

INCH-POUND

MIL-PRF-39009E  
15 December 2004  
SUPERSEDING  
MIL-PRF-39009D  
3 July 1997

## PERFORMANCE SPECIFICATION

RESISTORS, FIXED, WIRE WOUND,  
(POWER TYPE, CHASSIS MOUNTED),  
NONESTABLISHED RELIABILITY, ESTABLISHED RELIABILITY,  
GENERAL SPECIFICATION FOR

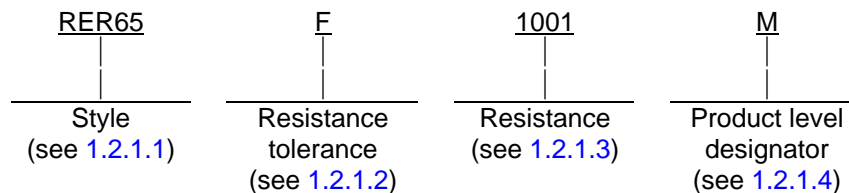
This specification is approved for all Departments  
and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers the general requirements for nonestablished reliability (non-ER), and established reliability (ER), power type, wire wound, fixed resistors which utilize the principal of heat dissipation through a metal mounting surface. These resistors have initial resistance tolerances of  $\pm 1$  percent. These resistors are suitable for continuous full load operation at an ambient temperature of  $+25^{\circ}\text{C}$ , and when derated up to  $+250^{\circ}\text{C}$  (see [figure 1](#)). These resistors should not be used in circuits where their ac performance is of critical importance in the operation of such circuits. However, provisions have been made in particular styles to minimize inductances (see [3.1](#)). These resistors will have life failure rate levels (FRL) ranging from 1.0 percent to 0.001 percent per 1,000 hours (see [1.2.1.4](#)). These FRL are established at a 60 percent confidence on the basis of the life tests. The FRL, identified by the appropriate symbol, is referred to operation at full rated wattage at  $+25^{\circ}\text{C}$ , with a permissible change in resistance of  $\pm 2$  percent as the criteria for failure.

1.2 Classification.

1.2.1 Part or Identifying Number (PIN). The PIN is in the following format, and as specified (see [3.1](#) and [6.5](#)).



Comments, suggestions, or questions on this document should be addressed to: US Army Communications - Electronics Command and Fort Monmouth, ATTN: AMSEL-LC-LEO-E-EP, Fort Monmouth, NJ 07703-5023, or emailed to [Jeffery.Carver@us.army.mil](mailto:Jeffery.Carver@us.army.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil>.

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1.2.1.1 Style. The style is to be identified by the three letter symbol "RER" followed by a two digit number; the letters identify ER, chassis mounted, power type, wire wound, fixed resistors, and the number identifies the sizes, and power rating of the resistors.

1.2.1.2 Resistance tolerance. The resistance tolerance is identified by a single letter in accordance with table I.

TABLE I. Resistance tolerance.

Symbol	Resistance tolerance percent ( $\pm$ )
F	1.0

1.2.1.3 Resistance. The nominal resistance is expressed in ohms and is identified by four digits; the first three digits represent significant figures and the last digit specifies the number of zeros to follow. When fractional values of an ohm, and values of less than 100 ohms are required, the letter "R" is substituted for one of the significant digits to represent the decimal point. When the letter "R" is used, succeeding digits become significant. The following are examples of symbols for resistance values:

R100 = 0.10 ohm  
 1R00 = 1.0 ohm  
 10R0 = 10.0 ohms  
 1000 = 100 ohms  
 1001 = 1,000 ohms  
 1002 = 10,000 ohms

Minimum and maximum resistance values are as specified (see 3.1). The standard resistance values for every decade follows the sequence demonstrated for 10 decade to 100 decade as specified in table II.

TABLE II. Standard resistance values for the 10 to 100 decade. 1/

F (1.0)					
10.00	14.70	21.50	31.60	46.40	68.10
10.20	15.00	22.10	32.40	47.50	69.80
10.50	15.40	22.60	33.20	48.70	71.50
10.70	15.80	23.20	34.00	49.90	73.20
11.00	16.20	23.70	34.80	51.10	75.00
11.30	16.50	24.30	35.70	52.30	76.80
11.50	16.90	24.90	36.50	53.60	78.70
11.80	17.40	25.50	37.40	54.90	80.60
12.10	17.80	26.10	38.30	56.20	82.50
12.40	18.20	26.70	39.20	57.60	84.50
12.70	18.70	27.40	40.20	59.00	86.60
13.00	19.10	28.00	41.20	60.40	88.70
13.30	19.60	28.70	42.20	61.90	90.90
13.70	20.00	29.40	43.20	63.40	93.10
14.00	20.50	30.10	44.20	64.90	95.30
14.30	21.00	30.90	45.30	66.50	97.60

1/ Resistors having resistance values not listed herein, or in any other decade, are considered as not conforming to the specification.

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1.2.1.4 Product level designator. The product level designators are specified in table III, by a single letter which identifies the product level for which the resistor is qualified (see 4.5).

TABLE III. Product level designators.

Product level designation	Product Level <u>1/</u>
C	Non-ER
M	1.0
P	0.1
R	0.01
S	0.001

1/ FR in percent/1,000 hours.

## 2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

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

## DEPARTMENT OF DEFENSE SPECIFICATIONS

- [MIL-PRF-39009/1](#) - Resistors, Fixed, Wire-wound (Power Type, Chassis Mounted), Nonestablished Reliability, and Established Reliability, Styles RER60, RER65, RER70, and RER75.
- [MIL-PRF-39009/2](#) - Resistors, Fixed, Wire-wound (Power Type, Chassis Mounted), Nonestablished Reliability, and Established Reliability, Styles RER40, RER45, RER50, and RER55.

## DEPARTMENT OF DEFENSE STANDARDS

- [MIL-STD-202](#) - Electronic and Electrical Component Parts, Test Methods for .
- [MIL-STD-690](#) - Failure Rate Sampling Plans and Procedures.
- [MIL-STD-790](#) - Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specifications.
- [MIL-STD-1285](#) - Marking of Electrical and Electronic Parts.

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

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2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

## ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

- [EIA-554-1](#) - Assessment of Outgoing Nonconforming Levels in Parts Per Million (ppm).
- [EIA-557](#) - Statistical Process Control Systems.

(Application for copies should be addressed to Electronic Industries Association (EI, 2500 Wilson Boulevard, Arlington, VA 22201-3834.)

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

## 3. REQUIREMENTS.

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. Resistors furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable [Qualified Products List](#) (QPL), before contract award (see [4.4](#) and [6.3](#)).

3.3 QPL system. The manufacturer shall establish and maintain a QPL system for parts covered by this specification. Requirements for this system are specified in [MIL-STD-790](#) (all product levels) and [MIL-STD-690](#) (ER parts only). The manufacturer shall also establish a Statistical Process Control (SPC), Part Per Million (PPM) and characterizing circuit reactance systems that meets the requirements as described in 3.3.1 and 3.3.2, respectively.

