

NOTE: The document identifier and heading has been changed on this page to reflect that this is a performance specification. There are no other changes to this document. The document identifier on subsequent pages has not been changed, but will be changed the next time this document is revised.

INCH-POUND

MIL-PRF-49485A
20 February 1990
SUPERSEDING
MIL-R-49485
18 April 1988

PERFORMANCE SPECIFICATION

RESISTORS, FIXED, METAL ELEMENT (POWER TYPE),
(VERY LOW RESISTANCE VALUES),
GENERAL SPECIFICATION FOR.

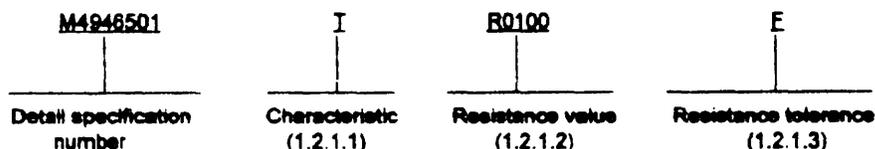
This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for power type, low value (1 ohm and below), fixed resistors (2 terminal and 4 terminal) for use in electrical, electronic, communications, and associated equipment. Included are precision resistors of 1, 3, and 5 percent (characteristic T) and 5 and 10 percent (characteristic L) initial resistance tolerances with power ratings ranging from 2 to 10 watts at +25°C derated to 0 power at +275°C.

1.2 Classification.

1.2.1 Military part number. Resistors specified herein should be identified by a military part number which should consist of the basic number associated detail specification and a coded number. Each associated specification covers a different resistor type. The number should be coded to provide information concerning resistor characteristic, resistance value and tolerance. The military part number should be in the following form with a coded number derived as indicated:



1.2.1.1 Characteristic. The characteristic is identified by a single letter that signifies the level of stability through various electrical and environmental tests and operating characteristics. Characteristics L and T are available with the stability as noted (see table I).

1.2.1.2 Resistance. The normal resistance expressed in ohms is identified by five digits. The letter "R" should be substituted for one of the significant digits to represent the decimal point. The succeeding digits of the group represent significant figures. Minimum and maximum resistance values should be as specified (see 3.1). The standard resistance values for each decade should follow the sequence demonstrated for the 0.01 to 0.1 decade in table II for all resistance tolerances. Only those resistance values which follow the sequence of values listed in the 0.01 to 0.1 decade in table II should be considered as conforming to this specification. The resistance value designations are shown in table III.

1.2.1.3 Resistance tolerances. The resistance tolerance, when applicable, should be identified by a single letter in accordance with table IV (see table I).

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 45444-5785 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter

MIL-R-49465A

TABLE 1. Characteristics.

Test or condition	Symbol		Units
	T	L	
Resistance-temperature characteristic (see 3.12)	(see 3.1)	(see 3.1)	Parts/million/°C
Maximum ambient temperature at rated wattage	25	25	Degrees celsius
Maximum ambient temperature at zero power (see figure 1)	275	275	
Thermal shock (see 3.11)	±0.2%	±3.0%	Maximum percent change in resistance (.0005 ohm additional allowed for measurement error)
Short time overload (see 3.14)	±0.5%	±2.0%	
Terminal strength (see 3.18)	±0.1%	±1.0%	
Dielectric withstanding voltage (see 3.15)	±0.1%	±1.0%	
Insulation resistance (see 3.16)	1,000 M ω	1,000 M ω	
High temperature exposure (see 3.22)	±1.0%	±3.0%	Maximum percent change in resistance (.0005 ohm additional allowed for measurement error)
Moisture resistance (see 3.17)	±0.2%	±4.0%	
Low temperature storage (see 3.13)	±0.2%	±2.0%	
Shock, specified pulse (see 3.19)	±0.1%	±1.0%	
Vibration, high frequency (see 3.20)	±0.1%	±2.0%	
Life (see 3.21)	±1.0%	±4.0%	
Tolerance	1, 3, 5	5, 10	* percent

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).

SPECIFICATION

MILITARY

MIL-R-39032 - Resistors, Packaging of.

(See supplement 1 for list of associated detail specifications.)

STANDARDS

MILITARY

- MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
- MIL-STD-810 - Environmental Test Methods and Engineering Guidelines.
- MIL-STD-1285 - Marking of Electrical and Electronic Parts.
- MIL-STD-45662 - Calibration Systems Requirements.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

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 specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. Resistors furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.4 and 6.3).

3.3 Material. The material shall be as specified herein. 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 as specified (see 3.1).

3.4.1 Construction. Internal construction shall consist of a metallic resistive element which has no joints, welds, or bonds, except at end terminals where welding, brazing, or silver solder only shall be employed. The resistive element shall be as free as practicable from particles or impurities, grain growth, or other factors contributing to spot weakness. Where abrasive resistance value adjustment is used, the abrasion must be evenly distributed across the resistive element.

MIL-R-49465A

TABLE II. Standard resistance values.

F	H	J	K	F	H	J	K
(1.0)	(3.0)	(5.0)	(10.0)	(1.0)	(3.0)	(5.0)	(10.0)
0.0100	0.0100		0.0100	0.0182	---		---
0.0102	---		---	0.0187	---		---
0.0105	---		---	0.0191	---		---
0.0107	---		---	0.0196	---		---
0.0110	0.0110		---	0.0200	0.0200		---
0.0113	---		---	0.0205	---		---
0.0115	---		---	0.0210	---		---
0.0118	---		---	0.0215	---		---
---	0.0120		0.0120	---	0.0220		0.0220
0.0121	---		---	0.0221	---		---
0.0124	---		---	0.0226	---		---
0.0127	---		---	0.0232	---		---
0.0130	0.0130		---	0.0237	---		---
0.0133	---		---	---	0.0240		---
0.0137	---		---	0.0243	---		---
0.0140	---		---	0.0249	---		---
0.0143	---		---	0.0255	---		---
0.0147	---		---	0.0261	---		---
0.0150	0.0150		0.0150	0.0267	---		---
0.0154	---		---	---	0.0270		0.0270
0.0158	---		---	0.0274	---		---
---	0.0160		---	0.0280	---		---
0.0162	---		---	0.0287	---		---
0.0165	---		---	0.0294	---		---
0.0169	---		---	---	0.0300		---
0.0174	---		---	0.0301	---		---
0.0178	---		---	0.0309	---		---
---	0.0180		0.0180	0.0316	---		---
---	---		---	---	---		---

MIL-R-49465A

TABLE II. Standard resistance values - Continued.

