INCH-POUND

MIL-R-39017E
19 March 1991
SUPERSEDING
MIL-R-39017D
14 September 1988

MILITARY SPECIFICATION

RESISTORS, FIXED, FILM (INSULATED)
ESTABLISHED RELIABILITY,
GENERAL SPECIFICATION FOR

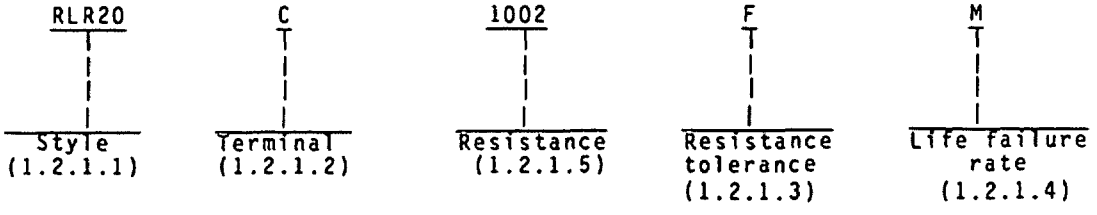
This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for insulated, film, fixed resistors of 1, 2, 5, and 10 percent resistance tolerance. These resistors are capable of full-load operation at an ambient temperature of 70°C and have a resistance-temperature characteristic of 100 and 350 parts per million per degree Celsius (PPM/°C). The resistors will have life failure rate levels ranging from 1.0 to 0.001 percent per 1,000 hours (see 1.2.1.4). These failure rate levels are established at a 60-percent confidence level on the basis of life tests. The failure rate level, identified by the appropriate symbol, is referred to operation at full rated wattage at 70°C, with a permissible change in resistance of 4 percent in 10,000 hours as the criteria for failure. Supplement 1 provides a summary of performance characteristics for these resistors. The term Part or Identifying Number (PIN) is equivalent to the term (part number, identification number, type designator, etc.) which was previously used in this specification. A part per million (PPM) quality system is used for documenting and reporting the average outgoing quality of resistors supplied to this specification. Statistical process control (SPC) techniques are required in the manufacturing process to minimize variation in production of resistors supplied to the requirements of this specification.

1.2 Classification.

1.2.1 PIN. The PIN shall be in the following form, and as specified (see 3.1).



1.2.1.1 Style. The style is identified by the three-letter symbol RLR followed by a two-digit number; the letters identify established reliability, insulated, film, fixed resistors, and the number identifies the size and power rating of the resistors.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to U.S. Army Laboratory Command, ATTN: SLCET-R-S, Fort Monmouth, NJ 07703-5000 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
DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

1.2.1.2 Terminals. The terminals are identified by a single letter in accordance with table I.

TABLE I. Terminal.

Symbol	Terminal
C 1/	Solderable/weldable (type C31, C32, or C52 of MIL-STD-1276)

1/ The maximum thickness of 200 microinches is not applicable.

1.2.1.3 Resistance tolerance. The resistance tolerance is identified by a single letter in accordance with table II.

TABLE II. Resistance tolerance.

Symbol	Resistance tolerance
	Percent (±)
F	1
G	2
J	5
K	10

1.2.1.4 Life failure rate level designation. The life failure rate level designation as shown in table III is signified by a single letter (M, P, R, or S), which identifies the life failure rate level for which the resistor is qualified (see 4.4).

TABLE III. Life failure rate level (established at 60-percent confidence).

Failure rate level designation	Failure rate level (%/1,000 hr)
M	1.0
P	0.1
R	0.01
S	0.001

1.2.1.5 Resistance. The nominal resistance expressed in ohms is identified by a resistance designation utilizing four digits. Minimum and maximum resistance values shall be as specified (see 3.1).

1.2.1.5.1 Four digit resistance designation. The four digit resistance designation is applicable to resistance tolerances "F" (1.0 percent), "G" (2.0 percent), "J" (5.0 percent), and "K" (10.0 percent). The nominal resistance identified by four digits; the first three digits represent significant figures and the last digit specifies the number of zeros to follow. When the value of resistance is less than 100 ohms, or when fractional values of an ohm are required, the letter "R" shall be substituted for one of the significant digits to represent the decimal point. When the letter "R" is used, succeeding digits of the group represent significant figures. The resistance value designations are shown in table IV. Standard values for every decade shall follow the sequence demonstrated for 10 to 100 decade in table V. Resistance values not listed in table V for the appropriate resistance tolerance shall be considered as not conforming to the specification. Although resistance tolerances "G", "J", and "K" normally requires less than three significant figures to adequately describe the true resistance value, for the purpose of this specification, the nominal value shall be three significant figures followed by the fourth digit to signify the number of zeros to follow.

TABLE IV. Designation of resistance values for resistance-tolerances of 1.0, 2.0, 5.0, and 10.0 percent.

Designation	Resistance ohms
1R00 to 9R76 incl.	1.00 to 9.76 incl.
10R0 to 97R6 incl.	10.0 to 97.6 incl.
1000 to 9760 incl.	100 to 976 incl.
1001 to 9761 incl.	1,000 to 9,760 incl.
1002 to 9762 incl.	10,000 to 97,600 incl.
1003 to 9763 incl.	100,000 to 976,000 incl.
1004 to 9764 incl.	1,000,000 to 9,760,000 incl.
1005 to 9765 incl.	10,000,000 to 97,600,000 incl.

TABLE V. Standard resistance value for 10 to 100 decade.

0.1	1.0	2.0 5.0	10.0	0.1	1.0	2.0 5.0	10.0	0.1	1.0	2.0 5.0	10.0
10.00	10.00	10.00	10.00	22.90	---	---	---	49.30	---	---	---
10.10	---	---	---	23.20	23.20	---	---	49.90	49.90	---	---
10.20	10.20	---	---	23.40	---	---	---	50.50	---	---	---
10.40	---	---	---	23.70	23.70	---	---	---	---	51.00	---
10.50	10.50	---	---	24.00	---	24.00	---	51.10	51.10	---	---
10.60	---	---	---	24.30	24.30	---	---	51.70	---	---	---
10.70	10.70	---	---	24.60	---	---	---	52.30	52.30	---	---
10.90	---	---	---	24.90	24.90	---	---	53.00	---	---	---
11.00	11.00	11.00	---	25.20	---	---	---	53.60	53.60	---	---
11.10	---	---	---	25.50	25.50	---	---	54.20	---	---	---
11.30	11.30	---	---	25.80	---	---	---	54.90	54.90	---	---
11.40	---	---	---	26.10	26.10	---	---	55.60	---	---	---
11.50	11.50	---	---	26.40	---	---	---	---	---	56.00	56.00
11.70	---	---	---	26.70	26.70	---	---	56.20	56.20	---	---
11.80	11.80	---	---	---	---	27.00	27.00	56.90	---	---	---
12.00	---	12.00	12.00	27.10	---	---	---	57.60	57.60	---	---
12.10	12.10	---	---	27.40	27.40	---	---	58.30	---	---	---
12.30	---	---	---	27.70	---	---	---	59.00	59.00	---	---
12.40	12.40	---	---	28.00	28.00	---	---	59.70	---	---	---
12.60	---	---	---	28.40	---	---	---	60.40	60.40	---	---
12.70	12.70	---	---	28.70	28.70	---	---	61.20	---	---	---
12.90	---	---	---	29.10	---	---	---	61.90	61.90	---	---
13.00	13.00	13.00	---	29.40	29.40	---	---	---	---	62.00	---
13.20	---	---	---	29.80	---	---	---	62.60	---	---	---
13.30	13.30	---	---	---	---	30.00	---	63.40	63.40	---	---
13.50	---	---	---	30.10	30.10	---	---	64.20	---	---	---
13.70	13.70	---	---	30.50	---	---	---	64.90	64.90	---	---
13.80	---	---	---	30.90	30.90	---	---	65.70	---	---	---
14.00	14.00	---	---	31.20	---	---	---	66.50	66.50	---	---
14.20	---	---	---	31.60	31.60	---	---	67.30	---	---	---
14.30	14.30	---	---	32.00	---	---	---	---	---	68.00	68.00
14.50	---	---	---	32.40	32.40	---	---	68.10	68.10	---	---
14.70	14.70	---	---	32.80	---	---	---	69.00	---	---	---
14.90	---	---	---	---	---	33.00	33.00	69.80	69.80	---	---
15.00	15.00	15.00	15.00	33.20	33.20	---	---	70.60	---	---	---
15.20	---	---	---	33.60	---	---	---	71.50	71.50	---	---
15.40	15.40	---	---	34.00	34.00	---	---	72.30	---	---	---
15.60	---	---	---	34.40	---	---	---	73.20	73.20	---	---
15.80	15.80	---	---	34.80	34.80	---	---	74.10	---	---	---
16.00	---	16.00	---	35.20	---	---	---	75.00	75.00	75.00	---
16.20	16.20	---	---	35.70	35.70	---	---	75.90	---	---	---
16.40	---	---	---	---	---	36.00	---	76.80	76.80	---	---
16.50	16.50	---	---	36.10	---	---	---	77.70	---	---	---
16.70	---	---	---	36.50	36.50	---	---	78.70	78.70	---	---
16.90	16.90	---	---	37.00	---	---	---	79.60	---	---	---
17.20	---	---	---	37.40	37.40	---	---	80.60	80.60	---	---
17.40	17.40	---	---	37.90	---	---	---	81.60	---	---	---
17.60	---	---	---	38.30	38.30	---	---	---	---	82.00	82.00
17.80	17.80	---	---	38.80	---	---	---	82.50	82.50	---	---

TABLE V. Standard resistance value for 10 to 100 decade - Continued.