3.3.1 SPC system. As part of the overall [MIL-STD-790](#) QPL system, the manufacturer shall establish a SPC system that meets the requirements of [EIA-557](#). Typical manufacturing processes for application of SPC include dc resistance values, cap/lead attachment, trimming, encapsulation, and weld strength. In addition, the manufacturer shall demonstrate resistance temperature characteristic (RTC) control in the process.

3.3.2 PPM system. As part of the overall [MIL-STD-790](#) QPL system, the manufacturer shall establish a PPM system for assessing the average outgoing quality of lots in accordance with [EIA-554-1](#) and [4.6.4](#). Data exclusion, in accordance with [EIA-554-1](#), may be used with approval of the qualifying activity. The PPM system shall identify the PPM rate at the end of each month and shall be based on a six month moving average. PPM and dc resistance shall be assessed for each style. Style reporting may include both non-ER and ER style combinations.

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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 Interface and physical dimension. Resistors shall meet the interface and physical dimensions specified (see 3.1). Resistors shall be wound with a resistance wire (round or flat wound ribbon), except as required for noninductive performance of applicable styles (see 3.1). When applicable, in order to minimize inductance, resistors shall be wound by one of the following methods:

- a. Ayrton-Perry.
- b. Bifilar.
- c. Or an equivalent method.

3.5.1 Protective coating or enclosure. The resistance element and caps shall be protected by a coating or an enclosure which shall completely cover the exterior of the resistance element and caps. The enclosure shall be free from holes, fissures, chips, and other faults. Small cracks and molding flaws which do not adversely affect the unit's ability to meet all environmental requirements of this specification will not be considered a cause for rejection. The exposed end of the enclosure shall prevent the entrapment of moisture.

3.5.2 Housing. The housing shall protect against corrosion. All fasteners shall be plated. Unplated copper bearing metals shall not be used in contact with aluminum.

3.5.3 Terminals. Terminal shall be treated to facilitate soldering. When a coating tin is used, the tin content shall range between 40 percent and 70 percent. The terminals shall be firmly secured and shall not be solely dependent on the protective coating or enclosure for mechanical anchorage.

3.5.3.1 Tin plated finishes. Uses of tin plating are prohibited as a final finish, and as an undercoat (see 6.7). Use of tin-lead (Sn-Pb) finishes is acceptable provided that the minimum lead content is 3 percent.

3.5.4 Solder dip (retinning) of leads. The manufacturer (or their authorized category B or category C distributor) may solder dip/retin the leads of product supplied to this specification provided the solder dip process (see A.5 of the appendix) has been approved by the qualifying activity.

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

3.6 Voltage rating. Resistors shall have a rated dc continuous working voltage or an approximate sine-wave root-mean-square (rms) 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 = Continuous rated dc or rms working voltage in volts.

P = Rated wattage in watts (see 3.1).

R = Nominal resistance in ohms.

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3.7 Power rating. Resistors shall have a power rating based on continuous full load operation at an ambient temperature of +25°C (see 3.1). This power rating is dependent on the ability of resistors to meet the FR requirements specified in 3.19. For temperatures in excess of those specified above, the load shall be derated in accordance with figure 1.

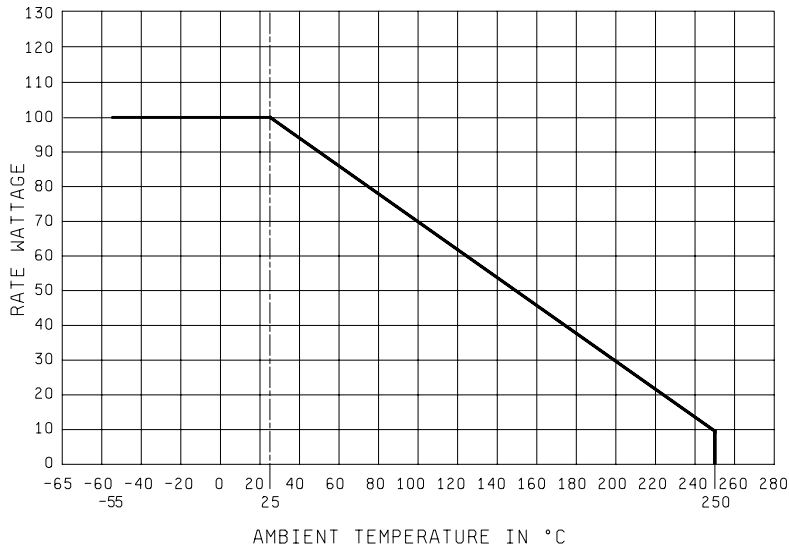


FIGURE 1. Derating curve for ambient temperatures.

3.8 Conditioning. When resistors are tested as specified in 4.8.2, there shall be no mechanical damage. The change in resistance shall not exceed  $\pm(0.2$  percent +0.01 ohm).

3.9 DC resistance. When resistors are tested as specified in 4.8.3, the dc resistance shall be within the specified tolerance of the nominal resistance (see 1.2.1.2 and 3.1).

3.10 Resistance temperature characteristic. When resistors are tested as specified in 4.8.4, the resistance temperature characteristic shall not exceed  $\pm 0.0030$  percent per °C (30 ppm) for resistance values of 20 ohms and higher and  $\pm 0.0050$  percent per °C (50 ppm) for resistance values from 1 ohm to 19.60 ohms and  $\pm 0.0100$  percent per °C (100 ppm) for resistance values below 1 ohm.

3.11 Dielectric withstanding voltage. When resistors are tested as specified in 4.8.5, there shall be no flashover, show any evidence of mechanical damage, arcing, or insulation breakdown; the change in resistance shall not exceed  $\pm(0.2$  percent +0.01 ohm) as applicable..

3.12 Insulation resistance. When resistors are tested as specified in 4.8.6, the insulation resistance shall not be less than 10,000 megohms.

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3.13 Low temperature operation. When resistors are tested as specified in 4.8.7, there shall be no evidence of mechanical damage which will result in degradation of performance. The change in resistance shall not exceed  $\pm(0.3$  percent  $+0.01$  ohm).

3.14 Short time overload. When resistors are tested as specified in 4.8.8, there shall be no evidence of mechanical damage; the change in resistance shall not exceed  $\pm(0.3$  percent  $+0.01$  ohm).

3.15 Moisture resistance. When resistors are tested as specified in 4.8.9, there shall be no evidence of breaking, cracking, loosening of terminals, or corrosion; the change in resistance shall not exceed  $\pm(0.5$  percent  $+0.01$  ohm). In addition, the insulation resistance shall not be less than 1,000 megohms.

3.16 Terminal strength. When resistors are tested as specified in 4.8.10, there shall be no evidence of mechanical damage. The change in resistance shall not exceed  $\pm(0.2$  percent  $+0.01$  ohm).

3.17 Shock (specified pulse). When resistors are tested as specified in 4.8.11, there shall be no evidence of mechanical or electrical damage; the change in resistance shall not exceed  $\pm(0.2$  percent  $+0.01$  ohm). There shall be no electrical discontinuity during the test. Resistors shall meet the dielectric withstanding voltage requirements specified in 3.11.

3.18 Vibration, high frequency. When resistors are tested as specified in 4.8.12, there shall be no evidence of mechanical damage; the change in resistance shall not exceed  $\pm(0.2$  percent  $+0.01$  ohm). There shall be no electrical discontinuity during the test. Resistors shall meet the dielectric withstanding voltage requirements specified in 3.11.