F (1.0)	H (3.0)	J (5.0)	K (10.0)	F (1.0)	H (3.0)	J (5.0)	K (10.0)
0.0324	---	---	---	---	0.0560	---	0.0560
---	0.0330	---	0.0330	0.0562	---	---	---
0.0332	---	---	---	0.0576	---	---	---
0.0340	---	---	---	0.0590	---	---	---
0.0348	---	---	---	0.0604	---	---	---
0.0357	---	---	---	0.0619	---	---	---
---	0.0360	---	---	---	0.0620	---	---
0.0365	---	---	---	0.0634	---	---	---
0.0374	---	---	---	0.0649	---	---	---
0.0383	---	---	---	0.0665	---	---	---
---	0.0390	0.0390	---	---	0.0680	---	0.0680
0.0392	---	---	---	0.0681	---	---	---
0.0402	---	---	---	0.0698	---	---	---
0.0412	---	---	---	0.0715	---	---	---
0.0422	---	---	---	0.0732	---	---	---
---	0.0430	---	---	0.0750	0.0750	---	---
0.0432	---	---	---	0.0768	---	---	---
0.0442	---	---	---	0.0787	---	---	---
0.0453	---	---	---	0.0806	---	---	---
0.0464	---	---	---	---	0.0820	---	0.0820
---	0.0470	0.0470	---	0.0825	---	---	---
0.0475	---	---	---	0.0845	---	---	---
0.0487	---	---	---	0.0866	---	---	---
0.0499	---	---	---	0.0887	---	---	---
---	0.0510	---	---	0.0909	---	---	---
0.0511	---	---	---	---	0.0910	---	---
0.0523	---	---	---	0.0931	---	---	---
0.0536	---	---	---	0.0953	---	---	---
0.0549	---	---	---	0.0976	---	---	---

3.4.1.1 Protective coating or enclosure. Resistor assemblies shall be protected by an enclosure of moisture-resistant insulating material which shall completely cover the exterior of the resistance element, including connections or terminations. The enclosure shall not crack, craze, drip, run, or form globules at any temperature up to and including +275°C, regardless of the mounting position of the resistor. This material shall afford adequate protection against the effects of prolonged exposure to high humidities. The protective coating or enclosure shall be such as to minimize the establishment of leakage paths between the terminals resulting from collection of moisture film on the exterior surface of the resistor.

3.4.1.2 Terminals. Terminals shall be made of a solid conductor of the length and diameter as specified (see 3.1).

3.4.1.3 Weight. Resistors shall not exceed the maximum weight as specified (see 3.1).

3.5 Power rating. Resistors shall have a power rating based on continuous full load operation at an ambient temperature of +25°C (see 3.1). For temperatures in excess of +25°C, the load shall be derated in accordance with figure 1.

TABLE III. Designation of resistance values.

Designation	Resistance (ohms)
R0100 to R0976 inclusive	.0100 to .0976 inclusive
R1000 to R9760 inclusive	.1000 to .9760 inclusive
1R000	1.000

TABLE IV. Resistance tolerance.

Symbol	Percent	Characteristic
F	1.0	T
H	3.0	T
J	5.0	T and L
K	10.0	L

3.6 Voltage rating. Each resistor element shall have a rated dc continuous working voltage or an approximate sine-wave root-mean-square (rms) continuous working voltage corresponding to the wattage (power) rating, as determined from the following formula:

$$E = \sqrt{PR}$$

E = Continuous rated dc or rms working voltage in volts.

P = Rated wattage in watts.

R = Nominal resistance in ohms.

In no case shall the rated voltage be greater than the applicable maximum voltage (see 3.1).

3.7 Current rating. Resistors which have a maximum current rating shall be as specified (see 3.1).

3.8 DC resistance. When resistors are tested as specified in 4.7.2, the dc resistance shall be within the specified tolerance of the nominal resistance (see 3.1).

