10	0
Operating Life (steady state).....	3.28	4.6.23	10	0
Pulse Life rating.....	3.11	4.6.6	10	0
Shock.....	3.24	4.6.19	10	0
Vibration.....	3.23	4.6.18	10	0
Constant acceleration.....	3.25	4.6.20	10	0
Energy rating.....	3.12	4.6.7	10	0

4.6 Methods of examination and test.

4.6.1 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 3.30). Defects are classified as shown in table IX.

TABLE IX. 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.

4.6.2 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.

4.6.3 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 $8 \times 20 \mu\text{s}$ (see 6.5.2) and peak value, ± 5 percent as specified (see 3.1).
- b. Pulse repetition rate: Shall not exceed one per second.
- c. Resistors shall be tested in both polarities.

4.6.4 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: $1.0 \pm 0.1 \text{ V rms}$.
- c. Test frequency: $1.0 \text{ MHz} \pm 5$ percent.

4.6.5 Peak current rating (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 percent (see 3.1).
- b. Pulse width: An impulse waveform of $8 \times 20 \mu\text{s}$ (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 4.6.3 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 4.6.2 and 4.6.3 respectively.
- g. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.6.6 Pulse Life rating (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 percent (see 3.1).
- b. Pulse width: $8 \times 20 \mu\text{s}$ (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 percent of the value of the transient average power dissipation, $W_{tm} \pm 10$ percent (see 3.1) and shall be computed by the following formula:

$$P_{RR} = \frac{.9 W_{tm}}{V_C} I_p \times 2 \times 10^{-5}$$

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 4.6.2 and 4.6.3, respectively.
- g. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.6.7 Energy rating (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 percent (see 3.1).
- b. Pulse width: $10 \times 1,000 \mu s$ (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 4.6.2 and 4.6.3, respectively.
- g. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.6.8 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 \pm 20 percent.
- e. Examination after test: Resistors shall be examined for evidence of flash-over, mechanical damage, arcing, and insulation breakdown.

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

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

4.6.10 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: D.
- b. Cooling time prior to final measurements: One hour.
- c. Measurements after test: Nominal voltage and clamping voltage shall be measured as specified in 4.6.2 and 4.6.3, respectively.
- d. Examination after test: Resistors shall be examined for evidence of mechanical damage.
- e. Method of internal examination: Not applicable.

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

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

4.6.12 Flammability (external flame) (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.

4.6.13 Terminal strength (lead fatigue) (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.

4.6.14 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 \pm 1 hour.
- c. Examination after test: Resistors shall be visually examined for evidence of mechanical damage.

4.6.15 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.

4.6.16 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.

4.6.17 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 4.6.2 and 4.6.8, respectively.
- c. Examination after test: Resistors shall be visually examined for evidence of mechanical damage.

4.6.18 Vibration (see 3.23). Resistors shall be tested in accordance with method 214 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 4.6.2 and 4.6.3, respectively.
- e. Examination after test: Resistors shall be visually examined for evidence of mechanical damage.

4.6.19 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 4.6.2 and 4.6.3, respectively.
- e. Examination after test: Resistors shall be visually examined for evidence of mechanical damage.

4.6.20 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 4.6.2 and 4.6.3, respectively.
- e. Examination after test: Resistors shall be visually examined for evidence of mechanical damage.

4.6.21 Low temperature storage (see 3.26).

4.6.21.1 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.

4.6.21.2 Procedure. Resistors shall be placed in a cold chamber which is at $-65^{\circ}\text{C} \pm 0^{\circ}$, -3°C for a period of 24 ± 4 hours. The resistors shall then be removed from the chamber and maintained at a temperature of $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for a period of 6 ± 2 hours. The nominal voltage and clamping voltage shall then be measured as specified in 4.6.2 and 4.6.3 respectively. The resistors shall be visually examined for evidence of mechanical damage.

4.6.22 High temperature storage (see 3.27).

4.6.22.1 Mounting. Resistors shall be mounted as specified in 4.6.21.1.

4.6.22.2 Procedure. Resistors shall be placed in a chamber which is at $125^{\circ}\text{C} \pm 3^{\circ}$, -0°C for a period of 340 ± 8 hours. The resistors shall then be removed from the chamber and maintained at a temperature of $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for a period of 6 ± 2 hours. The nominal voltage and clamping voltage shall then be measured as specified in 4.6.2 and 4.6.3 respectively. The resistors shall then be visually examined for evidence of mechanical damage.

4.6.23 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: $85^{\circ}\text{C} \pm 2^{\circ}\text{C}$.
- 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 4.6.2 and 4.6.3, respectively.
- g. Examination after test: Resistors shall be visually examined for evidence of mechanical damage.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-R-39032.

6. NOTES

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

6.1 Intended use. Resistors covered by this specification are primarily intended for use in electronic equipment to suppress transients which may damage voltage sensitive circuit components. When exposed to high voltage transients, the resistor impedance changes from a very high standby value to a very low conducting value thus absorbing the pulse energy and protecting the sensitive components. These devices may also be used in voltage regulation and reference applications.

6.2 Acquisition requirements.

- a. Title, number, and date of this specification.
- b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).
- c. Title, number and date of the applicable associated detail specification and the complete military PIN (see 3.1 and 1.2.1).