### 3.19 Life.

3.19.1 Qualification inspection. When resistors are tested as specified in 4.8.13, 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  $\pm(1.0$  percent  $+0.01$  ohm).

3.19.2 FR determination (extend FR test). When resistors are tested as specified in 4.8.13, there shall be no evidence of mechanical damage to the resistance element, coating, or enclosure. The change in resistance between the initial measurement shall not exceed  $\pm(2.0$  percent  $+0.01$  ohm). This single failure criteria shall be applicable to all measurements during the life test for purposes of determining FR level qualification and is applicable as a parallel requirement with 3.19.1 to the measurement made during the life tests specified for qualification inspection.

3.20 High temperature exposure. When resistors are tested as specified in 4.8.14, there shall be no evidence of mechanical damage and the change in resistance shall not exceed  $\pm(1.0$  percent  $+0.05$  ohm).

3.21 Solderability. When resistors are tested as specified 4.8.15, the flat portion of the terminal shall be considered as the solderable area, and meet the criteria for lug or tab terminal evaluation in the test method.

3.22 Low temperature storage. When resistors are tested as specified in 4.8.16, there shall be no evidence of mechanical damage. The change in resistance shall not exceed  $\pm(0.3$  percent  $+0.01$  ohm).

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3.23 Supplying to higher FR levels. A manufacturer may supply to all higher product levels than to which they are qualified. Parts qualified and marked to lower product levels are substitutable, with acquiring agency approval, for higher product level parts, and shall not be remarked unless specified in the contract or order (see table IV) (see 6.2).

TABLE IV. Product level substitution.

Product level	Product level substitute
S	
R	S
P	S, R
M	S, R, P
C	S, R, P, M

3.24 Marking. Resistors shall be marked with the PIN (see 1.2.1) and the JAN marking. Date and source codes shall be in accordance with MIL-STD-1285. The PIN shall be placed on the flat surface (top or sides) of the housing, parallel to the longitudinal axis. The marking must be visible after resistor is mounted. There shall be no space between the symbols which comprise the PIN. The PIN may appear on one flat, and the date code, and the manufacturer's name, trademark, or code symbol on the other. The date lot code shall provide traceability through all production operations and shall represent a specific critical point consistently provided by the manufacturer. Marking shall remain legible at the end of all tests. At the option of the manufacturer, the marking of resistors may be done after conditioning test (see 4.8.2).

3.24.1 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 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 part number 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 part number. Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein or in applicable specification 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 specification, the manufacturer shall remove completely the military part number and 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 drawing or specifications. The United States Government has obtained Certificate of Registration Number 504,860 for the certification mark "JAN" and Registration Number 1,586,261 for the certification mark "J".

3.24.2 Beryllium oxide (BeO). Manufacturers which use beryllium oxide in their construction shall mark each resistor body and resistor package with the symbol "BeO".



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3.25 Soldering. Where soldering is employed, only noncorrosive fluxes shall be used, unless it can be shown that corrosive elements have been satisfactorily removed after soldering. Solder shall not be used for obtaining mechanical strength. Electrical connections shall be mechanically secure before soldering and electrically continuous after soldering. Except for solder used to coat the terminals, the solder used shall in no case start to melt at a temperature less than +300°C.

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

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

#### 4. VERIFICATION

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

- a. Qualification inspection (see 4.4).
- b. Verification of qualification (see 4.5).
- c. Conformance inspection (see 4.6).
- d. Periodic group C inspection (see 4.7).

4.2 Reliability and quality.

4.2.1 QPL system. The manufacturer shall established and maintain a QPL system (see 3.3). Evidence of such compliance is a prerequisite for qualification and verification of qualification.

4.2.2 SPC. A SPC program shall be maintained in accordance with [EIA-557](#). Evidence of such compliance is a prerequisite for qualification and verification of qualification.

4.3 Inspection conditions and precautions.

4.3.1 Inspection 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. Precautions shall be also taken to prevent damage by heat when soldering resistor leads to terminals.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3).

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4.4.1 Samples. The number of samples units comprising a sample of resistors to be submitted for qualification inspection shall be as specified in the appendix to this specification. The samples shall be taken at random from a production run and shall be produced with equipment and procedures normally used in production.

4.4.2 Test routine. Sample units shall be subjected to the qualification inspection specified in [table V](#), in the order shown. All sample units shall be selected to the inspection of group I and group IA. The 252 sample units shall then be divided as specified in [table V](#) for group II to group V inclusive, and subjected to the inspection for their particular group. In addition, 10 sample units each shall be subjected to group VI.

4.4.3 Defectives. Defectives in excess of those allowed in [table V](#) shall be cause for refusal to grant qualification.

4.4.4 FR level and product level verification (ER only).

4.4.4.1 FR qualification. FR qualification shall be in accordance with the general and detail 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 of [table V](#) (see [4.4.2](#)). Entire life test sample shall continue on test to 10,000 hours as specified in [4.8.13](#), 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 unit hours from different resistance values within a style may be combined. Style combinations shall be as described for lot formation (see [4.6.2](#)).
- c. Procedure III: Maintenance of FR level qualification. Maintenance period B 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 [4.7](#), periodic group C inspection).

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TABLE V. Qualification inspection.

Inspection	Requirement paragraph	Method paragraph	Number of sample units <u>1/</u>		Defects allowed <u>2/</u>	
<u>Group I</u> <u>3/</u> Conditioning DC resistance	3.8 3.9	4.8.2 4.8.3	All sample units		N/A <u>4/</u>	
<u>Group IA</u> Visual and mechanical inspection <u>5/</u>	3.1, 3.3 thru 3.5.5 incl., and 3.24 thru 3.27 incl.	4.8.1	All sample units		0	
<u>Group II</u> Resistance temperature characteristic <u>6/</u> Low temperature storage Dielectric withstanding voltage <u>6/</u> Insulation resistance Low temperature operation Short time overload <u>6/</u> Moisture resistance Terminal strength	3.10 3.22 3.11 3.12 3.13 3.14 3.15 3.16	4.8.4 4.8.16 4.8.5 4.8.6 4.8.7 4.8.8 4.8.9 4.8.10	24	12 highest value 12 1-ohm or lowest value, whichever is higher	1	
<u>Group III</u> Shock, (specified pulse) Vibration, high frequency	3.17 3.18	4.8.11 4.8.12	24	12 highest value 12 1-ohm or lowest value, whichever is higher	1	
<u>Group IV</u> Life	3.19	4.8.13	102	34 highest value 34 1,000-ohm 34 1-ohm or lowest value whichever is greater	1	
<u>Group V</u> High temperature exposure	3.20	4.8.14	27 each style submitted	9 highest 9 1,000-ohm 9 1-ohm	102 minimum sample size	1
<u>Group VI</u> Solderability <u>7/</u>	3.21	4.8.15	10 both leads, any value		0	

1/ See [appendix A](#) for details.

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

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

4/ All units shall meet group I requirements before being subjected to subsequent qualification test groups.

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

6/ Nondestructive tests.

7/ Sample shall not be subjected to group I and group IA.