0.1	1.0	2.0 5.0	10.0	0.1	1.0	2.0 5.0	10.0	0.1	1.0	2.0 5.0	10.0
18.00	---	18.00	18.00	---	---	39.00	39.00	83.50	---	---	---
18.20	18.20	---	---	39.20	39.20	---	---	84.50	84.50	---	---
18.40	---	---	---	39.70	---	---	---	85.60	---	---	---
18.70	18.70	---	---	40.20	---	---	---	86.60	86.60	---	---
18.90	---	---	---	40.70	---	---	---	87.60	---	---	---
19.10	19.10	---	---	41.20	41.20	---	---	88.70	88.70	---	---
19.30	---	---	---	41.70	---	---	---	89.80	---	---	---
19.60	19.60	---	---	42.20	42.20	---	---	90.90	90.90	---	---
19.80	---	---	---	42.70	---	---	---	---	---	91.00	---
20.00	20.00	20.00	---	---	---	43.00	---	92.00	---	---	---
20.30	---	---	---	43.20	43.20	---	---	93.10	93.10	---	---
20.50	20.50	---	---	43.70	---	---	---	94.20	---	---	---
20.80	---	---	---	44.20	44.20	---	---	95.30	95.30	---	---
21.00	21.00	---	---	44.80	---	---	---	96.50			
21.30	---	---	---	45.30	45.30	---	---	97.60	97.60		
21.50	21.50	---	---	45.90	---	---	---	98.80	---		
21.80	---	---	---	46.40	46.40	---	---				
---	---	22.00	22.00	47.00	---	47.00	47.00				
22.10	22.10	---	---	47.50	47.50	---	---				
22.30	---	---	---	48.10	---	---	---				
22.60	22.60	---	---	48.70	48.70	---	---				

2. APPLICABLE DOCUMENTS

2.1 Governmment 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-F-14256 - Flux, Soldering, Liquid (Rosin Base).
MIL-R-39032 - Resistors, Packaging Of.

(See supplement 1 for list of associated specifications.)

STANDARDS

MILITARY

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-690 - Failure Rate Sampling Plans and Procedures.
MIL-STD-790 - Reliability Assurance Program for Electronic Parts Specification.
MIL-STD-810 - Environmental Test Methods and Engineering Guidelines.
MIL-STD-1276 - Leads for Electronic Component Parts.
MIL-STD-1285 - Marking of Electrical and Electronic Parts.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia PA 19111-5094.)

2.1.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA-554 - Assessment of Outgoing Nonconforming Levels in Parts Per Million (PPM).
EIA-557 - Statistical Process Control Systems (SPC).

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

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

3. REQUIREMENTS

3.1 Detail requirements for individual resistor types. Detail requirements or exceptions applicable to individual types of resistors shall be as specified in the detail specifications listed in supplement 1 to this specification. In the event of any conflict between requirements of this specification and the detail specifications, the latter shall govern (see 6.2)

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 (see 4.4 and 6.3). In addition, the manufacturer shall obtain certification from the qualifying activity that the reliability assurance requirements of 4.1.1.1 have been met and are being maintained. Authorized distributors that are approved to MIL-STD-790 distributor requirements by the Qualified Products List (QPL) manufacturers are listed in the QPL.

3.3 Reliability and quality.

3.3.1 Reliability. Reliability of resistors furnished under this specification shall be established and maintained in accordance with the procedures and requirements specified in MIL-STD-790 and MIL-STD-690 with details and exceptions specified in 4.1.1.1, 4.4.4, and 4.5.

3.3.2 Quality.

3.3.2.1 Statistical process control (SPC). The contractor shall implement and use statistical process control techniques in the manufacturing process for parts covered by this specification. The SPC program shall be developed and maintained in accordance with all the requirements of EIA-557. The SPC program shall be documented and maintained as part of the overall reliability assurance program as specified in MIL-STD-790. The implementation of statistical process control shall be 12 months from the date of this specification. Processes for application of SPC techniques should include but are not limited to:

a. Film deposition.

b. Cap and lead attachment.

c. Laser trimming.

d. Encapsulation.

e. Weld strength.

3.3.2.2 Quality levels. The quality of lots that have been subject to and passed the subgroup 1 100 percent screening inspection of the group A inspection shall be established and maintained in accordance with 4.6.1.2.3 and EIA-554 method B. Individual PPM defect level (i.e., PPM-2 and PPM-3) and an overall PPM defect level (i.e., PPM-5) shall be established based on the tests prescribed in the subgroup 2 tests of group A inspections. The defect level for PPM-2 shall be less than 100 PPM. Data shall not be excluded from the appropriate PPM calculation unless specifically authorized by the qualifying activity. Guidance for exclusion of data is specified in EIA-554. The implementation of part per million verification shall be 12 months from the date of this specification.

3.3.2.2.1 Noncompliance. The contractor shall notify the qualifying activity when the 100 PPM level is reached or exceeded for PPM-2. The contractor shall provide sufficient information to the qualifying activity documenting the causes of the problem and what corrective action is being taken. Failure to correct this problem shall be the basis for removal of the affected product from the QPL.

3.4 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 guarantee of the acceptance of the finished product.

3.5 Design, construction, and physical dimensions. Resistors shall be of the design, construction, and physical dimensions specified (see 3.1). Each resistor shall consist of a film-type resistance element protected against exposure to humidity and temperature conditions by an enclosure or a coating of moisture-resistant, insulating material.

3.5.1 Aqueous-extract-conductivity. The manufacturer shall verify by certification that the aqueous-extract-conductivity, when determined as specified in 4.7.21 does not exceed the values shown below for the incoming materials for the part indicated:

Part	Maximum conductivity (siemens (mhos) per cm)
Core - - - - - - - - -	0.5×10^{-6}

3.5.2 Films. Films shall be uniformly deposited. The film shall be free of blisters, thin spots, areas inadequately bonded to the core, discolored spots, or other blemishes likely to cause flaking or a nonuniform ribbon when spiraled (helixed). Where used, spiraling shall occupy no less than 70 percent of resistor element actual length. The resistor element actual length shall be defined as the nominal distance between terminal bands less .047 inch.

3.5.3 Terminal leads. Terminal leads shall be of a solid conductor of the length and diameter specified (see 3.1). Manufacturers shall verify by certification that all leads conform to all requirements of type C of table I. The leads shall be capable of meeting the requirements of solderability (see 3.16 and figure 1). Terminal leads meeting requirements specified herein shall be considered solerable and weldable. At the option of the manufacturer, the terminals may be solder-coated or otherwise treated to meet the solderability requirements following the power conditioning test specified in 4.7.2.

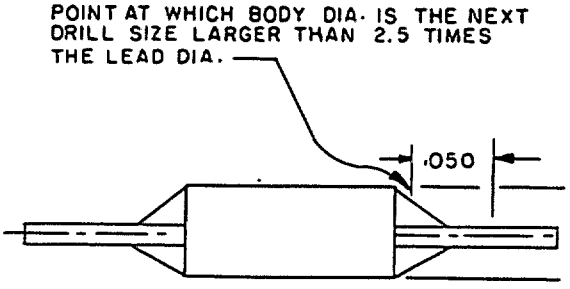


FIGURE 1. Solderability requirements.

3.5.4 Flux. The manufacturer shall verify by certification that only noncorrosive solder flux shall be used unless it can be shown that corrosive elements have been removed satisfactorily after soldering. Noncorrosive flux shall comply with the requirements for resistivity of water extract and effect on vacuum-deposited copper specified in MIL-F-14256. If cored solders are used, the proportion of flux to solder by volume shall be between 1 percent and 3 percent.

3.5.4.1 Solder dip (retinning) leads. Only the manufacturer (or his authorized category B or C distributor) may solder dip/retin the leads of the product supplied to this specification provided the solder dip/retin process has been approved by the qualifying activity.

3.5.4.1.1 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 lead 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 dc resistance test and other group A electricals. No defects are allowed.

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

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

(Note: Solder dip of gold plated leads is not allowed.)

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

a. After the 100 percent group A screening tests. Following the solder dip/retinning process, the electrical measurements required in group A, subgroup 1 100 percent screening tests shall be repeated on 100 percent of the lot (Note: The manufacturer may solder dip/retin prior to the 100 percent electrical measurements of the group A subgroup 1 tests). The percentage defective allowable (PDA) for the electrical measurements shall be as for the subgroup 1 tests.

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

c. After the group A inspection has been completed. Following the solder dip/retinning process, the electrical measurements required in group A, subgroup 1, 100 percent screening test shall be repeated on 100 percent of the lot. The PDA for the electrical measurements shall be as for the subgroup 1 tests. Following this test, the manufacturer shall submit the lot to the group A solderability test as specified in 4.6.1.2.5.

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

3.6 Power rating. Resistors shall have a power rating as specified (see 3.1), based on continuous full-load operation at an ambient temperature of 70°C. This power rating is dependent on the ability of resistors to meet the life requirements specified in 3.24 (see 6.5). For temperatures in excess of those specified above, the load life shall be derated in accordance with figure 4.

3.7 Voltage rating. Resistors shall have a rated direct current continuous working voltage or an approximate sine-wave root-mean-square (rms) alternating current (ac) continuous working voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula:

$$E = \sqrt{PR}$$

Where:

E = Rated dc or rms ac continuous working voltage at commercial-line frequency and waveform.
P = Power rating (see 3.1).
R = Nominal resistance (see 3.1).

In no case shall the rated dc or rms ac continuous working voltage be greater than the applicable maximum value (see 3.1).

3.8 Power conditioning. When resistors are tested as specified in 4.7.2, there shall be no evidence of mechanical damage and the change in resistance shall not exceed ±(0.5 percent +0.05 ohm for 100 PPM) or ±(1 percent +0.05 ohm for 350 PPM).