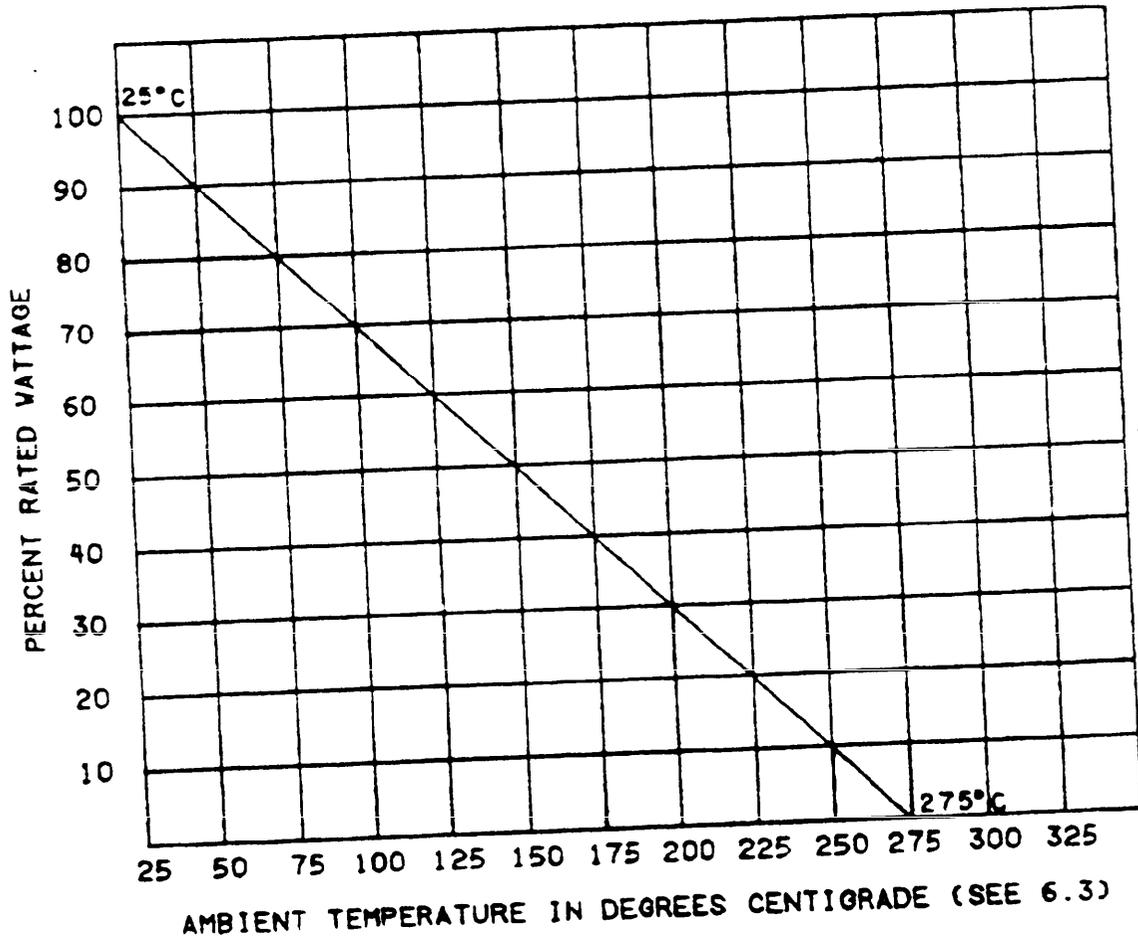


FIGURE 1. Derating curve for ambient temperatures.

3.9 Solderability. When resistors are tested as specified in 4.7.3, they shall meet the criteria for wire lead terminal evaluation in the test method.

3.10 Resistance to solvents. When resistors are tested as specified in 4.7.4, there shall be no evidence of mechanical damage and the markings shall remain legible.

3.11 Thermal shock. When tested as specified in 4.7.5, resistors shall not change in resistance in excess of $\pm(0.2 \text{ percent} + .0005 \text{ ohm})$ for characteristic T and $\pm(3.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic L, nor show any evidence of mechanical damage. There shall be no change in resistor enclosure or other part which will result in degradation in performance.

3.12 Resistance-temperature characteristic. When resistors are tested as specified in 4.7.6, the resistance temperature characteristic between -55°C and $+275^{\circ}\text{C}$ shall not exceed the value as specified (see 3.1).

3.13 Low temperature storage. When resistors are tested as specified in 4.7.7, there shall be no evidence of mechanical damage. The change in resistance between initial and final resistance measurements at $+25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ shall not exceed $\pm(0.2 \text{ percent} + .0005 \text{ ohm})$ for characteristic T and $\pm(2.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic L.

3.14 Short-time overload. When resistors are tested as specified in 4.7.8, there shall be no evidence of arcing, burning, or charring; and the change in resistance shall not exceed $\pm(0.5 \text{ percent} + .0005 \text{ ohm})$ for characteristic T and $\pm(2.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic L.

3.15 Dielectric withstanding voltage. When resistors are tested as specified in 4.7.9, the leakage rate shall not exceed 500 microamperes; there shall be no evidence of flashover, mechanical damage, arcing, or insulation breakdown, and the change in resistance shall not exceed $\pm(0.1 \text{ percent} + .0005 \text{ ohm})$ for characteristic T and $\pm(1.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic L.

3.16 Insulation resistance. When resistors are tested as specified in 4.7.10, the insulation resistance shall not be less than 1,000 megohms for characteristics T and L.

3.17 Moisture resistance. When resistors are tested as specified in 4.7.11, there shall be no evidence of mechanical damage, and the change in resistance shall not exceed $\pm(0.2 \text{ percent} + .0005 \text{ ohm})$ for characteristic T and $\pm(4.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic L. In addition, the dielectric withstanding voltage shall be as specified in 3.15, and the insulation resistance shall be 100 megohms minimum for both characteristics.

3.18 Terminal strength. When resistors are tested as specified in 4.7.12, there shall be no evidence of breaking or loosening of terminals from the resistor form, chipping of enclosure, or other evidence of mechanical damage. The change in resistance shall not exceed $\pm(0.1 \text{ percent} + .0005 \text{ ohm})$ for characteristic T and $\pm(1.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic L.

3.19 Shock, specified pulse. When resistors are tested as specified in 4.7.13, there shall be no evidence of breaking or loosening of terminals from the resistor form, chipping of enclosure or other evidence of mechanical damage. The change in resistance shall not exceed $\pm(0.1 \text{ percent} + .0005 \text{ ohm})$ for characteristic T and $\pm(1.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic L. There shall be no electrical discontinuity during the test.

3.20 Vibration, high frequency. When resistors are tested as specified in 4.7.14, there shall be no evidence of mechanical damage. The change in resistance shall not exceed $\pm(0.1 \text{ percent} + .0005 \text{ ohm})$ for characteristic T and $\pm(2.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic L. There shall be no electrical discontinuity during the test.

3.21 Life. When resistors are tested as specified in 4.7.15, the change in resistance between the initial measurement and the succeeding measurements shall not exceed $\pm(1.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic T and $\pm(4.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic L. There shall be no evidence of mechanical damage.

3.22 High temperature exposure. When resistors are tested as specified in 4.7.16, there shall be no damage. The change in resistance shall not exceed $\pm(1.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic T and $\pm(3.0 \text{ percent} + .0005 \text{ ohm})$ for characteristic L.

3.23 Fungus. All external materials shall be nonnutrient to fungus growth or shall be suitably treated to retard fungus growth. The manufacturer shall verify by certification that all external materials are fungus resistant or shall test the resistors as specified in 4.7.17. There shall be no evidence of fungus growth on the external surfaces.

3.24 Marking. Resistors shall be marked with the type designation, date code, and source code. Date and source code shall be in accordance with MIL-STD-1285. At the option of the manufacturer, the military part number may appear on two lines. In this event, the military part number shall be divided between the characteristic letter and the last digit of the military specification number. The following is an example of the complete marking:

```
12345 - - - - - Source code
8633J - - - - - Date code
M49465D1 - - - - - Military specification
1RUIUDF - - - - - Characteristic, resistance type designation, tolerance
```

3.24.1 Minimum marking. When the physical size of the resistor style precludes the marking of all of the information cited in the example in 3.24 the minimum marking required shall be as specified in the detail specification (see 3.1). Marking shall remain legible at the end of all tests. In those cases where full marking requirements are not on the resistor body, full marking shall be marked on the unit package.

3.25 Use of conductive inks. Conductive inks shall not be used to coat the body of the resistor as preparation for marking or used for marking of resistors.

3.26 Workmanship. Resistors shall be processed in such a manner as to be uniform in quality and shall meet the requirements of 3.4 through 3.4.1.2 inclusive, and shall be free from other defects that will affect life, serviceability, or appearance.