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4.5 Verification of qualification. Every 6 months, the manufacturer shall provide verification of qualification to the qualifying activity. Continued qualification is based on meeting the following requirements.

- a. [MIL-STD-790](#) program.
- b. Design of resistor has not been modified.
- c. Lot rejection for group A (subgroup 1 and subgroup 4) does not exceed 5 percent or one lot, whichever is greater.
- d. Lot rejection for group B inspection does not exceed 5 percent or one lot, whichever is greater.
- e. Periodic group C inspection.
- f. FR levels.
- g. PPM assessment (NOTE: Grouping of style is permitted).
- h. Continued qualification to non-ER level (C) shall be based on continued maintenance of qualification for the ER part (minimum P FR level maintained).

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery.

4.6.1.1 Non-ER resistors. The manufacturer's inspection system shall be used for preparation for delivery.

4.6.1.2 ER resistors. Inspection of product for delivery shall consist of group A and group B inspections. Group B inspection for delivery is not required when the qualifying activity has allowed group B testing to be preformed annually (see [table IX](#)).

4.6.2 Inspection and production lot.

4.6.2.1 Inspection lot. An inspection lot, as far as practical, shall consist of all the resistors of the same style, characteristic, protective enclosure or coating, and manufacturer under essentially the same process and conditions during a manufacturing period of 1 month maximum. For purposes of lot formation all terminal types may be included in the same lot; however, all lead types which are combined shall have the same method of terminal attachment. All leads in the lot shall be represented in a similar proportion by samples selected for inspection. Non-ER and ER lots shall be kept separate.

4.6.2.2 Production lot. A production lot shall consist of resistors of the same style, nominal resistance value, resistance tolerance, resistance temperature characteristic, and terminal 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 cycle. Non-ER and ER lots shall be kept separate.

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4.6.3 Group A inspection.

4.6.3.1 Non-ER resistors. The manufacturer shall establish and maintain an inspection system to verify that resistors meet dc resistance, visual/mechanical, and solderability requirements. In-line or process control may be part of such system. The inspection system shall also include criteria for lot rejection and corrective actions. The inspection system shall be verified under the overall MIL-STD-790 QPL system. NOTE: Since the non-ER (C level) is the ER design without the mandatory conformance inspection and FR level assessment, this product is still expected to meet the environmental qualification type requirements such as moisture resistance, shock, and vibration.

4.6.3.2 ER resistors. Group A inspection shall consist of the inspections specified in table VI, in the order shown.

TABLE VI. Group A inspection (ER only).

Inspection	Requirement paragraph	Test method paragraph	Sampling procedure
<u>Subgroup 1</u> <u>1/</u>			
Conditioning	3.8	4.8.2	100 percent inspection
DC resistance <u>2/</u>	3.9	4.8.3	
<u>Subgroup 2</u>			
Visual examination			See 4.6.3.2.3
Material	3.4		
Interface and physical dimension	3.5		
Marking <u>3/</u>	3.24	4.8.1	
Soldering	3.25		
Workmanship	3.27		
<u>Subgroup 3</u>			
Solderability <u>4/</u>	3.21	4.8.15	See 4.6.3.2.4

- 1/ At the manufacturer's option, the determination of resistance change may be by any method which is within the accuracy requirements of this specification.
- 2/ Resistors shall meet the specified initial resistance tolerance after being subjected to the preceding test.
- 3/ With the approval of the qualifying activity radiographic inspection can be conducted during production anytime after complete enclosure of the element.
- 4/ The manufacturer may request the deletion of the subgroup 3 solderability test, provided an in-line or process control system for assessing and assuring the solderability of leads can be validated and approved by the qualifying activity. Deletion of the test does not relieve the manufacturer from meeting this test requirement in case of dispute. If the design, material, construction, or processing of the part is changed or if there are any quality problems, the qualifying activity may require resumption of the test.

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4.6.3.2.1 Subgroup 1. Subgroup 1 tests shall be performed on a production lot basis of 100 percent of the lot. Resistors that are out of resistance tolerance, or which experience a change in resistance greater than that permitted, shall be removed from the lot and not supplied to this specification. Only lots having not more than 5 percent rejects or one resistor, whichever is greater due to exceeding the specified resistance change limit, shall be furnished on contracts.

4.6.3.2.2 Manufacturer's production inspection. If the manufacturer performs tests similar to those specified in group A, subgroup 1, as the final step of his manufacturing process, the subgroup 1 tests may be eliminated when approved by the qualifying activity. The following criteria must be complied with:

- a. The production test is identical or more stringent than the subgroup 1 tests.
- b. 100 percent of the product supplied to these tests.
- c. Failure criteria are identical or more stringent than the subgroup 1 tests.
- d. Lot rejection criteria are identical or more stringent than the subgroup 1 tests.
- e. Once approved, future changes require approval from the qualifying activity.

4.6.3.2.3 Subgroup 2 tests. The subgroup 2 tests shall be performed on an inspection lot basis for ER parts. A random sample of resistors shall be selected in accordance with table VII. In the event of one or more failures, the lot is rejected. The rejected lot may be rescreened and the defects removed and resubmitted to the table VII sample plan. If one or more defects are found in this second sample, the lot is rejected and shall not be supplied to this specification. (NOTE: This corrective action applies to the original quality defect found. If another defect type is found in the second sample, a rescreen for that defect is also permitted).

TABLE VII. Sampling plan for PPM categories.

Lot size	Sample size subgroup 2	Sample size PPM
1 - 13	100%	100%
14 - 125	13	100%
126 - 150	13	125
151 - 280	20	125
281 - 500	29	125
501 - 1,200	34	125
1,201 - 3,200	42	125
3,201 - 10,000	50	125
10,001 - 35,000	60	294
35,001 - 150,000	74	294
150,001 - 500,000	90	345
500,001 and over	102	435

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4.6.3.2.4 Subgroup 3 (solderability). The subgroup 3 test shall be performed on an inspection lot basis for ER parts. A sample shall be selected from each lot in accordance with table VIII. As an option, the manufacturer may use electrical rejects from the subgroup 1 tests for all or part of the sample. If there are one or more defects, the lot is rejected. The manufacturer may use one of the following options for corrective action:

- a. Each production lot that was used to form the failed inspection lot shall be individually submitted to the solderability test. Production lots that pass are available for shipment. Production lots that fail can be submitted to the solder dip procedure of 4.6.3.2.4b.

TABLE VIII. Solderability sample plan.

Lot size	Sample size
1 to 3,200	5
3,201 to 10,000	8
10,001 to 35,000	13
35,001 and over	20

- b. The failed lot is submitted to a 100 percent hot solder dip using an approved solder dip process in accordance with 3.5.4. A subsequent solderability test shall then be performed. If the lot passes, it is available for shipment; if the lot fails, the manufacturer may perform the hot solder dip one additional time. If the lot fails to pass, the lot is considered rejected and shall not be supplied to this specification.

4.6.3.2.4.1 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.

4.6.4 PPM assessment (non-ER and ER). The manufacturer shall establish and maintain a system for assessing the average outgoing quality in PPM of lots supplied to this specification. This PPM assessment should be based on inspections performed on each inspection lot to verify that resistors meet dc resistance and tolerance requirements. For ER resistors, this inspection shall occur after the group A, subgroup 1, 100 percent screens have been completed.