3.9 DC resistance. When resistors are tested as specified in 4.7.3, the dc resistance shall be within the specified tolerance of the nominal resistance (see 1.2.1.3).

3.10 Thermal shock. When resistors are tested as specified in 4.7.4, there shall be no evidence of mechanical damage and the change in resistance shall not exceed ±(0.25 percent +0.05 ohm for 100 PPM) or ±(1 percent +0.05 ohm for 350 PPM).

3.11 Resistance-temperature characteristic. When resistors are tested as specified in 4.7.5, the change in resistance at any temperature, referred to an ambient temperature of 25°C, shall not exceed ±0.010 percent per degree Celsius (100 PPM/°C).

3.12 Low-temperature storage. When resistors are tested as specified in 4.7.6, there shall be no evidence of mechanical damage and the change in resistance between the initial and final measurements at 25°C ±5°C shall not exceed ±(0.25 percent +0.05 ohm for 100 PPM) or ±(0.5 percent +0.05 ohm for 350 PPM).

3.13 Low-temperature operation. When resistors are tested as specified in 4.7.7, there shall be no evidence of mechanical damage and the change in resistance between the initial and final measurements at 25°C ±5°C shall not exceed ±(0.25 percent +0.05 ohm for 100 PPM) or ±(0.5 percent +0.05 ohm for 350 PPM).

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 ±(0.5 percent +0.05 ohm for 100 PPM) or ±(1 percent +0.05 ohm for 350 PPM).

3.15 Terminal strength.

3.15.1 Direct load. When tested as specified in 4.7.9, resistors shall withstand the specified load without mechanical damage and the change in resistance shall not exceed ±(0.25 percent +0.05 ohm for 100 PPM) or ±(0.5 percent +0.05 ohm for 350 PPM).

3.15.2 Twist. When resistors are tested as specified in 4.7.9.1, there shall be no evidence of breakage or other mechanical damage and the change in resistance shall not exceed ±(0.25 percent +0.05 ohm).

3.16 Solderability. When resistors are tested as specified in 4.7.10, they shall meet the criteria for wire lead terminal evaluation in the test method.

3.17 Resistance to solvents. When resistors are tested as specified in 4.7.11, there shall be no evidence of mechanical damage and the marking shall remain legible.

3.18 Dielectric withstanding voltage. When resistors are tested as specified in 4.7.12, there shall be no evidence of mechanical damage, arcing, or breakdown. The change in resistance shall not exceed ±(0.25 percent +0.05 ohm for 100 PPM and 350 PPM). The leakage current shall not exceed 1 milliampere at any time during the test.

3.19 Insulation resistance. When resistors are tested as specified in 4.7.13, the insulation resistance shall be not less than 1,000 megohms.

3.20 Resistance to soldering heat. When resistors are tested as specified in 4.7.14, there shall be no evidence of mechanical damage and the change in resistance shall not exceed ±(0.25 percent +0.05 ohm for 100 PPM) or ±(0.5 percent +0.05 ohm for 350 PPM).

3.21 Moisture resistance. When resistors are tested as specified in 4.7.15, there shall be no evidence of mechanical damage and the change in resistance between the initial and final measurements shall not exceed ±(1.0 percent +0.05 ohm for 100 PPM) or ±(5 percent +0.05 ohm for 350 PPM). The dielectric withstanding voltage shall be as specified in 3.18. The insulation resistance shall be not less than 100 megohms.

3.22 Shock (specified pulse). When resistors are tested as specified in 4.7.16, there shall be no evidence of mechanical or electrical damage and the change in resistance shall not exceed ±(0.5 percent +0.05 ohm) following vibration test of 3.23. There shall be no electrical discontinuity of 0.1 millisecond or greater duration during the test.

3.23 Vibration, high frequency. When resistors are tested as specified in 4.7.17, there shall be no evidence of mechanical or electrical damage and the change in resistance shall not exceed ±(0.5 percent +0.05 ohm) for 3.22 and 3.23 combined. There shall be no electrical discontinuity of 0.1 millisecond or greater duration during the test.

3.24 Life.

3.24.1 Qualification. When resistors are tested as specified in 4.7.18, there shall be no evidence of mechanical damage to the resistance element, coating, or enclosure. The change in resistance between the initial measurement and any succeeding measurement up to and including 2,000 hours shall not exceed ±2 percent.

3.24.2 Failure rate level determination (extended FR test). When resistors are tested as specified in 4.7.18, the change in resistance between the initial measurement and any succeeding measurement up to and including 10,000 +96, -0 hours shall not exceed ±(4.0 percent +0.05 ohm). This single failure criteria shall be applicable to all measurements during the life test for purpose of determining failure rate level qualification (see 4.6.2.1.1).

3.25 High temperature exposure. When resistors are tested as specified in 4.7.19, there shall be no evidence of mechanical damage and the change in resistance shall not exceed ±(2 percent +0.05 ohm for 100 PPM) or ±(5 percent +0.05 ohm for 350 PPM).

3.26 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 4.7.20. There shall be no evidence of fungus growth on the external surfaces.

3.27 Marking.

3.27.1 Full marking. Resistors shall be marked with the PIN, JAN marking, date code, source code, and manufacturer's production lot code (see 6.1). Date and source code shall be in accordance with MIL-STD-1285. Marking shall remain legible at the end of all tests. The full marking shall be as shown in the following example:

12345 - Source code.
7333AJ - Date code, lot symbol, and JAN marking.
RLR32C - Style and terminal.
1002FM - Resistance, tolerance, and failure rate.

The date code shall be the date of final assembly operation for the production lot as defined in MIL-STD-790. The common manufacturing record shall include the same date code as that on the parts covered by the record. Lot symbol shall be assigned as in accordance with MIL-STD-1285. The manufacturer must provide for lot traceability by date code and lot symbol.

3.27.2 Minimum marking. When the physical size of the resistor precludes the marking of all the above in 3.27.1, the minimum marking required shall be as specified in the detail specification (see 3.1). In those cases where full marking requirements are not on the resistor body, the full marking shall be marked on the unit package (see section 5). Marking shall remain legible at the end of all tests.

3.27.3 JAN and J marking. The United States Government has adopted, and is exercising legitimate control over the certification marks "JAN" and "J", respectively, to indicate that items so marked or identified are manufactured to, and meet all the requirements of military specifications. Accordingly, items acquired to, and meeting all of the criteria specified herein and in applicable specifications shall bear the certification mark "JAN" except that items too small to bear the certification mark "JAN" shall bear the letter "J". The "JAN" or "J" shall be placed immediately before the PIN except that if such location would place a hardship on the manufacturer in connection with such marking; the "JAN" or "J" may be located on the first line above or below the PIN. Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein or in applicable specifications shall not bear "JAN" or "J". In the event an item fails to meet the requirements of this specification and the applicable specification sheets or associated detail specifications, the manufacturer shall remove the "JAN" or the "J" from the sample tested and also from all items represented by the sample. The "JAN" or "J" certification mark shall not be used on products acquired to contractor drawings or specifications. The United States Government has obtained Certificate or Registration Number 504,860 for the certification mark "JAN".

3.27.4 Supplying to higher FR levels. A manufacturer may supply to all higher failure rate levels than that to which he is qualified. Parts qualified and marked to lower failure rate levels, with procuring agency approval, are substitutable for higher rate level parts, and shall not be re-marked unless specified in the contract or purchase order (see 6.2 and table VI).

TABLE VI. Failure rate substitution.

Failure rate	Acceptable failure rate substitute
S (.001)	---
R (.01)	S
P (0.1)	S, R
M (1.0)	S, R, P

3.27.5 Supplying lower resistance tolerances. Parts qualified and marked to more restrictive tolerance levels, with procuring agency approval, are substitutable for parts marked to higher tolerance levels and shall not be remarked unless specified in the contract or purchase order (see 6.2 and table VII).

TABLE VII. Resistance tolerance substitution.

Resistance tolerance	Acceptable resistance tolerance substitute
F	---
G	F
J	F, G
K	F, G, J

3.28 Workmanship. Resistors shall be processed in such a manner as to be uniform in quality, shall meet the requirements of 3.4, 3.5 through 3.5.5, and 3.27 to 3.27.4 inclusive, as applicable, and shall be free from cracks, holes, chips, malformation, and other defects that will affect life or serviceability.

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 must 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 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.

4.1.1.1 Reliability assurance program. A reliability assurance program shall be established and maintained in accordance with MIL-STD-790. Evidence of such compliance shall be verified by the qualifying activity of this specification as a prerequisite for qualification and continued qualification.

4.1.2 Statistical process control. A SPC program shall be established and maintained in accordance with EIA-557. Evidence of such compliance shall be verified by the qualifying activity as a prerequisite for qualification and retention of qualification.

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

a. Qualification inspection (see 4.4).

b. Verification of qualification (see 4.5).

c. 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 test conditions specified in the general requirements of MIL-STD-202.

4.3.2 Precautions. Adequate precautions shall be taken during inspection to prevent condensation of moisture on resistors, 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 size. 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. With the exception of styles RLR32 and RLR42, each 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 VIII, in the order shown. All 294 sample units shall be subjected to the inspection of group I. The 294 sample units shall then be divided as specified in table VIII for groups III through VII inclusive, and subjected to the inspection for their particular group. Ten or 20 additional samples shall be subjected to group II. An additional 10 units shall be subjected to group VIII.