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 inspections 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 acceptable 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 supplier. 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 inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.4).
- b. Quality conformance inspection (see 4.6).

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 inspection to prevent condensation of moisture on resistors, except during moisture-resistance test.

4.4 Qualification inspection. 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 as specified in the appendix to this specification. The sample shall be taken at random from a production run and shall be produced with equipment and procedures normally used in production. The sample units shall have been subjected to and passed the requirements of group A inspection (see 4.6.1.2). Qualification shall not be granted if group A inspection requirements are not met. Each resistor style shall be qualified separately (see 3.1).

4.4.2 Test routine. Sample units shall be subjected to the qualification inspection specified in table V in the order shown. All sample units with the exception of those for groups II through VIII inspection, shall be subjected to the inspections and tests of group I. The sample units shall then be divided as specified in table V for groups III, IV, VI, and VII, and subjected to the inspection for their particular group. In addition, four unenclosed sample units shall be selected and subjected to group V inspection. An additional 14 sample units each shall be subjected to group II tests, with 6 sample units to the solderability test and 8 sample units to the resistance to solvents test. Ten samples shall be subjected to the tests of group VIII.

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

MIL-R-49465A

4.5 Retention of qualification. To retain qualification, the contractor shall forward a report at 6-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 6-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 6-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 6-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.

4.6 Quality 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 lot. An inspection lot shall consist of all the resistors of similar styles with the same protection enclosure or coating design configuration presented for shipping against this document during a period of not more than a month. Resistors of various resistance values and tolerance may be combined to form a lot provided they are all made with the same enclosure material on the same production line using the same methods and processes. Characteristics shall not be combined.

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

TABLE V. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected <u>1/</u>	Number of failures allowed <u>2/</u>
<u>Group I</u>				
Visual and mechanical inspection <u>3/</u>	3.1, 3.3 to 3.4.1.3 inclusive, 3.24 to 3.26 inclusive	4.7.1	All samples 80	1 <u>4/</u>
DC resistance <u>5/</u>	3.8	4.7.2		
<u>Group II</u>				
Solderability (all leads)	3.9	4.7.3	6	1
Resistance to solvents	3.10	4.7.4	8	
<u>Group III</u>				
Thermal shock	3.11	4.7.5		
Resistance-temperature characteristic	3.12	4.7.6		
Low temperature storage	3.13	4.7.7		
Short time overload	3.14	4.7.8	10 highest	1
Dielectric withstanding voltage	3.15	4.7.9	10 lowest	20 1
Insulation resistance	3.16	4.7.10		
Moisture resistance	3.17	4.7.11		
Terminal strength	3.18	4.7.12		
<u>Group IV</u>				
Shock (specified pulse)	3.19	4.7.13	10 highest	
Vibration, high frequency	3.20	4.7.14	10 lowest	20 1
<u>Group V</u> <u>(unenclosed) 6/</u>				
Visual and mechanical inspection	3.1, 3.3, 3.4, 3.24, 3.24.1 and 3.26	4.7.1, as applicable	2 highest 2 lowest	4 0

See footnotes at end of table.

TABLE V. Qualification inspection - Continued.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected <u>1/</u>	Number of failures allowed <u>2/</u>
Life	3.21	4.7.15	10 highest 10 lowest	20 1 1
High-temperature exposure	3.22	4.7.16	10 highest 10 lowest	20 1 1
Fungus	3.23	4.7.17	10	0 0

1/ See appendix for details.

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

3/ Marking shall be considered defective only if illegible or missing. Marking shall remain legible at the end of all tests.

4/ Items subjected to groups II through VIII inclusive, must meet requirements of group I.

5/ Tests shall not be performed if a manufacturer presents certified data proving tests have been performed on the qualification sample.

6/ Unenclosed sample units shall be subjected to visual and mechanical inspection in accordance with group I only.

MIL-R-49465A

4.6.1.2.1 Sampling plan. Subgroup 1 tests shall be performed on a production lot basis on 100 percent of the product supplied under this specification. Networks that are out of resistance tolerance, or which experience a change in resistance greater than that permitted for the tests of this subgroup shall be removed from the lot. Lots having more than 10-percent total rejects, due to exceeding the specified resistance change limit shall not be furnished on contracts.

4.6.1.2.2 Subgroup 2. A sample of 13 parts shall then be randomly selected, if one or more defects are found, the lot shall be rescreened and defects removed. A new sample of 13 parts shall then randomly be selected, if one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

TABLE VI. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of samples
<u>Subgroup 1</u>			
DC resistance	3.8	4.7.2	100 percent inspection
<u>Subgroup 2</u>			
Visual and mechanical inspection	3.1, 3.3 to 3.4.1.1, 3.4.1.3, and 3.24	4.7.1	13 / failure
Terminals	3.4.1.2		
Marking	3.24, 3.24.1		

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

TABLE VII. Group B inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of samples
<u>Subgroup I</u>			
Solderability	3.9	4.7.3	6
Resistance to solvents	3.10	4.7.4	8
<u>Subgroup II</u>			
Thermal shock	3.11	4.7.5	13
Short-time overload	3.14	4.7.8	
Insulation resistance	3.16	4.7.10	

4.6.1.3.1 Subgroup 1. A sample of 14 parts shall then be randomly selected, 8 samples to the resistance to solvents test and 6 samples to the solderability test. If one or more defects are found, the lot shall be rescreened and defects removed. A new sample of 14 parts shall then randomly be selected, if one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

4.6.1.3.2 Subgroup 2. A sample of 13 parts shall then randomly be selected, if one or more defects are found, the lot shall be rescreened and defects removed. If one or more defects are found, a new sample of 13 parts shall then be randomly be selected, if one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

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

4.6.2 Periodic inspection. Periodic inspection shall consist of group C. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.6.2.1.3), delivery of products which have passed groups A and B shall not be delayed pending the results of these periodic inspections.

4.6.2.1 Group C inspection. Group C inspection shall consist of the tests specified in table VIII, in the order shown. The specified number of sample units shall be selected from inspection lots that have been subjected to and have passed groups A and B inspections. A separate sample shall be selected from lots as defined in 4.6.1.1 for each enclosure material and element technology. Group C samples shall be representative of production.