4.6.4.1 Sampling plan. Minimum sample sizes for inspection lots shall be selected in accordance with table VII. For non-ER resistors, the sampling system and plan used for the group A inspection (see 4.6.3.1) may be the basis for assessing PPM.

4.6.4.2 Rejected lots. Any rejected lot shall be segregated from new lots and those lots which have passed the PPM assessment. A rejected lot may be rescreened for the quality characteristic found defective in the sample and any defects removed. A new second sample shall be randomly selected. If one or more defects are found, this lot is rejected and shall not be supplied to the specification.

4.6.4.3 PPM calculations. PPM calculations shall be based on the accumulated results of the initial sample. Calculations and exclusions shall be in accordance with EIA-554-1. (NOTE: PPM calculations shall not be based on the second sample submission for a rejected lot as described in 4.6.4.2).

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4.6.5 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table IX, in the order shown. ER parts shall be performed on inspection lots, that have been subjected to and have passed group A inspection. Sample units selected shall be of the highest resistance value in the lot.

TABLE IX. Group B inspection (ER only).

Inspection	Requirement paragraph	Test method paragraph	Sample size
<u>Subgroup 1</u> <u>1/</u> Visual and mechanical examination (when applicable)	3.1 and 3.24	4.8.1	13
<u>Subgroup 2</u> <u>2/</u> Resistance temperature characteristic	3.10	4.8.4	13 (highest value)

- 1/ Only applicable when marking inspection is not performed in group A inspection. No defects shall be permitted. Marking shall remain legible at the end of all tests.
- 2/ If the manufacturer can demonstrate that this test has been performed five consecutive times with zero failures, the frequency of this test, with the approval of the qualifying activity, can be performed on an annual basis. If the design, material, construction or processing of the part is changed, or if there are any quality problems or failures, the qualifying activity may require resumption of the original test frequency.

4.6.5.1 Sampling plan (ER only). All qualified styles may be grouped together in a single sample. This can be accomplished by proportion based on manufacturing percentages by style, equally divided by style, or by establishing an alternating style sequence. In order to incorporate a style sampling grouping, a written description must be presented and approved by the qualifying activity. This plan must assure that the grouping only combines styles of the same basic design, encapsulation material, and the same element type. Style grouping is not permitted in cases where group B inspection is being performed on an annual basis.

4.6.5.2 Subgroup 1. A sample of 13 parts shall be randomly selected. If one or more defects are found, the lot shall be rescreened and defects removed. A new sample of 13 parts shall be randomly selected. If one or more defects are found in this second sample, the inspection lot shall be rejected and shall not be supplied to this specification.

4.6.5.3 Subgroup 2. A sample of 13 parts (highest value) shall be randomly selected. If one or more defects are found, the lot shall be rescreened and defects removed. A new sample of 13 parts (highest value) shall be randomly selected. If one or more defects are found in this second sample, the inspection lot shall be rejected and shall not be supplied to this specification.

4.6.5.4 Disposition of sample units. Sample units which have been subjected to group B, subgroup 1 and subgroup 2 inspections may be delivered on the acquisition document provided they are within resistance tolerance and meet requirements of group B inspection.



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4.7 Periodic Group C inspection (ER only). Periodic inspection shall consist of group C inspection tests specified in [table X](#), in the order shown. They shall be performed on sample units selected from lots that have passed group A and group B inspection. Except where the results of these inspections show noncompliance with the applicable requirements (see [4.7.6](#)), delivery of products which have passed group A and group B inspections shall not be delayed pending the results of these periodic inspections.

4.7.1 Sampling plan. If more than 1,000 resistors of any style or style grouping are produced over the maintenance period, the group C tests shall be performed as specified. If the production rate is less than 1,000 resistors for any style or style grouping over the maintenance period then the monthly, quarterly or semi-annual group C inspection may be postponed until at least 1,000 resistors of that style or style grouping are produced (except for the monthly life test). In any case, the monthly tests shall be performed at least once every 3 months. The quarterly tests shall be performed at least every 6 months and the semi-annual tests shall be performed at least once every year. This requirement is waived if the manufacturer has obtained a reduced inspection status through the qualifying activity.

All qualified styles may be grouped together in a single sample. This can be accomplished by proportion based on manufacturing percentages by style, equally divided by style, or by establishing an alternating style sequence. In order to incorporate a style sampling grouping, a written description must be presented and approved by the qualifying activity. This plan must assure that the grouping only combines styles of the same basic design, encapsulation material, and the same element type.

4.7.2 Monthly.

4.7.2.1 Monthly (subgroup 1). A minimum of five samples shall be selected from each inspection lot and placed on extended life test of [4.8.13](#) once a month for the full 10,000-hour life test. A sufficient number of samples shall be selected from each lot by the manufacturer so that the maintenance of the FR requirements is complied within specified maintenance period. As far as practicable, the manufacturer shall select the resistance values so that the full range of all resistance decades produced during the maintenance period is represented. The accumulated data shall be used for maintenance or extension of FR qualification (see [3.19.2](#)).

4.7.2.2 Monthly (subgroup 2 and subgroup 3). Each month the specified number of sample units shall be subjected to the inspections of [table X](#).

4.7.3 Quarterly. Sample units and tests shall be as specified in [table X](#).

4.7.4 Annual. Sample units and test shall be as specified in [table X](#).

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

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TABLE X. Group C inspection (ER only).

Inspection	Requirement paragraph	Test method paragraph	Number of samples	Number of defects allowed
<u>Monthly</u>				
<u>Subgroup 1</u>				
Life	3.19	4.8.13	See 4.7.2.1	See 4.7.2.1
<u>Monthly</u>				
<u>Subgroup 2</u>				
Moisture resistance	3.15	4.8.9	18 (highest value)	1
<u>Monthly 1/</u>				
<u>Subgroup 3</u>				
Dielectric withstanding voltage	3.11	4.8.5	18 (highest value)	1
Insulation resistance	3.12	4.8.6		
Low temperature operation	3.13	4.8.7		
Low temperature storage	3.22	4.8.16		
Terminal strength	3.16	4.8.10		
<u>Quarterly 1/</u>				
Short time overload	3.14	4.8.8	18 (highest value)	1
Shock (specified pulse)	3.17	4.8.11		
Vibration, high frequency	3.18	4.8.12		
<u>Annual</u>				
High temperature exposure	3.20	4.8.14	27 each style 102 minimum sample size	1

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

4.7.6 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 products which can be corrected, and which are considered subject to the same failure. For ER acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity, has been taken. For C level parts, stop shipment may not be necessary depending on the nature of the failure. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed, at the option of the qualifying activity). Group A and group B inspection may be reinstated; however, final acceptance and shipment shall be withheld until the group C inspection has shown that the corrective action was successful.

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4.8 Methods of inspections.

4.8.1 Visual and mechanical inspection. Resistors shall be inspected to verify that the materials, design, construction, physical dimensions, and workmanship are in accordance with the acceptable requirements (see 3.1, 3.4 to 3.5.5 inclusive, and 3.24 to 3.27 inclusive).