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

4.4.4 FR qualification. FR qualification shall be in accordance with the general and detailed requirements of MIL-STD-690 and the following details:

a. Procedure I: Qualification at the initial FR level. Level "M" (1.0 percent) of FRSP-60 shall apply. Sample units shall be subjected to the qualification inspection specified in group VI, table VIII (see 4.4.2). Entire life test sample shall be continued on test to 10,000 hours as specified in 4.7.18, upon completion of the 2,000-hour qualification.

b. Procedure II: Extension of qualification to lower FR levels. To extend qualification to the "R" (0.01 percent) and "S" (0.001 percent) FR levels, data from two or more styles of similar construction may be combined.

c. Procedure III: Maintenance of FR level qalification. Maintenance period "A" of FRSP-10 shall apply. Regardless of the number of production lots produced during this period, the specified number of unit hours shall be accumulated to maintain qualification (see 4.6.2.1).

TABLE VIII. Qualification inspection.

Inspection	Number of sample units	Requirement paragraph	Method paragraph	Number of defectives allowed 1/
Certification requirements				
Terminal leads 2/		3.5.3	---	
Aqueous-extract-conductivity 2/		3.5.1	4.7.21	
Fungus 2/		3.26	4.7.20	
Group I				
Visual and mechanical inspection 3/	All sample units 5/	3.1, 3.4, 3.5, 3.5.2, 3.5.3, 3.5.4, 3.5.5, 3.27 and 3.28	4.7.1	Not applicable
Power conditioning 4/		3.8	4.7.2	
DC resistance 4/		3.9	4.7.3	
Group II				
Solderability	20 (20 single or 10 both leads)	3.16	4.7.10	1
Resistance to solvents		3.17	4.7.11	
Group III				
Thermal shock	30 (10 high, 10 critical 6/, 10 low)	3.10	4.7.4	1
Resistance temperature characteristic		3.11	4.7.5	
Low-temperature storage		3.12	4.7.6	
Low-temperature operation		3.13	4.7.7	
Short-time overload		3.14	4.7.8	
Terminal strength		3.15	4.7.9	
Group IV				1
Dielectric withstanding voltage	30 (10 high, 10 critical 6/, 10 low)	3.18	4.7.12	
Insulation resistance		3.19	4.7.13	1
Thermal shock		3.10	4.7.4	
Resistance to soldering heat		3.20	4.7.14	
Moisture resistance		3.21	4.7.15	
Group V				
Shock (specified pulse)	30 (10 high, 10 critical 6/, 10 low)	3.22	4.7.16	1
Vibration, high frequency		3.23	4.7.17	

See footnotes at end of table.

TABLE VIII. Qualification inspection - Continued.

Inspection	Number of sample units	Requirement paragraph	Method paragraph	Number of defectives allowed 1/
Group VI				
Life	102 (34 high, 34 critical 7/, 34 low)	3.24	4.7.18	1
Group VII				
High temperature exposure	102 (34 high, 34 critical 7/, 34 low)	3.25	4.7.19	1
Group VIII				
Fungus	10	3.26	4.7.20	0

1/ Failure of a single resistor in one or more test of a group shall be charged as a single defective.

2/ The manufacturer shall verify by certification that these requirements have been met in fabricating resistors furnished to this specification. The fungus requirement is either by certification or performance (see group VIII).

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

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

5/ Sample units for groups II and VIII shall not be subjected to group I.

6/ Where no critical value is specified, an additional 5 units of the highest value and 5 units of the lowest value shall be substituted.

7/ Where no critical value is specified, 17 units of the highest value and 17 units of the lowest value shall be substituted.

4.4.4.1 Quality level verification. The contractor is responsible for establishing a quality system to verify the PPM defect level of lots that are subjected to subgroup 2 tests of the group A inspections. The PPM defect level shall be based on a 6-month moving average. The contractor shall verify and report the monthly individual PPM categories (i.e., PPM-5).

4.5 Verification of qualification. Every 6 months the manufacturer shall compile a summary of the results of quality conformance inspections and extended failure rate (FR) test data, in the form of a verification of qualification report, and forward it to the qualifying activity within 30 days after the end of the reporting period as the basis of continued qualification approval. In addition, the manufacturer shall immediately notify the qualifying activity whenever the FR data indicates that the manufacturer has failed to maintain the qualified FR level or the group C inspection data indicates failure of the qualified product to meet the requirements of this specification. Continuation shall be based on evidence that over the 6-month period the following has been met:

a. Verification by the qualifying activity that the manufacturer meets the requirements of MIL-STD-790.

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

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

d. Lot rejection for group A inspection does not exceed 15 percent or one lot, whichever is greater.

e. Lot rejection for group B inspection does not exceed 15 percent or one lot, whichever is greater.

f. The requirements for group C inspection are met.

g. The records of FR tests combined substantiate that the "M" (1.0 percent), or "P" (0.1 percent) FR level has been maintained, or that the manufacturer continues to meet the "R" (0.01 percent), and "S" (0.001 percent) FR level for which qualified, although the total component hours of testing does not, as yet, meet the requirements of 4.4.4c.

h. The contractor shall provide documentation to the qualifying activity pertaining to PPM calculations including numbers of part types tested, individual PPM defect categories (i.e., PPM-2, PPM-3) and the overall PPM defect rate (PPM-5). This information shall be submitted on a detail specification basis.

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

If a group C test requires a comparison of "post-test" readings with initial readings (delta measurements), the verification of qualification summary shall include the maximum and minimum delta changes for each inspection lot. For life testing, delta "R" readings shall be reported at each interval in which readings are taken.

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 and production lot.

4.6.1.1.1 Inspection lot. An inspection lot, as far as practical, shall consist of all the resistors of the same style, characteristic, and protective enclosure or coating and manufactured under essentially the same process and conditions during a manufacturing period of 1 month maximum. All leads in the lot shall be represented in a similar proportion by samples selected for inspection.

4.6.1.1.2 Production lot. A production lot shall consist of all resistors of the same style, nominal resistance value, resistance tolerance, and termination type. Manufacture of all parts in the lot shall have been started, processed, assembled, and tested as a group. Lot identity shall be maintained throughout the manufacturing process.

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

4.6.1.2.1 Sampling plan. Subgroup 1 test shall be performed on a production lot basis on 100 percent of the product supplied under this specification. Resistors 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. Only lots having not more than 3 percent rejects on values up to 200 kilohm and 5 percent rejects on values of 200 kilohm to 3 megohm and 10 percent for values of 3 megohm and above, or one resistor, whichever is greater, due to exceeding the specified resistance change limit as a result of subgroup 1 tests shall be furnished on orders. Corrective action shall be taken on such values and new pieces furnished.

4.6.1.2.2 Manufacturer's production inspection. If the manufacturer performs tests equal to or more stringent than those specified in subgroup 1, table IX as the final step of this production process, group A, subgroup 1 inspection may be waived and the data resulting from the manufacturer's production tests may be used instead. Authority to waive the subgroup 1 inspection shall be granted by the qualifying activity only. The following criteria must be complied with:

a. Tests conducted by the manufacturer during production shall be clearly identical to or more stringent than that specified for subgroup 1. Test conditions shall be equal to or more stringent than those specified for subgroup 1 tests.

b. Manufacturer subjects 100 percent of the product supplied under this specification to his production tests.

c. The parameters measured and the failure criteria shall be the same or more stringent than those specified herein.

d. The lot rejection criteria is the same or more stringent than that specified herein.

e. The manufacturer shall make available all information concerning the test procedures and instrumentation used in his production tests. This data shall be provided as part of the evaluation required for MIL-STD-790, for all failure rate levels. The manufacturer shall also make available to the Government all records of all detail test data resulting from production tests.

f. Once approved, the manufacturer shall not change the test procedures or criteria without prior notification and concurrence by the qualifying activity.

4.6.1.2.3 Subgroups 2a and 2b tests (PPM categories).

4.6.1.2.3.1 Sampling plan. Subgroups 2a and 2b tests shall be performed on an inspection lot basis. Samples subjected to subgroups 2a and 2b shall be selected in accordance with table IXa based on the size of the inspection lot. (Note: Larger samples may be inspected by the contractor in order to calculate PPM, however, rejection of the lot shall be based on 1 or more defects.) In the event of 1 or more failures, the lot shall be rejected. Equipment used to perform the subgroups 2a and 2b tests shall not be the same as those used in the subgroup 1 100 percent tests.

4.6.1.2.3.2 Rejected lots. The rejected lot shall be segregated from new lots and those lots that have passed inspection. The rejected lot shall be 100 percent inspected for those quality characteristics found defective in the sample and any defects found removed from the lot. A new sample of parts shall then be randomly selected in accordance with table IXa. If 1 or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

4.6.1.2.3.3 PPM calculations. PPM calculations shall be based on the results of the first sample check as prescribed in 4.6.1.2.3.1. Calculations and data exclusion shall be in accordance with EIA-554 method B. (Note: PPM calculations shall not use data on the second sample submission).

4.6.1.2.4 Subgroup 3 tests. Subgroup 3 and statistical sampling inspection shall be performed on an inspection lot basis. A sample of 13 parts shall then be randomly selected, if one or more rejects are found, the lot shall be rescreened and defects removed. A new sample of 13 parts shall then be randomly 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.

4.6.1.2.5 Subgroup 4 (solderability).

4.6.1.2.5.1 Sampling plan. Thirteen samples shall be selected randomly from each inspection lot and subjected to the subgroup 4 solderability test. The manufacturer may use electrical rejects from the subgroup 1 screening tests for all or part of the samples to be used for solderability testing. If there is one or more defects, the lot shall be considered to have failed.

4.6.1.2.5.2 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 4.6.1.2.5.1. 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 in accordance with 3.5.4.1. 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. (Note: If hermetic seal is required in the group A, subgroup 1 tests, these tests shall be repeated). Thirteen additional samples shall be then selected and subjected to the solderability test with zero defects allowed. If the lot fails this solderability test, the lot shall be considered rejected and shall not be furnished against the requirements of this specification.