4.6.2.1.1 Sampling plan.

4.6.2.1.1.1 Monthly. Each month the specified number of sample units shall be subjected to the examination and test of table VIII. The samples shall be selected from a lot as defined in 4.6.1.1, and where possible shall be representative of the styles included in the lot. Over a 6-month period, the manufacturer should select samples so that a maximum variety of styles produced are tested. A separate set of samples shall be tested for each enclosure material each month.

4.6.2.1.1.2 Quarterly and semiannually. Sample units and tests shall be as specified in table VIII. The test sample should include all styles allowed to be combined for lot formation (see 4.6.1.1) as practicable. A complete separate sample shall be selected for each enclosure material.

4.6.2.1.1.3 Annually. Sample units and tests shall be as specified in table VIII. The test sample shall include all styles allowed to be combined for lot formation (see 4.6.1.1) as practicable. A complete separate sample shall be selected for each enclosure material.

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

TABLE VIII. Group C inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of failures allowed
<u>Monthly</u>				
<u>Subgroup 1</u>				
Thermal shock	3.11	4.7.5	6 highest 4 lowest	10
Resistance temperature characteristic	3.12	4.7.6		
Low temperature storage	3.13	4.7.7		
Dielectric withstanding voltage	3.15	4.7.9		
Insulation resistance	3.16	4.7.10		
Moisture resistance	3.17	4.7.11		
Terminal strength	3.18	4.7.12		
<u>Quarterly</u>				
Life	3.21	4.7.15	10 highest 10 lowest	20
<u>Semiannually</u>				
<u>Subgroup 1</u>				
Thermal shock	3.11	4.7.5	15 highest 15 lowest	30
Shock	3.19	4.7.13		
Vibration	3.20	4.7.14		
<u>Annually</u>				
<u>Subgroup 2</u>				
High temperature exposure	3.22	4.7.17	15 highest 15 lowest	30

4.6.2.1.3 Noncompliance. If a sample fails to pass group C inspection, the manufacturer shall immediately notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed, at the option of the qualifying activity). Groups A and B inspections 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 shall be furnished to the cognizant inspection activity and the qualifying activity.

MIL-R-49465A

4.6.3 Inspection of packaging. The sampling and inspection of the preservation, packaging, and container marking shall be in accordance with the requirements of MIL-R-39032.

4.7 Methods of inspections.

4.7.1 Visual and mechanical inspection. Resistors shall be examined to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.4 to 3.4.1.3 inclusive, and 3.24 to 3.26 inclusive).

4.7.2 DC resistance (see 3.8). Resistors shall be tested in accordance with method 303 of MIL-STD-202. The following details and exceptions shall apply:

- a. Measuring apparatus. The same measuring instrument shall be used for any one test but not necessarily for all tests. The measuring instrument shall be of a four-terminal kelvin type.
- b. Limit of error of measuring apparatus. $\pm(0.1 \text{ percent} + 0.00001 \text{ ohm})$, but not exceeding one-fourth of the resistor tolerance or the resistance - change limit for which the measurement is being made. Manufacturers, at their option, may use an apparatus of less accuracy, provided the limits are reduced to fully compensate for accuracy deviation.
- c. Test voltage and currents. The test voltage and current shall be such that sufficient resolution is obtained (see 4.7.2b) without an excessive amount of heating effect.
- d. Points of measurement.
 - (1) Two terminal devices: The point-to-point voltage measurement shall be made at a distance as specified in the detail specification, $\pm.064$ inch.
 - (2) Four terminal devices: The detail specification shall identify voltage and current leads. If no identification is given, a random determination will be made and this combination shall be used for any one test, but not necessarily for all tests.

4.7.3 Solderability (see 3.9). Resistors shall be tested in accordance with method 208 of MIL-STD-202. The following details shall apply:

- a. All leads shall be tested.
- b. The leads shall be dipped within .062 inch of the body.

4.7.4 Resistance to solvents (see 3.10). Resistors shall be tested in accordance with method 215 of MIL-STD-202. The following details shall apply:

- a. The marked portion of the resistor body shall be brushed.
- b. The number of sample units shall be as specified in table V.
- c. Resistors shall be examined for mechanical damage and legibility of markings.

MIL-R-49465A

4.7.5 Thermal shock (see 3.11). Resistors shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:

- a. Mounting: In such a manner that there is at least 1 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.
- b. Measurement before cycling: DC resistance shall be measured as specified in 4.7.2.
- c. Test condition: B.
- d. Climate chamber: The rate of temperature change within the climate chamber shall be not less than 2°C per minute. The temperature shall be maintained at each of the extreme temperatures by means of circulating air. The air temperature shall be measured by a suitable method and as near the center of the group of resistors as possible.
- e. When two climate chambers are used: The resistors may be transferred from one chamber to another, in which case they shall be kept at room temperature for not more than 15 minutes between exposures to the extreme temperatures.
- f. Measurement after cycling: Not less than 1 hour, but within a 24-hour period after the last cycle, DC resistance shall be measured as specified in 4.7.2.
- g. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.7.6 Resistance-temperature characteristic (see 3.12). Resistors shall be tested in accordance with method 304 of MIL-STD-202. The test temperature shall be in accordance with table IX.

TABLE IX. Temperature for resistance-temperature characteristic test.

Sequence	Temperature °C	
	For qualification inspection	For quality conformance inspection
1	25 <u>1/</u>	25 <u>1/</u>
2	-15	---
3	-55	-55
4	25 <u>1/</u>	25 <u>1/</u>
5	125	125
6	200	---
7	275	275

1/ This temperature shall be considered the reference temperature for each of the succeeding temperatures.

4.7.7 Low temperature storage (see 3.13).

4.7.7.1 Mounting. Resistors shall be mounted in such a manner that there is at least 1 inch of fine 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.

4.7.7.2 Procedure. DC resistance shall be measured as specified in 4.7.2. Within 1 hour after this measurement, the resistors shall be placed in a cold chamber at a temperature of $-65\text{ C} \pm 2\text{ C}$ for a period of 24 ± 4 hours. The resistors shall then be removed from the chamber and maintained at a temperature of $+25\text{ C} \pm 5\text{ C}$ for a period of approximately 2 to 8 hours; the dc resistance shall again be measured as specified in 4.7.2. Resistors shall then be examined for evidence of mechanical damage.