4.8.2 Conditioning (see 3.8). Resistors shall be conditioned in accordance with [method 108](#) of [MIL-STD-202](#). The following details and exceptions shall apply:

- a. Method of mounting: Supported by their terminal leads (resistor not mounted on life test chassis). Resistors shall be so arranged that the temperature of any one resistor shall not appreciably influence the temperature of any other resistor. There shall be no undue draft on the resistors.
- b. Test temperature and tolerance: +25°C, +15°C, -0°C.
- c. Initial measurements: Initial resistance shall be measured as specified in 4.8.3 at +25°C +15°C, -0°C. This initial measurement shall be used as the reference for all subsequent measurements.
- d. Operating conditions: Rated dc continuous working voltage or rated working voltage from an alternating current (ac) power supply at commercial line frequency and waveform, shall be applied intermittently, 1 hour 30 minutes on and 30 minutes hour off for 96 hours +48 hours, -0 hours. Each resistor shall dissipate a wattage equal of the power rating (free air) of the resistor. (See 3.1)
- e. Measurement after condition: Resistance shall be measured at the end of 96 hours +48 hours, -0 hours as specified in 4.8.3 after load has been removed and the resistors stabilized.
- f. Examination after conditioning: Resistors shall be examined for evidence of mechanical damage.

4.8.3 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: Different types of measuring test equipment (multimeters, bridges, or equivalent) are permitted to be used on the initial and final readings of this test, provided the equipment is the same style, model, or if it can be shown that the performance of the equipment is equivalent or better.
- b. The same measuring apparatus shall be used for any one test, but not necessarily for all tests.
- c. Test voltage: Measurements of resistance shall be made using a dc potential resulting in not more than 1 percent of rated wattage. This same voltage shall be used whenever a subsequent resistance measurement is made.
- d. Measurement energy for electronic test equipment: The measurement energy applied to the unit under test shall not exceed 10 percent of the 25°C rated wattage times 1 second.

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4.8.4 Resistance temperature characteristic (see 3.10).

4.8.4.1 Qualification inspection. Resistors shall be tested in accordance with [method 304](#) of [MIL-STD-202](#). The following details and exceptions shall apply:

- a. Test temperature: As specified in table XI.
- b. Measurement at the end of each period: Resistance shall be measured as specified in [4.8.3](#) at the temperature maintain during the period.

4.8.4.2 Conformance inspection. Resistors shall be tested as specified in 4.8.4.1, except that sequences 1, 2, 3, and 6 of table XI shall be performed only, in that order.

TABLE XI. Resistance temperature characteristic.

Sequence <u>1/</u>	Test ambient Temperature in <u>2/</u>
	$^{\circ}\text{C} \pm 3^{\circ}\text{C}$
1	<u>3/</u> 25
2	-55
3	<u>4/</u> 25
4	125
5	200
6	250

1/ Sequence 3 through 6 can, at the option of the test facility, be performed prior to sequences 1 and 2.

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

1.  $25 \pm 3^{\circ}\text{C}$ .
2.  $+250 \pm 3^{\circ}\text{C}$ .
3.  $25 \pm 3^{\circ}\text{C}$ .
4.  $-55 \pm 3^{\circ}\text{C}$ .

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

4/ This temperature shall be considered the reference temperature for those in sequences 4 to 6 inclusive.

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4.8.5 Dielectric withstanding voltage (3.11).

4.8.5.1 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 mounted firmly on a metal plate by means of the normal mounting hardware. The plate shall be of sufficient size to extend beyond the resistor extremities.
- b. Magnitude of test voltage: As specified (see [3.1](#)).
- c. Nature of potential: An ac supply at commercial line frequency and waveform.
- d. Points of application of test voltage: Between the resistor terminals tied together and mounting plate, making certain that there is good electrical contact between the metal of the mounting tab, if any, and mounting
- e. Measurement and examination: DC resistance shall be measured before the test as specified in [4.8.3](#). At the conclusion of the test, resistors shall be examined for evidence of flashover, mechanical damage, arcing, and insulation breakdown.

4.8.5.2 Barometric pressure. Following the test specified in [4.8.5.1](#), resistors shall be tested in accordance with [method 105](#) of [MIL-STD-202](#). The following details shall apply:

- a. Method of mounting: As specified in [4.8.5.1a](#).
- b. Test condition: C.
- c. Magnitude of test voltage: As specified in [3.1](#).
- d. Nature of potential: As specified in [4.8.5.1c](#).
- e. Points of application of test voltage: As specified in [4.8.5.1d](#).
- f. Measurement and examination: DC resistance shall be measured before the test as specified in [4.8.3](#). At the conclusion of the test, resistors shall be examined for evidence of flashover, mechanical damage, arcing, and insulation breakdown.

4.8.6 Insulation resistance (see [3.12](#)). Resistors shall be tested in accordance with [method 302](#) of [MIL-STD-202](#). The following details shall apply:

- a. Test condition A.
- b. Special preparation: As specified in [4.8.5.1a](#).
- c. Points of measurement: As specified in [4.8.5.1e](#).

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4.8.7 Low temperature operation (see 3.13). Resistors shall be mounted as specified in 4.8.13a. Following a measurement of resistance (4.8.3), rated voltage from an ac supply at commercial-line frequency and waveform (see 3.6) shall be applied until thermal stability has been reached. The potential shall be removed, and within 8 seconds to 12 seconds, the resistors shall be subjected to an air temperature of -55°C, +0°C, -5°C for a period of not less than 15 minutes or more than 30 minutes. Resistance (see 4.8.3) shall again be measured not less than 2 hours after final exposure. Resistors shall then be examined for evidence of mechanical damage.

4.8.8 Short time overload (see 3.14). Resistors shall be mounted as specified in 4.8.13a. One of the resistor terminals shall be grounded to the resistor housing during the test. Following a measurement of resistance (see 4.8.3), a test potential from an ac supply at commercial line frequency and waveform which will result in five times the rated wattage (see 3.1), but not to exceed the specified voltage used for dielectric withstanding voltage test (atmospheric pressure) (see 3.1), shall be applied to the resistors for 5 seconds. Resistance (see 4.8.3) shall be measured after the resistors have stabilized at room temperature. Resistors shall then be examined for evidence of arcing, burning, and charring.

4.8.9 Moisture resistance (see 3.15). Resistors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

- a. Mounting: Resistors under load shall be mounted as specified in 4.8.13a. Resistors under polarization shall be mounted as specified in 4.8.5.1a.
- b. Initial measurements: Resistors shall be measured as specified in 4.8.3.
- c. Load and Polarization: One-half of the resistors shall be subjected to load and the remaining half to polarization.
  - (1) Load: During the first 2 hours of step 1 and step 4, the rated dc continuous working voltage (see 3.6), derated in accordance with figure 1 to the temperature attained at the end of the two hour period, shall be applied to the resistors. The negative terminals shall be electrically grounded to the mounting surface.
  - (2) Polarization: During steps 1 to 6 inclusive, a 100 volt dc potential shall be applied with the positive lead connected to the resistor terminals tied together, and the negative lead connected to the mounting plate.
- d. Final measurements and examination: At the end of the final cycle, the resistors shall be removed from the chamber, conditioned at room ambient conditions, and the dc resistance and insulation resistance shall be measured as specified in 4.8.3 and 4.8.6, respectively, within 8 hours of removal from the chamber. The resistors shall not be wiped or forced air dried prior to these measurements. Resistors shall then be examined for evidence of breaking, cracking, loosening of terminals, and corrosion. (The subsequent 4 hour to 24 hour conditioning period and measurements do not apply).
- e. Step 7b: Vibration subcycle, step 7b is not required to be performed.