4.6.1.2.5.3 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 IX. Group A inspection.

Inspection	Requirement paragraph	Method paragraph	Sampling procedure
Subgroup 1			
Power conditioning	3.8	4.7.2	100-percent inspection
DC resistance 1/	3.9	4.7.3	
Subgroup 2a (PPM) 2/			
DC resistance (PPM-2)	3.9	4.7.3	See table IXa
Subgroup 2b (PPM) 2/			
Mechanical examination (PPM-3)	3.1	4.7.1	See table IXa
Subgroup 3			
Visual inspection	3.1, 3.4, 3.5.2, 3.5.3, 3.5.4, 3.27, and 3.28	4.7.1	13 samples 0 failures
Subgroup 4			
Solderability	3.16	4.7.10	13 samples 0 failures

1/ Resistors shall meet the specified initial resistance tolerance. The resistance measurement made upon completion of the power conditioning test may be used if a measurement has been made which can, without conversion, be directly related to nominal resistance value and tolerance.
2/ Inspection lot definition can be different for subgroup 2a and subgroup 2b.

TABLE IXa. Sampling plans for PPM categories.

Lot size	DC resistance sample size	Mechanical examination sample size
0 - 32	100 percent	100 percent
33 - 125	100 percent	32
126 - 3,200	125	50
3,201 - 10,000	200	80
10,001 - 35,000	315	125
35,001 - 150,000	500	200
150,001 - 500,000	800	315
500,001 - up	1,250	500

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

4.6.1.3.1 Sampling plan.

4.6.1.3.1.1 Subgroup 1. 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. If one or more defects are found, a new sample of 13 parts shall then be randomly 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.

4.6.1.3.1.2 Subgroup 2. A sample of 8 parts shall then be randomly 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 8 parts shall then be randomly 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.

4.6.1.3.2 Disposition of sample units. Sample units which have passed subgroup 1 of group B inspection may be delivered on the contract or purchase order provided they are within resistance tolerance and meet requirements for visual and mechanical inspection. No units from subgroup 2 of group B inspection may be delivered on the contract or purchase order.

TABLE X. Group B inspection.

Test	Requirement paragraph	Method paragraph	Number of samples
Subgroup 1			
Resistance-temperature characteristic	3.11	4.7.5	13
Dielectric withstanding voltage	3.18	4.7.12.1	
Thermal shock	3.10	4.7.4	
Short-time overload	3.14	4.7.8	
Subgroup 2			
Resistance to solvents	3.17	4.7.11	8

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 XI in the order shown. They shall be performed on sample units of each style and selected from lots that have passed groups A and B inspections.

4.6.2.1.1 Sampling plan.

4.6.2.1.1.1 Monthly (subgroup 1). Test samples shall be selected for each inspection lot produced during a 1-month period. These samples shall be accumulated and placed on the life test as specified in 4.7.18, once a month, for the full 10,000-hour life test period. The test sample size shall be determined by the manufacturer so that the unit hours generated meet the maintenance of qualification requirements specified for the qualified failure rate level (see 4.4.4). In any event a minimum of 5 samples shall be selected from each lot. As far as is practicable, the resistance values tested durng a maintenance period shall be representative of all resistance decades produced during this period. The accumulated data shall be used for maintenance and extension of failure rate qualification.

4.6.2.1.1.2 Monthly (subgroup 2). Each month the tests specified in subgroup 2 shall be performed on sample units of each style and selected from lots produced during the previous month that have passed groups A and B inspection. For sample units without a critical value (see table XI), 10 sample units of the most populous, highest decade value produced during the period shall be inspected. One defective shall be allowed for each subgroup.

4.6.2.1.1.3 Quarterly. Ten sample units between critical and highest resistance values shall be subjected to the tests of subgroup 1. Ten sample units between critical and highest resistance value shall be subjected to the tests of subgroup 2. One defective shall be allowed in subgroups 1 and 2 but no more than one defective for the two subgroups combined. For sample units without a critical value (see table XI), 10 sample units of the most populous, highest decade value produced during the period shall be inspected.

4.6.2.1.1.4 Semiannual. One hundred and two sample units divided equally among the nearest to the low, critical, and high resistance values shall be subjected every 6 months to inspection. The samples shall be taken from lots that have passed groups A and B inspections. One defective shall be allowed.

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.

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 inspection, or the inspection which the original sample failed, at the option of the qualifying activity). Groups A and B inspections may be reinstituted; however, final acceptance and shipment shall be withheld until the group C inspection 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.

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

TABLE XI. Group C inspection.

Inspection	Requirement paragraph	Method paragraph	Number of sample unit for inspection	Number of defectives allowed
Monthly				
Subgroup 1				
Life	3.24	4.7.18	See 4.6.2.1.1	
Subgroup 2				
Dielectric withstanding voltage	3.18	4.7.12	10	1
Insulation resistance	3.19	4.7.13		
Thermal shock	3.10	4.7.4		
Resistance to soldering heat	3.20	4.7.14		
Moisture resistance	3.21	4.7.15		
Quarterly				
Subgroup 1				
Shock (specified pulse)	3.22	4.7.16	10	1
Vibration, high frequency	3.23	4.7.17		
Subgroup 2				
Low-temperature storage	3.12	4.7.6	10	
Low-temperature operation	3.13	4.7.7		
Terminal strength	3.15	4.7.9		
Semiannual				
High temperature exposure	3.25	4.7.19	102	1

4.7 Methods of inspection.

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, 3.5 to 3.5.5 inclusive, and 3.27 to 3.28 inclusive). Visual aid for this requirement shall not exceed 10X.

4.7.2 Power conditioning (see 3.8).

4.7.2.1 Mounting.

4.7.2.1.1 Qualification inspection. Resistors shall be mounted horizontally in free space with no object closer than 3 inches to the resistor case, except the mounting base, which shall be no closer than 2 inches below the resistors. They shall be mounted in still air, with no circulation other than that caused by the heat of the resistors being operated. Test ambient temperature shall be 20°C to 45°C.

4.7.2.1.2 Quality conformance inspection. Resistors may be mounted in any position and allotted any size space as deemed necessary by the manufacturer. Forced air cooling may be used to maintain a test ambient temperature of 20°C to 45°C. The velocity of the forced air, if employed, shall not exceed 500 feet per minute. When forced air is employed, there shall be no direct impingement of the forced-air supply upon the resistors.

4.7.2.2 Procedure. The load applied shall be 1.5X rated power for a duration of 24 hours. The maximum voltage shall be as specified (see 3.1). The voltage applied may be ac or dc. DC resistance as specified in 4.7.3 shall be measured before and after the test following a 2-hour stabilization period at 25°C ±2°C. Resistors shall be examined for evidence of arcing, burning, or charring.

4.7.3 DC resistance (see 3.9). 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.

b. Test voltage: Measurements of resistance shall be made by using the test voltages specified in table XII. The test voltage chosen, whether it be the maximum or a lower voltage which would still provide the sensitivity required, shall be applied across the terminals of the resistor. This same voltage shall be used whenever a subsequent resistance measurement is made.

c. Temperature: The dc resistance test specified in group 1 of table VIII shall be performed at 25°C ±2°C. For all other tests, unless otherwise specified herein, the temperature at which subsequent and final resistance measurements are made shall be within ±2°C of the temperature at which the first resistance measurement was made.

TABLE XII. DC resistance test voltages.

Resistance, nominal	Test potential
Ohms	Volts
4.3 to 9.1 incl.	.0043 to .1 incl.
10 to 91 incl.	0.5 to 1 incl.
100 to 910 incl.	2.5 to 3 incl.
1,000 to 9,100 incl.	8 to 10 incl.
10,000 to 91,000 incl.	24 to 30 incl.
0.1 megohm or higher	80 to 100 incl.

4.7.4 Thermal shock (see 3.10). Resistors shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:

a. Special mounting:

(1) Qualification inspection: Resistors shall be mounted by means other than soldering.

(2) Quality conformance inspection: Resistors shall be mounted by means other than soldering or may be placed in trays. When trays are used, they must be designed to present a minimum of obstruction to the airstream. In no case shall the fixture prevent the specified ambient temperature from being achieved within 4 minutes after resistors are placed in chamber.

b. Measurement before cycling: DC resistance shall be measured as specified in 4.7.3.

c. Test condition letter:

(1) Qualification inspection: Test condition F.

(2) Quality conformance inspection: Test condition B, except that the extreme low temperature shall be -55°C +0°C, -10°C. These extreme temperatures shall be achieved within 4 minutes after resistors are in the chamber.

d. Measurement after cycling: Within 3 hours after completion of the final cycle and as soon as the resistors stabilize at room temperature, dc resistance shall again be measured as specified in 4.7.3.

e. Inspection after test: Resistors shall be inspected for evidence of mechanical damage.

4.7.5 Resistance-temperature characteristic (see 3.11). Resistors shall be tested in accordance with method 304 of MIL-STD-202. The following details and exceptions shall apply: Test temperature: In accordance with table XIII.

TABLE XIII. Ambient temperature for resistance-temperature characteristic test.

Sequence	Temperature °C	
	Qualification inspection	Group B inspection 1/
1	25 ±3 2/	25 ±3 2/
2	-15 ±3	-55 ±3
3	-55 ±3	25 ±3 2/
4	25 ±3 2/	150 ±3 3/
5	65 ±3	---
6	150 ±3 3/	---

1/ At the option of the manufacturer, the reverse sequence may be as follows:

1	25 ±3	2/
2	150 ±3	3/
3	25 ±3	2/
4	-55 ±3	

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

3/ 125°C ±3°C for resistance temperature coefficient of ±350 PPM (see 3.1).