4.7.8 Short-time overload (see 3.14). DC resistance shall be measured as specified in 4.7.2. The resistors shall then be mounted by means other than soldering and shall be subjected to an overload voltage which will result in 5 times rated wattage for a 5-second duration. DC resistance shall again be measured after the resistors have cooled to room temperature. Care should be taken so as not to exceed the maximum overload current rating (see 3.1).

4.7.9 Dielectric withstanding voltage (see 3.15).

4.7.9.1 Atmospheric pressure. Resistors shall be tested in accordance with method 3C1 of MIL-STD-202. The following details and exceptions shall apply:

- a. Special preparation: Axial lead resistors shall be placed in a conductive material which will conform to the resistor surface so that at least 90 percent of the outer periphery is contacted. The resistor leads shall be so positioned that one of the points of contact of the periphery of the resistor with the V-block is the point at which the distance from the surface of the resistor leads to the periphery of the resistor body is a minimum. The minimum distance to the periphery of the resistor body shall be measured from the point of emergence of the resistor lead.

Radial lead resistors shall be clamped between two metal plates with the leads extending outward. The metal plates shall be of sufficient size to extend beyond the resistor extremities avoiding contact with the terminals. The terminals of the resistor shall be connected together.
- b. Initial measurement: DC resistance shall be measured as specified in 4.7.2.
- c. Magnitude of test voltage: 1,000 volts rms.
- d. Nature of potential: An alternating current (ac) supply at commercial-line frequency and waveform.
- e. Duration of application of test voltage: 1 minute for qualification and group C inspection.
- f. Rate of application of voltage: The test voltage shall be raised from zero to the application value as uniformly as practicable, at the rate of 100 volts rms per second for group C and qualification testing.
- g. Points of application of test voltage: Between the resistor terminals connected together and the mounting hardware, or the V-block, as applicable.
- h. Measurement during the test: The leakage current shall be monitored during the application of the test voltage.

- i. Measurement after test: The dc resistance shall be measured as specified in 4.7.2.
- j. Examinations after test: Resistors shall be examined for evidence of flashover, mechanical damage, arcing, and insulation breakdown.

4.7.10 Insulation resistance (see 3.16). Tests shall be made in accordance with method 302 of MIL-STD-202 with the following exceptions:

- a. Test condition: A.
- b. Special preparation: In accordance with 4.7.9.1a.
- c. Points of measurement: In accordance with 4.7.9.1g.

4.7.11 Moisture resistance (see 3.17). Resistors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

- a. Mounting: Soldered by their leads to rigid mounts or terminal lugs. The spacing of the mounts or terminal lugs shall be such that the length of each resistor lead is approximately .375 inch when measured from the edge of the supporting terminal to the resistor body. One-half of the sample units shall be covered with a V-shaped metal strap whose width is equal to the length of the resistor body as indicated on figure 2. The strap shall be made of a corrosion-resistant metal and shall be kept in contact with the resistor body by supporting the body as indicated on figure 2, with a nonconducting, noncorrosive support whose width is less than that of the body and which will not act as a moisture trap. For group C inspection, each half of the sample shall be apportioned as three highest values, two lowest values for a total of five sample units per half. The mounting straps may be individual for each resistor, or continuous for all resistors.

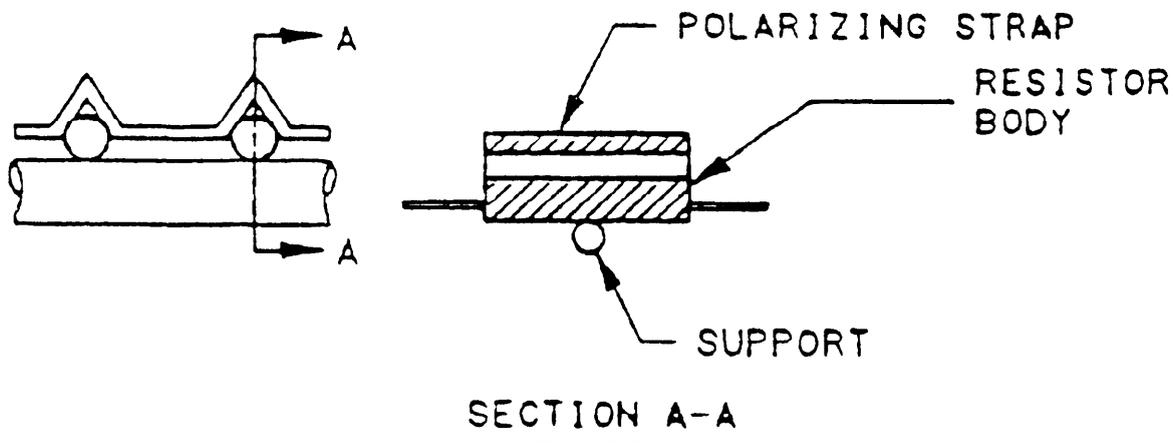


FIGURE 2. Mounting straps for moisture - resistance test.

MIL-R-49465A

- b. Mounting (special body configuration): If the procedure in 4.7.11 does not lend itself to the body configuration, special details shall be as specified in the detail specification (see 3.1).
- c. Initial measurement: Immediately following the initial drying period, dc resistance shall be measured as specified in 4.7.2 at test conditions specified in 4.3.1.
- d. Polarization and loading voltage:
 - (1) Polarization voltage: During steps one to six inclusive, a 100 V dc potential shall be applied only to those resistors which have a polarizing strap. This potential shall be applied with the positive lead connected to the resistor terminals tied together, and the negative lead connected to the polarizing straps.
 - (2) Loading voltage: During the first 2 hours of steps one and four, a dc test potential equivalent to 100-percent rated wattage shall be applied to those resistors which do not have the polarizing strap specified in 4.7.11a.
- e. Subcycle: Step 7b shall not be applicable. Step 7a shall be performed during any five of the first nine cycles only.
- f. Final measurements: Upon completion of step six of the final cycle, the resistors shall be held at the high-humidity condition and a temperature of $+25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for a period of 1 hour 30 minutes to 3 hours 30 minutes. Resistors shall then be removed from the chamber, and within 30 minutes, the dielectric withstanding voltage (atmospheric), insulation resistance, and dc resistance tests shall be performed as specified in 4.7.9, 4.7.10, and 4.7.2, respectively. The same straps used for polarizing the resistors may also be used for the dielectric withstanding voltage and insulation resistance tests.
- g. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.7.12 Terminal strength (All terminals on each resistor shall be tested). Tests shall be in accordance with method 211 of MIL-STD-202 with the following exceptions:

- a. Test conditions: A and D. (Pull test and twist test, respectively.)
- b. Measurement before test (A): DC resistance as specified in 4.7.2.
- c. Method of holding (A): Resistors shall be clamped by one terminal lead for axial terminal and by the body for radial lead.
- d. Applied force (A): As specified (see 3.1) to each terminal.
- e. Applied force (D): If the terminal configuration prevents performance of this test, special details will be as specified (see 3.1).
- f. Measurement after test (D): DC resistance as specified in 4.7.2 and examined for evidence of breaking and loosening of terminals and chipping of coating.

