INCH-POUND
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SUPERSEDING
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PERFORMANCE SPECIFICATION

RESISTORS, FIXED, WIRE-WOUND (POWER TYPE, CHASSIS MOUNTED), NONESTABLISHED RELIABILITY, AND 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 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. The resistors have an initial resistance tolerance of ±1 percent. These resistors are suitable for continuous full load operation at an ambient temperature of +25°C, and when derated up to +250°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 inductance (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°C, with a permissible change in resistance of ±2 percent as the criteria for failure.

1.2 Classification.

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

RER65	F	1001	M
Style (see 1.2.1.1)	Resistance tolerance (see 1.2.1.2)	Resistance (see 1.2.1.3)	Product level designator (see 1.2.1.4)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Communications-Electronics Command, ATTN: AMSEL-LC-LEO-E-EP, Fort Monmouth, NJ 07703-5023 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5905

1.2.1.1 Style. The style is identified by the three-letter symbol "RER" followed by a two digit number; the letters identify established reliability, chassis mounted, power type, wire-wound, fixed resistor, and the number identifies the size and power rating of the resistor.

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
F	±1.00

1.2.1.3 Resistance. The nominal resistance value expressed in ohms is identified by a four digit number; the first three represent significant figures, and the last digit specifies the number of zeros to follow. Where 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, the succeeding digits become significant. The following are examples of symbols for resistance values:

R100	=	0.10 ohm
1R00	=	1.00 ohm
10R0	=	10.0 ohms
1000	=	100 ohms
1001	=	1,000 ohms
1002	=	10,000 ohms

Minimum and maximum nominal resistance values are as specified (see 3.1). The standard resistance values for every decade follows the sequence demonstrated for the "1 to 10" decade (see table II).

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

F (1.0)					
1.00	1.47	2.15	3.16	4.64	6.81
1.02	1.50	2.21	3.24	4.75	6.98
1.05	1.54	2.26	3.32	4.87	7.15
1.07	1.58	2.32	3.40	4.99	7.32
1.10	1.62	2.37	3.48	5.11	7.50
1.13	1.65	2.43	3.57	5.23	7.68
1.15	1.69	2.49	3.65	5.36	7.87
1.18	1.74	2.55	3.74	5.49	8.06
1.21	1.78	2.61	3.83	5.62	8.25
1.24	1.82	2.67	3.92	5.76	8.45
1.27	1.87	2.74	4.02	5.90	8.66
1.30	1.91	2.80	4.12	6.04	8.87
1.33	1.96	2.87	4.22	6.19	9.09
1.37	2.00	2.94	4.32	6.34	9.31
1.40	2.05	3.01	4.42	6.49	9.53
1.43	2.10	3.09	4.53	6.65	9.76

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

1.2.1.4 Product level designation. The product level designation as shown in table III is signified by a single letter (C, M, P, R, S), which identifies the product level for which the resistor is qualified (see 4.5).

TABLE III. Product level designator.

Product level designator	Product level
C	non-ER
M	1.0 1/
P	0.1 1/
R	0.01 1/
S	0.001 1/

1/ Failure rate in percent/1000 hrs.

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 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

DEPARTMENT OF DEFENSE

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

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-202 - Electronic and Electrical Component Parts, Test Methods for.
MIL-STD-690 - Failure Rate Sampling Plans and Procedures.
MIL-STD-790 - Standard Practice for Established Reliability and High Reliability Qualified Product List (QPL) Systems for Electrical, Electronic and Fiber Optic Parts Specifications.
MIL-STD-1276 - Leads For Electronic Components Parts.
MIL-STD-1285 - Marking of Electrical and Electronic Parts.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Defense Printing Service Detachment Office, Bldg. 4D, Customer Service, 700 Robbins Avenue, Philadelphia PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents 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-554-1 - Assessment of Average Outgoing Quality Levels in Parts Per Million (ppm).
EIA-557 - Statistical Process Control Systems.

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

(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.)

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

3. REQUIREMENTS

3.1 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 (see 6.2).

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). In addition, the manufacturer shall obtain certification from the qualifying activity that the product assurance requirements of 3.3 and 4.2 have been met and are being maintained.

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). In addition, the manufacturer shall also established a Statistical Process Control (SPC) and Part Per Million (ppm) system 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 cap weld strength and winding dc resistance. 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 combinations.

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 suitably plated. Unplated copper bearing metals shall not be used in contact with aluminum.