4.7.6 Low-temperature storage (see 3.12).

4.7.6.1 Mounting. Resistors shall be mounted 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.

4.7.6.2 Procedure. DC resistance shall be measured as specified in 4.7.3. Within 1 hour after this measurement, the resistors shall be placed in a cold chamber at a temperature of -65°C ±2°C for a period of 24 ±4 hours. The resistors shall then be removed from the chamber and maintained at a temperature of 25°C ±5°C for a period of approximately 2 to 8 hours; the dc resistance shall again be measured as specified in 4.7.3. Resistors shall then be examined for evidence of mechanical damage.

4.7.7 Low-temperature operation (see 3.13).

4.7.7.1 Mounting. As specified in 4.7.4a.

4.7.7.2 Procedure. Following the final measurement of dc resistance as specified in 4.7.3, the resistors shall be placed in a cold chamber at room temperature. The temperature shall be gradually decreased to -55°C +0°C, -5°C, within a period of not less than 1 hour 30 minutes, nor more than 2 hours. For quality conformance inspection only, and at the option of the manufacturer, the resistors may be placed in the cold chamber when the chamber is already at the extreme temperature. After 1 hour of stabilization at this temperature, the full rated continuous working voltage (see 3.7) shall be applied for 45 minutes. The resistors may be loaded individually or in parallel. Fifteen +5, -0 minutes after the removal of voltage, the temperature in the chamber shall be gradually increased to room temperature within a period of not more than 8 hours. The resistors shall be removed from the chamber and maintained at a temperature of 25°C ±5°C for a period not to exceed 24 hours; the dc resistance shall then be measured as specified in 4.7.3. Resistors shall then be examined for evidence of mechanical damage.

4.7.8 Short-time overload (see 3.14).

4.7.8.1 Mounting.

4.7.8.1.1 Qualification inspection. Resistors shall be mounted horizontally in free space with no object closer than 3 inches to the resistor case, except the mounting base, which shall be not closer than 2 inches below the resistors. They shall be mounted in still air, with no circulation other than that caused by the heat of the resistors being operated.

4.7.8.1.2 Quality conformance inspection. Resistors may be mounted in any position and allotted any size space as deemed necessary by the manufacturer. Forced air cooling may be used to maintain a test ambient temperature of 25°C ±10°C. The velocity of the forced air, if employed, shall not exeed 500 feet per minute. When forced air is employed, there shall be no direct impingement of the forced-air supply upon the resistors.

4.7.8.2 Procedure. DC resistance shall be measured as specified in 4.7.3. Following this measurement, a potential of 2.5 times the rated continuous working voltage but not to exceed twice the maximum voltage (see 3.1) shall be applied for 5 seconds to the resistor terminals. Thirty +5, -0 minutes after removal of the test potential, the dc resistance shall again be measured as specified in 4.7.3.

4.7.9 Terminal strength (see 3.15). Resistors shall be tested in accordance with method 211 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition: A (pull test).

b. Measurement before test: DC resistance shall be measured as specified in 4.7.3.

c. The resistors shall be clamped by one terminal lead.

d. The applied load shall be 5 pounds for styles RLR07, RLR20, RLR32, and RLR42. For style RLR05, the applied load shall be 2 pounds.

e. Examination after test: DC resistance shall be measured as specified in 4.7.3. Resistors shall be examined for evidence of mechanical damage (see 3.15.1).

4.7.9.1 Twist test. Resistors shall be tested in accordance with method 211 of MIL-STD-202. The following details shall apply:

a. Test condition: D.

b. Test to be performed following tests specified in 4.7.9.

c. Following the test, dc resistance shall be measured as specified in 4.7.3, and resistors shall be examined for evidence of breakage and other mechanical damage (see 3.15.2).

4.7.10 Solderability (see 3.16). Resistors shall be tested in accordance with method 208 of MIL-STD-202. The following detail shall apply:

One or two terminal leads of each resistor shall be tested (see table VIII).

4.7.11 Resistance to solvents (see 3.17). 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 tables VIII and X, as applicable.

c. Resistors shall be examined for mechanical damage and legibility of markings.

4.7.12 Dielectric withstanding voltage (see 3.18).

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

a. Special preparations: Resistors shall be placed in a conductive material which will conform to the resistor surface so that between 90 and 100 percent of the outer periphery is contacted. The conductive material shall be centered on the resistor body. Care should be taken that any part of the resistor lead is as far away from the conductive material as possible (see figure 2).

b. Initial measurement: DC resistance shall be measured as specified in 4.7.3.

c. Magnitude of test voltage: See 3.1.

d. Nature of potential: An ac supply at commercial-line frequency (not more than 100 cycles per second) and waveform.

e. Duration of application of test voltage: 60 seconds.

f. Rate of application of test voltage: 100 volts per second.

g. Points of application of test voltage: Between the resistor terminals connected together and the conductive material. (No longer mounted in a V-block.)

h. Measurements after test: DC resistance shall be measured as specified in 4.7.3.

i. Examinations after test: Resistor shall be examined for evidence of mechanical damage, arcing, and breakdown.

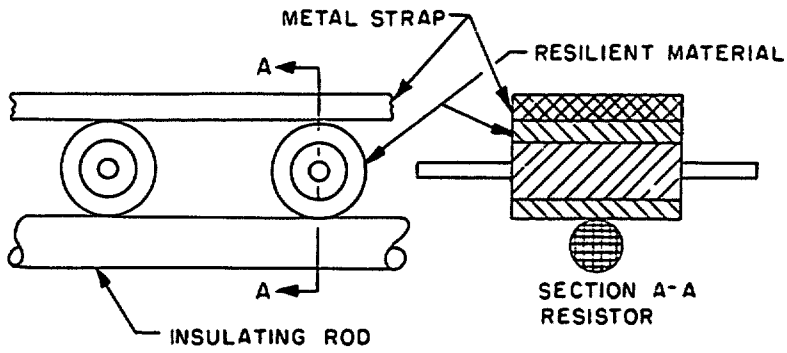


FIGURE 2. Resistor-contacting assembly for dielectric strength and final moisture-resistance measurements.

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

a. Method of mounting: As specified in 4.7.12.1a.

b. Initial measurement: DC resistance shall be measured as specified in 4.7.3.

c. Test condition: D.

d. Test voltages during subjection to reduced pressure: See 3.1.

e. Nature of potential: As specified in 4.7.12.1d.

f. Duration of application of test voltage: 60 seconds.

g. Rate of application: 100 volts per second.

h. Points of application of test voltage: As specified in 4.7.12.1g.

i. Measurement after test: DC resistance shall be measured as specified in 4.7.3.

j. Examinations after test: As specified in 4.7.12.1i.

4.7.13 Insulation resistance (see 3.19). Resistors shall be tested in accordance with method 302 of MIL-STD-202. The following details and exceptions shall apply:

a. Special preparations: As specified in 4.7.15a.

b. Test condition: A or B, whichever is practicable for styles RLR07, RLR20, RLR32, and RLR42. For style RLR05, test condition A (100 volts) shall be used.

c. Points of measurement: Between the resistor terminals connected together and the mounting strap.

4.7.14 Resistance to soldering heat (see 3.20). Resistors shall be tested in accordance with method 210 of MIL-STD-202. The following details shall apply:

a. Measurement before test: DC resistance shall be measured as specified in 4.7.3.

b. Special preparation of the specimen: Both leads shall be dipped in RMA flux in accordance with MIL-F-14256, and then dipped into solder, both for 5 ±.5 seconds. The bath shall be maintained at 260°C ±5°C. The parts shall be immersed to within .075 ±.025 inch of the body.

c. Test condition: Test condition C (260°C ±5°C, 10 ±2 seconds). A board with a maximum area of 9 square inches shall be used, and the leads shall not be cut.

d. Post test conditioning: The resistors shall be inserted in a vapor degreasing apparatus containing boiling 1-1-1 trichloroethane for 1.5 +.5, -0 minutes. The parts shall then be cleaned with isopropyl alcohol.

e. Measuremnts after test: After completion of the cleaning process and following a minimum 3-hour cooling period, the dc resistance shall be measured as specified in 4.7.3.

f. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.7.15 Moisture resistance (see 3.21). Resistors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exception shall apply:

a. Mounting: Resistors shall be soldered by their leads to standoff insulators on a suitable panel so that there will be at least 1 inch of free air space around each resistor. 1/ The spacing of the mounts shall be such that the length of each resistor lead is .375 ±.063 inch when measured from the edge of the supporting terminal to the resistor body. Resistor leads may be formed, if necessary, so as not to compromise the seal of the resistor. In addition, 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 3. 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 3, with a nonconducting, noncorrosive support whose width is less than that of the body and which shall not act as a moisture trap. The mounting straps may be individual for each resistor or continuous for all resistors. These resistors with strapping shall be subjected to the polarization voltage.

1/ Standoff insulators of polytetrafluoroethylene are preferred for use with resistors of high resistance values.

b. Initial measurement: Following thermal stabilization (within 30 minutes after resistors have been removed from drying oven), dc resistance shall be measured as specified in 4.7.3.

c. Polarization and loading voltage:

(1) Polarization voltage: During steps 1 to 6 inclusive, a 100-volt dc potential shall be applied only to 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 1 and 4, a dc test potential equivalent to 100-percent rated dc continuous working voltage shall be applied to those resistors which do not have the polarizing strap specified in 4.7.15a.