MIL-R-49465A

4.7.13 Shock (specified pulse) (see 3.19). Resistors shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:

- a. Special mounting means: Resistors shall be rigidly mounted on approximate jig fixtures with their bodies restrained from movement and their leads supported at a distance of $.375 \pm .062$ inch from the resistor body. These fixtures shall be constructed in a manner to insure that the points of the resistor-mounting supports will have the same motion as the shock table. Test leads used during this test shall be no larger than AWG size 22 stranded wire, so that the influence of the test lead on the resistor will be held to a minimum. The test-lead length shall be no longer than necessary. In all cases, the resistors shall be mounted in relation to the test equipment in such a manner that the stress applied is in the direction which would be considered most detrimental.
- b. Measurement before shock: DC resistance shall be measured as specified in 4.7.2.
- c. Test condition: I.
- d. Number and direction of applied shocks: The resistors shall be subjected to a total of 10 shocks in each of two mutually perpendicular planes, one perpendicular and the other parallel to the longitudinal axis of the resistor.
- e. Measurement during shock: Each resistor shall be monitored to determine electrical discontinuity by a method which shall at least be sensitive enough to monitor or register, automatically, any electrical discontinuity of 0.1 millisecond or greater duration.
- f. Measurement after shock: DC resistance shall be measured as specified in 4.7.2.
- g. Examination after test: Resistors shall be examined for evidence of mechanical and electrical damage.

4.7.14 Vibration, high frequency (see 3.20). Resistors shall be tested in accordance with method 204 of MIL-STD-202. The following details and exceptions shall apply:

- a. Mounting of specimens: Resistors shall be mounted on appropriate jig fixtures with their bodies restrained from movement and their leads supported at a distance of $.375 \pm .062$ inch from the resistor body. These fixtures shall be constructed in a manner to insure that the points of the resistor mounting supports will have the same motion as the vibration within the test frequency range, and the fixture shall be monitored for these features on the vibration table. Test leads used during this test shall be no larger than AWG size 22 stranded wire, so that the influence of the test lead on the resistor will be held to a minimum. The test lead length shall be no greater than is absolutely necessary. A shielded cable which may be necessary because of the field surrounding the vibration table, shall be clamped to the resistor mounting jig.
- b. Initial measurement: DC resistance shall be measured as specified in 4.7.2.
- c. Test condition: D.
- d. Direction of motion: In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistor. Total test time shall be 6 hours in each direction for a total of 12 hours.

MIL-R-49465A

- e. Measurement during test: Each resistor shall be monitored to determine electrical discontinuity by a method which shall at least be sensitive enough to monitor or register, automatically, any electrical discontinuity of 0.1 millisecond or greater duration.
- f. Measurement after vibration: DC resistance shall be measured as specified in 4.7.2.
- g. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.7.15 Life (see 3.21). Resistors shall be tested in accordance with method 10B of MIL-STD-202. The following details and exceptions shall apply:

- a. Method of mounting: Resistors shall be mounted on lightweight terminals. The integrity of the terminations shall be determined at each measurement interval. The voltage applied to any resistor shall not be less than 95 percent of the dc, ac line or true rms rated continuous working voltage. Resistors shall be so arranged that the temperature of any one resistor shall not appreciably influence the temperature of any other resistor. If forced air circulation is employed, the air velocity shall not exceed 100 feet per minute, and there shall be no direct impingement of the forced air supply on the resistors.
- b. Test temperature: $+25^{\circ}\text{C} \pm 5^{\circ}\text{C}$.
- c. Initial measurements: Initial resistance shall be measured after mounting at $+25^{\circ}\text{C} \pm 5^{\circ}\text{C}$. This initial measurement shall be used as the reference temperature for all measurements.
- d. Operating conditions: Resistors shall be operated at full rated wattage by applying dc continuous working voltage, or ac rated continuous working voltage from an ac supply at commercial line frequency, intermittently, 1 hour 30 minutes "on" and 30 minutes "off" for the applicable number of hours (see 4.7.16f). "On time" shall be three-fourths of the total elapsed time, the actual test time shall be recorded. Where resulting waveform is other than that of a commercial line, voltages shall be set using a "true rms" voltmeter, and the peak voltage shall not exceed 2.5 times the rated continuous working voltage.
- e. Test condition: 2,000 hours for all samples.
- f. Measurements during test: Resistance (see 4.7.2) shall be measured at the end of the 30 minutes "off" periods after 250 ± 48 , -0 hours, 500 ± 48 , -0 hours, 1,000 ± 48 , -0 hours, and 2,000 ± 48 , -0 hours have elapsed. Measurements shall be made as near as possible to the specified time but may be adjusted so that measurements need not be made during other than normal working days.
- g. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.7.16 High-temperature exposure (see 3.22).

- a. Mounting: Resistors shall be placed in a metal tray or basket.
- b. Initial measurements: DC resistance shall be measured as specified in 4.7.2.
- c. Procedure: Following initial resistance measurements, resistors shall be placed in a chamber maintained at $+275^{\circ}\text{C} \pm 7^{\circ}\text{C}$ for a period of 250 ± 6 hours with no load applied.

MIL-R-49465A

- d. Measurements during test: 250 +48, -0 hours.
- e. Final measurements: After removal from the test chamber, resistors shall be permitted to stabilize at room ambient temperatures and within 6 hours after removal, cleaning of the leads will be allowed and the dc resistance shall be measured as specified in 4.7.2. Resistors shall be examined for evidence of mechanical damage.

4.7.17 Fungus (see 3.23). Unless certification is provided, resistors shall be tested in accordance with method 508 of MIL-STD-810.