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4.8.10 Terminal strength (see 3.16). Tests shall be in accordance with [method 211](#) of [MIL-STD-202](#) with the following exceptions:

- a. Test condition A (Pull test). Applied force: As specified (see [3.1](#)). Resistor body firmly clamped and pull applied to hole of each terminal for at least 30 seconds, one terminal at a time, in a direction away from resistor and parallel to the longitudinal axis.
- b. Measurement before and after test: DC resistance as specified in [4.8.3](#).
- c. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.8.11 Shock (specified pulse) (see 3.17). Resistors shall be tested in accordance with [method 213](#) of [MIL-STD-202](#). The following details shall apply:

- a. Special mounting means: Resistors shall be mounted by their normal mounting means on a vibration test jig. The jig shall be constructed as to preclude any resonances within the test range. Resistors shall be vibrated so that 12 cycles are performed in each of three mutually perpendicular directions (total of 36 times).
- b. Test condition I.
- c. Measurement before shock: DC resistance shall be measured as specified in [4.8.3](#).
- d. 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 discontinuity having a duration of 0.1 millisecond as well as those of greater duration.
- e. Measurement, examination, and test after shock: DC resistance shall be measured as specified in [4.8.3](#). Resistors shall be examined for evidence of mechanical damage. Resistors shall then be subjected to the dielectric withstanding voltage test (at atmospheric pressure) as specified in [4.8.5.1](#).

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

- a. Mounting specimens: Resistors shall be mounted by their normal mounting means on a vibration test jig. The jig shall be constructed as to preclude any resonances within the test range. 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. Test condition: D (0.06 inch (1.5 mm) double amplitude or 20G).
- c. Measurement during vibration: DC resistance shall be measured as specified in [4.8.3](#).
- d. Measurement during vibration: Each resistor shall be monitored to determine electrical discontinuity having a duration of 0.1 millisecond as well as those of greater duration.
- e. Measurement, examination, and test after vibration: DC resistance shall be measured as specified in [4.8.3](#). Resistors shall be examined for evidence of mechanical damage. Resistors shall then be subjected to the dielectric withstanding voltage test (at atmospheric pressure) as specified in [4.8.5.1](#).

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4.8.13 Life (see 3.19). 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, on an aluminum chassis of the dimensions specified (see [3.1](#)), with the longitudinal axis of the chassis. The chassis shall be horizontally supported by a material having low thermal conductivity. The method of attaching the resistor leads to the terminals shall be at the option of the manufacturer. The integrity of the terminations shall be determined at each measurement interval. The voltage applied to any resistor shall not be less than 95 percent of the dc, ac line or true rms rate continuous working voltage. Resistors shall be arranged so that the temperature of any one resistor shall not appreciably influence the temperature of any other resistor. There shall be no circulation of air over the resistors other than that caused by the heat of the resistors.
- b. Test temperature:  $+25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ .
- c. Initial measurements: Initial resistance shall be measured after mounting at  $+25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ . This initial measurement shall be used as the reference temperature for all measurements.
- d. Operating conditions: Resistors shall be operated at full rated wattage (chassis mounted) by applying dc continuous working voltage, or ac rated continuous working voltage, from an ac supply at commercial line frequency and waveform, intermittently, 1 hour and 30 minutes "on" and 30 minutes "off" for the applicable number of hours. "On time" shall be 75 percent of the total elapsed time. The actual test time shall be recorded.
- e. Test condition: 2,000 hours for qualification inspection with all samples continued on test to 10,000 hours. Ten thousand hours for FR level determination.
- f. Measurements during test:
  - (1) Qualification inspection: Resistance (see [4.8.3](#)) shall be measured at the end of the 30 minutes "off" periods after 250 hours +72 hours, -24 hours, 500 hours +72 hours, -24 hours, 1,000 hours +72 hours, -24 hours, and 2,000 hours +96 hours, -24 hours have elapsed. Units continued on test shall be measured at intervals above 2,000 hours +96 hours, -24 hours in accordance with 4.8.13f(2).
  - (2) Extended life testing: Resistance (see [4.8.3](#)) shall be measured at the end of the 30 minutes "off" periods after 250 hours +72 hours, -24 hours, 500 hours +72 hours, -24 hours, 1,000 hours +72 hours, -24 hours, 2,000 hours +96 hours, -24 hours and every 2,000 hours +96 hours, -24 hours thereafter, until the required extended life period (10,000 hours +120 hours, -0 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 working days.



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4.8.14 High temperature exposure (see [3.20](#)).

- a. Mounting: No special mounting required.
- b. Initial measurement: DC resistance shall be measured as specified in [4.8.3](#) at room ambient conditions.
- c. Procedure: Following initial resistance measurements, resistors shall be placed in a chamber maintained at  $+250^{\circ}\text{C} \pm 7^{\circ}\text{C}$  for a period of 2,000 hours +72 hours, -24 hours with no load applied.
- d. Measurement during test: 250 hours +48 hours, -0 hours.
- e. Final measurements: After removal from the test chamber, resistors shall be permitted to stabilize at room ambient temperature and within 6 hours after removal, cleaning of the leads will be allowed and the dc resistance shall be measured as specified in [4.8.3](#). Resistors shall be examined for evidence of mechanical damage.

4.8.15 Solderability (see [3.21](#)). Resistors shall be tested in accordance with [method 208](#) of [MIL-STD-202](#). The following details shall apply:

- a. Both leads shall be tested (spade portion only).
- b. Terminals shall be immersed to a depth sufficient to cover test wire and flatted portion of the terminal.

4.8.16 Low temperature storage (see [3.22](#)).

4.8.16.1 Mounting. 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 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. One chamber may be used for this test.

4.8.16.2 Procedure. DC resistance shall be measured as specified in [4.8.3](#). Within 1 hour after this measurement, the resistors shall be placed in a cold chamber at a temperature of  $-55^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for a period of 24 hours  $\pm 4$  hours. The resistors shall then be removed from the chamber and maintained at a temperature of  $+25^{\circ}\text{C} \pm 5^{\circ}\text{C}$  for a period of approximately 2 hours to 8 hours; the dc resistance shall again be measured as specified in [4.8.3](#). Resistors shall then be examined for evidence of mechanical damage.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see [6.2](#)). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

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## 6. NOTES

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

6.1 Intended use. Resistors described herein are intended to be used to utilize the principal of heat dissipation through a metal mounting surface. Resistors should not be used in circuits where their ac performance is of critical importance in the operation of such circuits.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification, the applicable associated specification, and the complete PIN (see [1.2.1](#)).
- b. If not otherwise specified (see [2.1](#)), the versions of the individual documents referenced will be those in effect on the date of release of the solicitation.
- c. Packaging requirements (see [5.1](#)).
- d. Allowable substitution (see [3.23](#)).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in [Qualified Products List](#) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the US Army Communications-Electronics Command, ATTN: AMSEL-LC-LEO-E-EP , Fort Monmouth, NJ 07703-5023, however, information pertaining to qualification of products may be obtained from the Defense Supply Center, Columbus (DSCC-VQP), Post Office Box 3990, Columbus, Ohio 43218-3990.