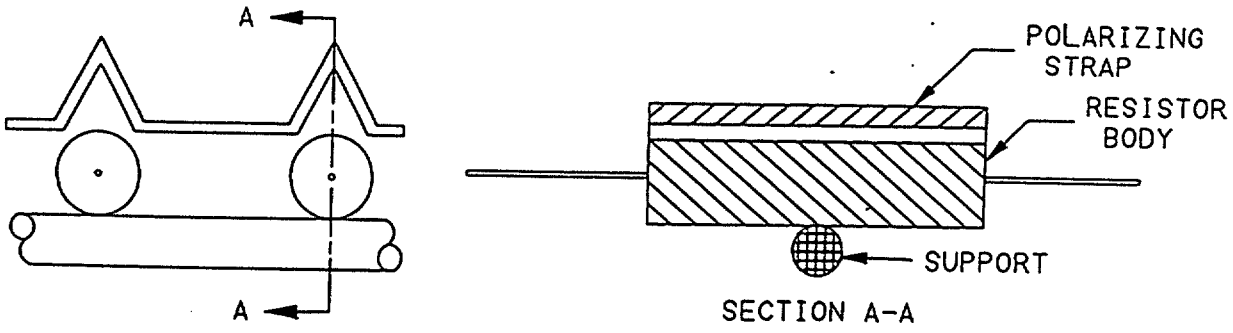


FIGURE 3. Mounting straps for moisture-resistance test for polarized units only.

d. Subcycle: Step 7a shall be performed during any five of the first nine cycles. Step 7b shall not be applicable. All polarizing straps shall be removed to perform step 7a and then be replaced prior to returning the resistors to the humidity chamber.

e. Final measurements: Upon completion of step 6 of the final cycle, the resistors shall be held at the high-humidity condition and a temperature of 25°C ±2°C for a period of 1 hour 30 minutes to 3 hours 30 minutes. Resistors shall be removed from the chamber and within 30 minutes, without any additional handling, the dc resistance, dielectric withstanding voltage, and insulation resistance shall be measured in that order, as specified in 4.7.3, 4.7.12.1, and 4.7.13, respectively. The straps specified in 4.7.12 and figure 3, shall be used for these measurements. Sample units shall not be subjected to forced air drying prior to or during these final measurements.

f. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.7.16 Shock (specified pulse) (see 3.22). 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 mounted on approximate jig fixtures with their bodies restrained from movement and their leads supported at a distance of .25 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. Measurements before shock: DC resistance shall be measured as specified in 4.7.3.

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

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

a. Mounting of specimens: Resistors shall be mounted on appropriate jig fixtures and supported by their leads at a distance of .25 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 test table. The fixtures shall also be of a construction that will preclude any resonance in the fixture when subjected to 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: Use initial measurement of 4.7.16. (Requirement is for 4.7.16 and 4.7.17 combined).

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. Six hours in each direction for a total of 12 hours.

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 4.7.3.

g. Examination after test: Resistors shall be examined for evidence of mechanical and electrical damage.

4.7.18 Life (see 3.24). Resistors shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

a. Method of mounting: Resistors shall be mounted on lightweight terminals. The effective length of each lead shall be .5 inch minimum. Resistors shall be soldered to the terminals. Resistors shall be so arranged that the temperature of any one resistor shall not appreciably influence the temperature of any other resistor.

b. Test temperature: +70°C +15°C, -5°C.

c. Initial measurements: Measurements may be made inside or outside the chamber.

(1) Inside chamber: When measurements are to be made inside the chamber, the initial dc resistance shall be measured after mounting at the applicable test temperature after temperature stabilization and within 8 hours of exposure of the resistors to the test temperature. This initial measurement shall be used as the reference temperature for all subsequent measurements under the same conditions.

(2) Outside chamber: When measurements are to be made outside the chamber, the initial dc resistance shall be measured after mounting at the room temperature. This initial measurement shall be used as the reference temperature for all subsequent measurements under the same conditions.

d. Operating conditions: Rated dc continuous working voltage (RCWV), or filtered or nonfiltered full-wave rectified ac voltage shall be applied intermittently, 1 hour 30 minutes on and 30 minutes off, for the applicable number of hours (see 4.7.18f) and at the applicable test temperature. "On time" shall be three-fourth of the total elapsed time. Voltage shall be maintained within 5 percent of RCWV.

e. Test condition: 2,000 hours elapsed time for qualification inspection with all samples continued to 10,000 hours; 10,000 hours for failure rate level inspection of group C.

f. Measurements during test:

(1) Qualification inspection: DC resistance shall be measured at the end of the 30 minutes off periods after 250 +72, -24; 500 +72, -24; 1,000 +96, -24; and 2,000 +96, -0 hours have elapsed.

(2) Extend life testing: DC resistance shall be measured at the end of the 30 minutes off periods after 250 +72, -24; 500 +72, -24; 1,000 +96, -24; 2,000 +96, -24 and 2,000 +96, -24 hours thereafter (except at the final 2,000 hours its +96 -0) until the required 10,000 hours, has 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 workdays.

(3) Measurements outside of chamber: When measurements are made outside the chamber, resistors shall be outside of the chamber, for a minimum of 45 minutes and stabilized at room temperature before measurement.

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

4.7.19 High temperature exposure (see 3.25).

a. Mounting: Resistors shall be mounted by their normal mounting means.

b. Initial measurements: DC resistance shall be measured as specified in 4.7.3 at room ambient conditions.

c. Procedure: Following initial resistance measurements resistors shall be placed in a chamber maintained at 150°C +15°C, -0°C for 100 PPM (125°C +15°C, -0°C for resistance temperature coefficient of 350 PPM) (see 3.1) for a period of 2,000 +72, -0 hours with no load applied.

d. Measurements during test: At 250 +48, -0 hours, resistors shall be removed from chamber and permitted to stabilize at room temperature and within 6 hours after removal, the dc resistance shall be measured as specified in 4.7.3. Resistors shall be examined for evidence of mechanical damage.

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, the dc resistance shall be measured as specified in 4.7.3. Resistors shall be examined for evidence of mechanical damage.

4.7.20 Fungus (see 3.26). Resistors shall be tested in accordance with method 508 of MIL-STD-810.

4.7.21 Aqueous-extract-conductivity test procedure (see 3.5.1).

4.7.21.1 Outline of method. The sample is extracted with hot water. The conductivity of electrolytic surface contaminants is measured with a conductivity bridge or resistance indicator and compared with a deionized or distilled-water blank.

4.7.21.2 Apparatus.

4.7.21.2.1 Conductivity bridge. A conductivity bridge or resistance indicator which shall be capable of measuring resistance up to at least 2 megohms. Within the range of 0.3 to 1 megohm inclusive, the accuracy of adjustment shall be within 5 percent.

4.7.21.2.2 Constant-temperature bath. A water bath maintained at 25°C ±0.5°C. If the conductivity bridge as described in 4.7.21.2.1 is capable of automatic temperature compensation to within ±0.5°C, the water bath tempeature shall be 25°C ±0.5°C.

4.7.21.2.3 Beakers. Two acid and alkali-resistant glass, 125-milliliter (ml), tall-form beakers or any beakers of such dimensions that when the dip-type cell is immersed in 100 ml of liquid contained therein, the electrodes are fully covered.

4.7.21.2.4 Thermometer. A thermometer having a range of -5°C to +50°C inclusive, graduated in 0.1°C intervals (for constant-temperature bath). Accuracy of thermometer shall be equal to or better than one-half of the graduations.

4.7.21.2.5 Conductivity cell. Either a platinum or gold electrode dip cell may be used. The dip-type cell must be securely mounted and adequately protected so that their relative positions shall not be affected by handling or moderate jarring.

Platinum cells. The area of each electrode shall be not less than 2 square centimeters (cm^2). The cell shall be so constructed that the electrodes shall be completely immersed upon dipping the cell into the liquid medium. The cell constant shall be 0.1 reciprocal cm. The electrodes shall be platinized (in accordance with 4.7.21.2.7.1) if the measurements are made at low frequency (60 cycles). At a frequency of 1,000 cycles, this precaution is unnecessary.

4.7.21.2.5.1 Preparation and calibration of conductivity cell (not applicable to gold cells). If unplatinized, clean a new cell with warm chromic-acid solution, wash thoroughly with distilled water, and rinse with alcohol and ether. If the electrodes are already platinized, omit the chromic-acid wash. To platinize the electrodes, immerse the cell in a solution of 310 grams (g) of chloroplatinic acid and 0.010 g of lead acetate in 100 ml of distilled water. Electrolyze, using a current density of 30 mA per cm^2 for 8 minutes, reversing the current every 2 minutes. Wash the electrodes thoroughly with distilled water. To test for completeness of removal of electrolyte, immerse the cell in 50 ml of distilled water and measure the resistance initially and at the end of 10 minutes; if a decrease in resistance occurs, repeat the washing. Keep the cell immersed in distilled water when not in use. To determine the cell constant, place a beaker containing 0.01 molar potassium-chloride solution in the constant-temperature bath maintained at 25°C ±0.5°C. After thermal equilibrium is established, measure the resistance of this solution. The cell constant "K" may be calculated as follows:

Where: K = C x R per cm.

R = resistance in ohms.

C = conductivity of the potassium-chloride solution. (The value for C at 25°C is 1.41×10^{-3} ohms per cm.)

4.7.21.2.5.2 Calibration of gold conductivity cell (not applicable to platinum cells). Dip the conductivity cell into a 10 µmho per cm conductivity standard solution (potassium chloride type). Adjust calibration knob on the conductivity bridge to 10 µmho.

4.7.21.3 Reagents.

4.7.21.3.1 Reagent water. Either distilled or deionized water may be used. The water must meet type II reagent water in accordance with ASTM D1193 (minimum of 1 megohm - cm).

4.7.21.3.2 Potassium-chloride solution. Prepare a 0.01 molar solution with reagent-grade potassium chloride which has been dried for 2 hours at 100°C. After cooling, dissolve 0.7455 g of the dried salt in distilled water and make up to 1 liter in a volumetric flask at 20°C.