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 Notes. The notes specified in MIL-R-49465 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of the specification.
- b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).
- c. Title, number, and date of the applicable detail specification and complete military part number.
- d. Whether bracket assembly is required (see 6.5).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for such products that have, prior to the time set for opening of bids, been tested and approved for inclusion in the applicable qualified products list whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the federal Government, tested for qualification, in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is US Army Laboratory Command; however, information pertaining to qualification of products may be obtained from the Defense Electronics Supply Center, Directorate of Engineering Standardization (DESC-E), 1507 Wilmington Pike, Dayton, Ohio 45444.

6.4 Derating. The intention of this specification is to cover resistors capable of full-load operation at any ambient temperature up to and including +25 C. However, if it is desired to operate these resistors at ambient temperatures greater than +25 C, the resistors should be derated in accordance with figure 1. For efficient and long-life operation, resistors should be derated by more than 50 percent.

6.5 Mounting. Under conditions of severe shock or vibration, or a combination of both, resistors of all sizes described in this specification should be mounted in such a fashion that the body of the resistor is restrained from movement with respect to the mounting base. It should be noted that if clamps are used, certain electrical characteristics of the resistor shall be altered. The heat-dissipating qualities of the resistor shall be enhanced or retarded depending upon whether the clamping material is a good or poor heat conductor. Under less severe vibration conditions, axial lead styles may be supported by their leads only. The lead lengths should be kept as short as possible, .250 inch or less preferred, but not longer than .625 inch. The longer the lead, the more likely that a mechanical failure will occur.

6.6 Power dissipation. When higher ambient temperatures exist or when resistors are mounted in enclosures which limit ventilation, the wattage dissipation of any resistor should be reduced so that the maximum hot-spot temperature permissible for the resistor is never exceeded under the most severe combination of temperature conditions.

6.7 Spacing. When resistors are mounted in rows or banks, they should be so spaced that, taking into consideration the restricted ventilation and heat dissipation by the nearby resistors, none of the resistors in the bank or row exceeds its maximum permissible hot-spot temperature. An appropriate combination of resistor spacing and resistor power rating must be chosen if this is to be assured.

6.8 Secondary insulation. Where high voltages are present between resistor circuits and grounded surfaces on which resistors are mounted, secondary insulation capable of withstanding the voltage conditions should be provided between resistors and mountings or between mountings and ground.

6.9 Choice of styles. The styles of resistors to be used in equipment should be chosen that, when mounted in the equipment, they shall not operate at a temperature in excess of their rating. This should be applicable under the worst possible specified conditions, i.e., with the equipment operating as follows:

- a. In the maximum specified ambient temperature.
- b. Under conditions producing maximum temperature rise in each resistor.
- c. For a sufficient length of time to produce maximum temperature rise, or for the maximum specified time.
- d. With all enclosures in place.
- e. With natural ventilation only. (This should permit the use of any special ventilating provisions included as a standard part of the equipment.)
- f. At high altitude.

6.10 Standard resistor types. Equipment designers should refer to MIL-STD-199, "Resistors, Selection and Use of," for standard resistor types and selected values chosen from this selection. MIL-STD-199 provides a selection of standard resistors for new equipment design.

6.11 Subject term (key word) listing.

Element, metal

Resistor, fixed

Resistor, low ohmic

6.12 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.

APPENDIX

PROCEDURE FOR QUALIFICATION APPROVAL

10. SCOPE

10.1 This appendix details the procedure for submission of samples, with related data, for qualification testing and approval of resistors covered by this specification. The procedure for extending qualification approval of the required sample to other resistors covered by this specification is also outlined herein. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance only.

20. APPLICABLE DOCUMENTS. This section is not applicable to this appendix.

30. SUBMISSION

30.1 Sample. A sample consisting of 42 highest values ^{1/} and 42 lowest values, ^{1/} coated or enclosed resistors in each style, with the lowest resistance tolerance for which qualification is desired, shall be submitted in accordance with 40. In addition, 14 sample units of any resistance value shall be submitted and subjected to the tests of groups II and 10 sample units shall be submitted to group VIII. Four uncoated or unenclosed resistors (two at the highest value and two at the lowest value), shall also be submitted in each style. ^{2/} If enclosures are used in lieu of coatings, four enclosures shall be furnished.

30.2 Test data. Each submission shall be accompanied by test data covering nondestructive tests listed in table IV which are performed on the submitted specimens. All test data shall be submitted in duplicate.

30.3 Description of items. The manufacturers shall submit a detailed description of the resistors being submitted for test, including a description of the resistance element, the type of coating or enclosure, and the material used for the terminals. All submitted samples shall be representative of the manufacturer's normal production. After qualification has been granted, no changes shall be made in materials, design, or construction without prior notification to the qualifying activity.

- ^{1/} One additional sample unit of each resistance value shall be submitted to permit substitution for the allowable defect in group I inspection.
- ^{2/} The uncoated and unenclosed resistors shall be individually packaged to preclude damage in shipment.

MIL-R-49465A

APPENDIX

40. EXTENT OF QUALIFICATION

40.1 The extent of qualification of resistance values for each style shall range between the highest and lowest values qualified.

40.2 The extension of qualification between tolerances shall be as follows.

40.2.1 Characteristic L.

<u>Tolerance qualified</u>	<u>Will qualify</u>
J	J and K
K	K

40.2.2 Characteristic T.

<u>Tolerance qualified</u>	<u>Will qualify</u>
F	F, H, and J
H	H and J
J	J

40.3 The extension of qualification between styles can be accomplished by submitting the largest physical size for which qualification is sought as shown in table X. Similar enclosure materials and construction must be utilized for cross qualification.

TABLE X. Extension of qualification between sizes.

<u>Slash sheet</u>	<u>Will qualify slash sheets</u>
/1	/1
/2	/2, /9*
/3	/2, /3, /9*, /10*
/4	/2, /3, /4, /9*, /10*, /11*
/5	/2, /3, /4, /5, /9*, /10*, /11*, /12*
/6	/6
/7	/6, /7
/8	/8
/9	/9
/10	/9, /10
/11	/9, /10, /11
/12	/9, /10, /11, /12

* 10 highest and 10 lowest values of the larger size two terminal resistor shall be subjected to group 1 of table V.

MIL-R-49465A

CONCLUDING MATERIAL

Custodians:
Army - ER
Navy - EC
Air Force - B5

Review activities:
Army - AR, MI
Navy - AS, DS
Air Force - 99
DLA - ES

User activities:
Navy - CG, MC
Air Force - 19

Preparing activity:
Army - ER

Agent:
DLA - ES

(Project 5905-1159)