6.4 Selection and use information. Equipment designers should refer to [MIL-HDBK-199](#), "Resistors, Selection and Use of", for a selection of standard resistor types and values for any new equipment design. All applications and use information concerning these resistors are provided in [MIL-HDBK-199](#).

6.5 MIL-PRF-18546 substitution data. Resistors of this specification, regardless of their FR designation, are substitutes for resistors of the same resistance value as follows:

<u>Substitution specification</u>	<u>Inactivated specification and characteristic</u>
<a href="#">MIL-PRF-39009/1</a>	<a href="#">MIL-R-18546/1</a> characteristic G
<a href="#">MIL-PRF-39009/2</a>	<a href="#">MIL-R-18546/1</a> characteristic N

6.6 Retinning leads. If retinning (hot solder dip) of the leads is required see [3.5.4](#).

6.7 Tin plated finishes. Tin plating is prohibited (see [3.5.3.1](#)) since it may result in tin whisker growth. Tin whisker growth could adversely affect the operation of electronic equipment systems. For additional information on this matter refer to [ASTM B545](#) (Standard Specification for Electrodeposited Coating of Tin).

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6.8 Safety precautions. CAUTION: These devices use beryllium oxide ceramics in their construction. Any mechanical or chemical treatment of these ceramics which produces dust or fumes even in minute amounts can be deadly. Care should be taken to ensure that all those who handle, use, or dispose of these devices are aware of its nature and of the necessary safety precaution. In particular it should never be thrown out with general industrial or domestic waste.

6.9 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. Table XII lists the Environmental Protection Agency (EPA) top seventeen hazardous materials targeted for major usage reduction. Unless needed to meet the requirements specified herein (see [section 3](#)), use of these materials should be minimized or eliminated.

TABLE XII. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and Compounds	Lead and Compounds	Toluene
Carbon Tetrachloride	Mercury and Compounds	1,1,1 - Trichloroethane
Chloroform	Methyl Ethyl Ketone	Trichloroethylene
Chromium and Compounds	Methyl Isobutyl Ketone	Xylenes
Cyanide and Compounds	Nickel and Compounds	

6.10 Subject term (key word) listing.

Enclosure  
Heat dissipation  
Metal mounting surface  
Solderable  
Weldable

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

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## APPENDIX A

## PROCEDURE FOR QUALIFICATION INSPECTION

## A.1 SCOPE

A.1.1 Scope. This appendix details the procedure for submission of samples, 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.

## A.2 APPLICABLE DOCUMENTS

A.2.1 General. The documents listed in this appendix are specified in sections A.3, A.4, and A.5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections A.3, A.4, and A.5 of this specification, whether or not they are listed.

A.2.2 Government documents.

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

## DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-1276 - Leads for Electronic Components Parts.

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

A.2.3 Order of precedence. In the event of a conflict between the text of this document, and the references cited herein (except for related specification sheets) the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## A.3 SUBMISSION

A.3.1 Product levels. Qualification of the C (nonestablished reliability) level, is predicated upon meeting the established reliability qualification requirements for FR level P (see A.4.1). The procedure for submitting samples to become qualified to the initial failure level M is specified in A.3.2.

A.3.2 Sample. A sample consisting of 252 units in each style shall be subjected to the qualification inspection specified in table V, in the order shown. All sample units shall be subjected to the inspection of group I and group IA. The sample units shall then be divided as specified in table V for group II to group V. In addition, ten sample units shall be subjected to group VI.

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## APPENDIX A

## A.4 EXTENSION OF QUALIFICATION

A.4.1 Qualification extension of FRL. The extension of qualification or resistance values for each style shall range between the highest and lowest values qualified. The extension of qualification between the FR shall be as follows:

<u>FRL</u>	<u>Will qualify FRL</u>
S	R, P, M, C
R	P, M, C
P	M, C
M	
C	

A.4.2 Qualification between styles. Noninductive type styles will qualify corresponding inductive type styles as specified as follows:

<u>Noninductive style</u> <sup>1/</sup>	<u>Will qualify style</u>
RER40	RER60
RER45	RER65
RER50	RER70
RER55	RER75

<sup>1/</sup> Qualification of maximum resistance values in the 40, 45, 50, and 55 series will also qualify the highest resistance values in 60, 65, 70, and 75 series.

## A.5 SOLDER DIP (RETIMMING) LEADS

A.5.1 Solder dip (retinning) leads. The manufacturer (or their authorized category B or category C distributor) may solder dip/retin the leads of product supplied to this specification provided the solder dip process (see A.5.2) or an equivalent process has been approved by the qualifying activity.

A.5.2 Qualifying activity approval. Approval of the solder dip process will be based on one of the following options:

- a. When the original lead finish qualified was hot solder dip lead finish 52 of [MIL-STD-1276](#). (NOTE: The 200 microinch maximum thickness is not applicable.) The manufacturer shall use the same solder dip process for retinning as is used in the original manufacture of the product.
- b. When the lead originally qualified was not hot solder dip lead finish 52 of [MIL-STD-1276](#) as prescribed in A.5.2a, approval for the process to be used for solder dip shall be based on the following test procedure:
  - (1) Thirty samples of any resistance value for each style and lead finish are subjected to the manufacturer's solder dip process. Following the solder dip process, the resistors are subjected to the dc resistance test (and other group A electricals). No defects are allowed.
  - (2) Ten of the 30 samples are then subjected to the solderability test. No defects are allowed.
  - (3) The remaining 20 samples are subjected to the resistance to solder heat test followed by the moisture resistance test. No defects allowed.

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A.5.3 Solder dip/retraining options. The manufacturer (or authorized category B or category C distributor) may solder dip/retin as follows:

- a. After the 100 percent group A screening tests: Following the solder dip/retraining process, the electrical measurements required in group A, subgroup 1, 100 percent screening 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 percent 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: The lot may be retrained no more than two times. The lot after retraining shall be 100 percent screened for group A electricals requirements (dc resistance). Any parts failing (not exceeding the PDA for group A, subgroup 1 electricals, see [4.6.3.2.1](#)) these screens shall not be supplied to this specification. If electrical failures are detected after the second retraining operation exceeding 3 percent of the lot, the lot shall not be supplied to this specification.
- c. After the group A inspection has been completed: Following the solder dip/retraining process, the electrical measurements required in group A, subgroup 1, shall be repeated on 100 percent of the lot. The PDA for the electrical measurements shall be as for the subgroup 1 tests. Following these tests, the manufacturer shall submit the lot to the group A solderability test as specified in [4.8.15](#).

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Custodians:

Army - CR  
Navy - EC  
Air Force - 11

Preparing activity:  
Army - CR

Agent:  
DLA - CC

Review activities:

Army - AR, AV, CR4, MI  
Navy - AS, CG, MC, OS  
Air Force - 19

(Project 5905-2006)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil>.