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 Products List QPL No. 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 Qualified Products List is 645 Logistics and Operations Group, Electronic Support Division, Gentile Air Force Station, Dayton OH 45444-5400. However, information pertaining to qualification of products may be obtained from the Defense Electronics Supply Center (DESC-E), 1507 Wilmington Pike, Dayton, Ohio 45444.

6.4 PIN. PIN is a new term encompassing terms previously used in specifications such as part number, type designation, identification number etc. (see 1.2.1).

6.5 Application notes.

6.5.1 Caution note. Should the resistor 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 shall use the waveform of figure 1. The waveform shall be specified by its peak current value and by its time dimensions; for example, 8 x 20 μ S, where 8 is the virtual front duration and 20 is the impulse duration in μ S. The applied test waves shall be accurate to a tolerance of ± 10 percent for virtual front durations, and to a tolerance of ± 20 percent for impulse durations.

6.6 Subject term (key word) listing.

Part or Identifying Number
Power rating
Production lot
Solder dip/reforming

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

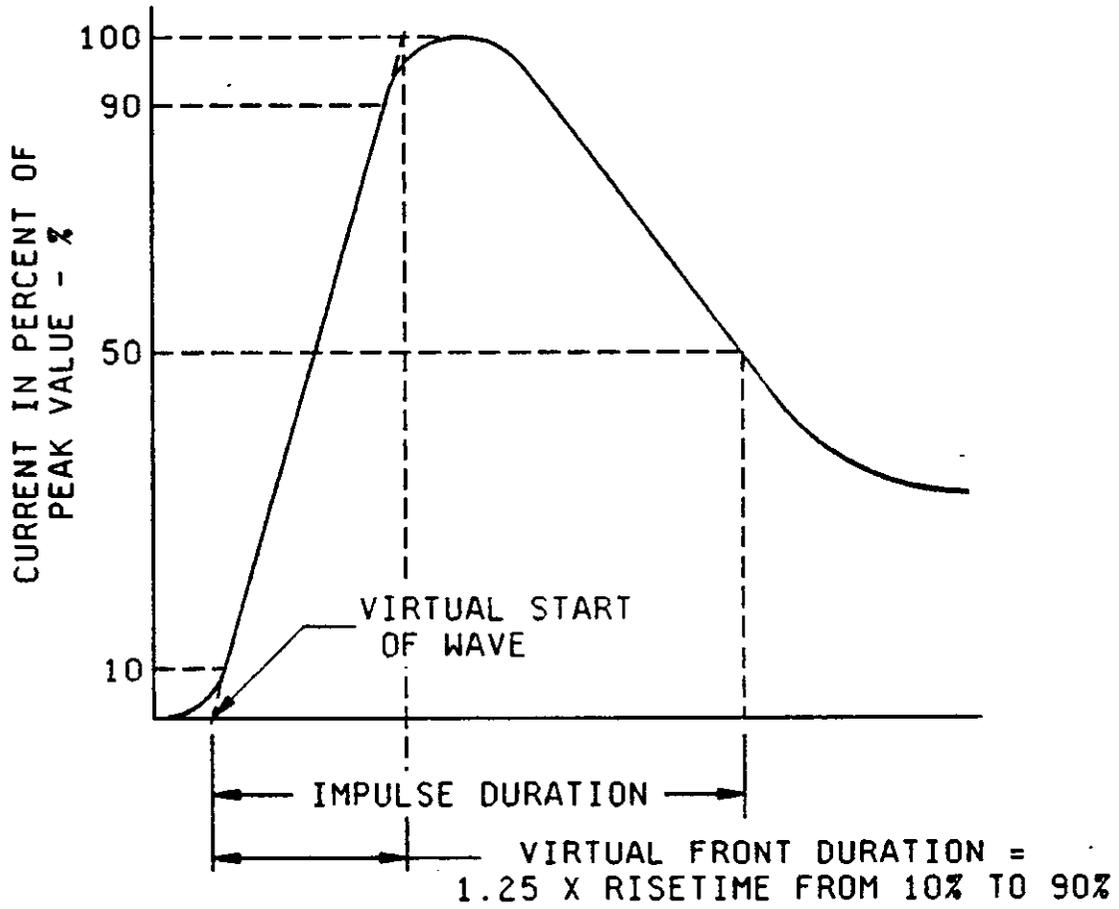


FIGURE 1. Pulse current waveform.

APPENDIX

PROCEDURE FOR QUALIFICATION INSPECTION

10. SCOPE

10.1 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.

20. APPLICABLE DOCUMENTS.

This section is not applicable to this appendix.

30. SUBMISSION

30.1 Sample. A sample consisting of 52 sample units of each PIN for which qualification is sought shall be submitted and subjected to the inspections of table III.

30.2 Test data. When examinations and tests are to be performed at a Government laboratory, prior to submission, all sample units shall be subjected to all of the tests indicated as nondestructive in table III. Each submission shall be accompanied by the test data obtained from these tests. The performance of the destructive inspections and tests by the manufacturer on a duplicate set of sample units is encouraged, although not required. All test data shall be submitted in duplicate.

30.3 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.

MIL-R-83530A

CONCLUDING MATERIAL

Custodians:

Army - ER
Navy - EC
Air Force - 85

Review activities:

Army - AR, MI
Navy - AS, OS
Air Force - 17
DLA - ES

User activities:

Army - AT, AV, ME
Navy - CG, MC
Air Force - 19

Preparing activity:
Air Force - 85

Agent:
DLA - ES

(Project 5905-1312)