4.7.21.4 Procedure.

a. Place an unbroken sample or samples with a minimum surface area of 50 square inches in a suitable breaker or flask so that a maximum of 100 ml of boiling distilled or deionized water will completely cover the sample. Prepare a blank, using a like amount of distilled or deionized water in the equivalent beaker, and with both sample and blank proceed as follows: Heat the contents of the beaker to 90°C minimum for 5 ±0.5 minutes. Care should be taken in this operation so that the sample remains unbroken.

b. Place the beakers in a water bath as described in 4.7.21.2.2 at 25°C.

c. As soon as thermal equilibrium is established, place the dip-type cell in the extract solution, making certain that the electrodes are immersed to the depth specified (see 4.7.21.2.5a or 4.7.21.2.5b). Measure the resistance on the most sensitive scale of the bridge. Move the cell up and down in the solution several times and repeat the measurement until successive readings are constant. Before each measurement, rinse the cell throughly in distilled or deionized water and gently shake off any water on the surface. Correct the conductivity of the extract solution for the blank.

4.7.21.5 Report. The conductivity shall be reported in microsiemens per cm for a sample having a minimum of 50 square inches surface area.

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. These film resistors described herein are intended to be used in electronic circuits where semiprecision characteristics and small sizes are required.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

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 2.1).

c. Title, number and date of the applicable detail specification, and the complete type designation (see 3.1).

d. Marking requirement for failure rate level (see 3.27.4).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in QPL 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 proposed to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the QPL is the Defense Electronics Supply Center, Dayton, Ohio 45444 and information pertaining to qualification of products may be obtained from that activity. Application for qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6".

6.4 Resistance tolerance. Designers should bear in mind that operation of these resistors under the ambient conditions for which military equipment is designed, may cause permanent or temporary changes in resistance sufficient to throw them out of their initial tolerance. In particular, operation at extreme temperatures may cause relatively large temporary changes in resistance.

6.5 Maximum voltage. The maximum continuous working voltage specified for each of the styles (see 3.1) should in no case be exceeded, regardless of the theoretically calculated rated voltage (see 3.7).

6.6 Derating. The intention of this specification is to cover resistors capable of full-load operation at any ambient temperature up to 70°C. However, if it is desired to operate these resistors at ambient temperatures greater than 70°C, the resistors should be derated in accordance with figure 4. The slope of the derating curve is estimated and is not completely substantiated by test data, therefore it should be used only as an application guide.

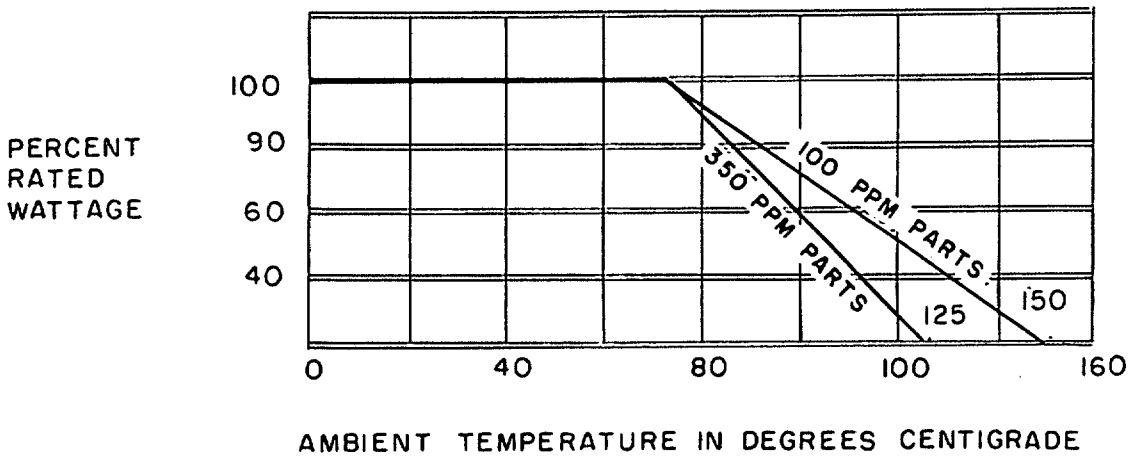


FIGURE 4. Derating curve for high ambient temperatures.

6.7 Shelf life. Resistors are not expected to change in resistance more than 0.2 (average) percent per year under normal storage conditions (25°C ±10°C with a relative humidity not exceeding 90 percent).

6.8 Flammability. It should be noted that this specification contains no requirements concerning the flammability of the material used in the construction of the resistors. Users should take this into consideration when a particular application involves this requirement.

6.9 Supersession data. The styles of this specification supersede other styles in accordance with table XIV.

TABLE XIV. Styles.

Styles in MIL-R-39017E	Supersedes styles in MIL-R-39017C	Supersedes styles in MIL-R-38101	Supersedes styles in MIL-R-22684(USAF)
RLR07	39017/1 (RLR07)	38101/21	(RL07-TX)22684/5(USAF)
RLR20	39017/2 (RLR20)	38101/22	(RL20-TX)22684/6(USAF)
RLR32 1/	39017/3 (RLR32)	38101/23	(RL32-TX)22684/7(USAF)

1/ Failure rate level "M" is the equivalent level for supersession of the referenced MIL-R-22684(USAF) style.

6.9.1 Supersession data. Resistor style RL42--TX in accordance with MIL-R-22684/8 is a substitute for resistor style RLR42 in MIL-R-39017/4, which is inactive for new design.

6.9.2 Resistance (not for Navy use). Resistors specified with a 2 percent resistance tolerance by this specification supersede and are interchangeable with resistors of the same resistance value, tolerance, style, and performance characteristics specified in MIL-R-39017B as listed in table XV.

TABLE XV. Designation of resistance values.

Resistance designations		Resistance		
MIL-R-39017E	MIL-R-39017B			
10R0 to 91R0 incl.	100 to 910 incl.	10.0	to	91.0
1000 to 9100 incl.	101 to 911 incl.	100	to	910
1001 to 9101 incl.	102 to 912 incl.	1,000	to	9,100
1002 to 9102 incl.	103 to 913 incl.	10,000	to	91,000
1003 to 9103 incl.	104 to 914 incl.	0.1 megohm	to	.91 meghom
1004 to 9104 incl.	105 to 915 incl.	1.0 megohm	to	9.1 megohms

6.9.3 Resistance tolerance (not for Navy use). Resistance tolerance "G" (2.0 percent) supersedes and is a substitute for resistance tolerance "J" (5.0 percent).

6.9.4 Three digit resistance value. The three digit resistance designator that appeared in MIL-R-39017D is inactive for new design and has been removed from section 1 of this document.

6.10 Terminal supersession. Terminal type "C" of MIL-R-39017C supersedes terminal types "S" and "D" of MIL-R-39017. Type "C" also supersedes the weldable lead specified in MIL-R-22684/5(USAF) through MIL-R-22684/8(USAF).

6.11 Selection and use information. Equipment designers should refer to MIL-STD-199, "Resistors, Selection and Use of" for a selection of standard resistor types and values for new equipment design. All application and use information concerning these resistors is also provided in MIL-STD-199.

6.12 MIL-R-22684 substitution data. Resistors of this specification, regardless of their failure rate designation are substitutes for resistors of the same resistance value and tolerance specified in inactivated specification sheets of MIL-R-22684 as follows:

Substitute specification	Inactivated specification sheet
MIL-R-39017/1	MIL-R-22684/1
MIL-R-39017/2	MIL-R-22684/2
MIL-R-39017/3	MIL-R-22684/3
MIL-R-22684/8	MIL-R-39017/4

6.13 Subject term (key word) listing.

Axial leads

6.14 Changes from previous issue. Asterisks 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 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. The procedure for extending qualification 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 294 sample units, 98 of the lowest, 98 of the highest, and 98 of the critical or nearest to critical value (see table XVI), and in each style and characteristic and resistance tolerance for which qualification is sought, shall be submitted and subjected to the inspection of table VIII. If no critical value is specified, the samples will be equally divided between the highest and lowest resistance values. In addition, 10 or 20 sample units, as applicable, of any value or characteristic and 10 further sample units of any resistance value shall be submitted and subjected to the tests of groups II and X, respectively of table VIII. When qualification for both RLR32 and RLR42 is desired, the above sample size shall be divided equally between both styles.

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 VIII. Each submission shall be accompanied by the test data obtained from these tests. The performance of the destructive examinations 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 resistance element and the protective enclosure or coating. After qualification has been granted, no changes shall be made in materials, design, or construction without prior notification to the qualifying activity.

TABLE XVI. Critical resistance value for qualification inspection. 1/

Style	Critical resistance value 2/
	Megohms
RLR07	.240
RLR20	.240
RLR32	.240
RLR42	.120

1/ Maximum continuous working voltage shall be applied (see 3.1).

2/ The critical resistance value is the maximum standard resistance value which will dissipate full wattage when the maximum continuous working voltage is applied.

APPENDIX

40. EXTENT OF QUALIFICATION

40.1 Extension of qualification. The resistance range include in the qualification of any one style and tolerance shall be between any two adjacent-resistance values which pass the required qualification inspection. The extent of qualification between failure rate levels and resistance tolerances shall be as follows:

Failure rate level	Will qualify failure rate level
S	R, P, M
R	P, M
P	M
M	---

Tolerance	Will qualify tolerance
F	G, J, K
G	J, K
J	K
K	---

CONCLUDING MATERIAL

Custodians:
Army - ER
Navy - EC
Air Force - 85
NASA - NA

Review activities:
Army - AR, MI
Navy - AS, OS
Air Force - 17, 99
DLA - ES

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

Preparing activity:
Army - ER

Agent:
DLA - ES

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