3.5.3 Terminals. Connection of resistor windings to terminals shall result in a joint that is electrically stable and mechanically strong. Terminals shall be suitably treated to facilitate soldering. When a coating containing 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 Solder dip (retinning) leads. The manufacturer (or his authorized category B or category C distributor) may solder dip/retin the leads of product supplied to this specification provided the solder dip process has been approved by the qualifying activity. The manufacturer (or his authorized category B or category C distributor) shall maintain a solder purity in accordance with table IV, during the tinning process.

TABLE IV. Contamination limits.

Contamination	Tinning percent by weight 1/
Copper	.75
Gold	.50
Cadmium	.01
Zinc	.008
Aluminum	.008
Antimony	.50
Iron	.02
Arsenic	.03
Bismuth	.25
Silver	.75
Nickel	.025

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

3.5.3.2 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 3.5.3.2a, 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 manufacturing'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.

3.5.3.3 Solder dip/retinning 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/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, the lot may be retinned no more than two times. The lot after retinning shall be 100 percent screened for group A electrical requirement (dc resistance) any parts failing (not exceeding the PDA for group A, subgroup 1 electricals, see 4.5d) these screens shall not be supplied to this specification. If electrical failures are detected after the second retinning 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/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 these tests, the manufacturer shall submit the lot to the group A solderability test as specified in 4.8.15.

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

3.6 Voltage rating. Resistors shall have a rated direct current continuous working voltage, or an approximate sine wave root mean square 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 continuous working voltage.
P = power rating (see 3.1).
R = nominal resistance.

3.7 Conditioning. When resistors are tested as specified in 4.8.2, there shall be no mechanical damage. The change in resistance shall not exceed ±(0.2 percent +.01 ohm).

3.8 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).

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

3.10 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 failure rate (FR) requirements specified in 3.19. For temperatures in excess of those specified above, the load shall be derated in accordance with figure 1.

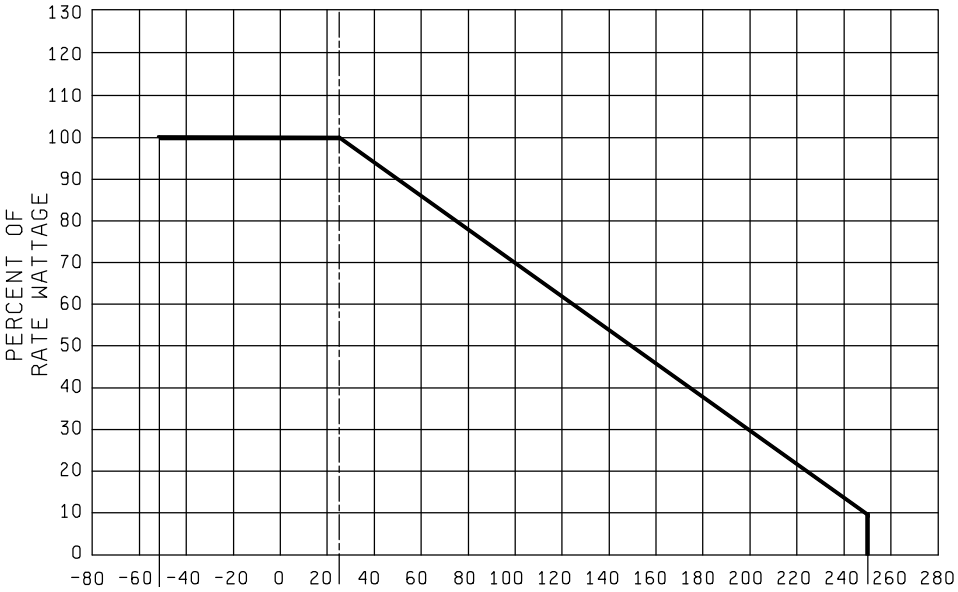

FIGURE 1. Derating curve for high ambient temperatures.

3.11 Dielectric withstanding voltage. When resistors are tested as specified in 4.8.5, resistors shall not flashover, show any evidence of damage, arcing, or insulation breakdown, nor a change in resistance in excess of ±(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.

3.13 Low temperature operation. When resistors are tested as specified in 4.8.7, the change in resistance shall not exceed ±(0.3 percent +0.01 ohm), nor shall there be any evidence of mechanical damage which will result in degradation of performance.

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

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

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 ±(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 electrical discontinuity during the test, the change in resistance shall not exceed ±(0.2 percent +0.01 ohm), and there shall be no evidence of mechanical damage. 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 electrical discontinuity during the test, the change in resistance shall not exceed ±(0.2 percent +0.01 ohm), and there shall be no evidence of mechanical damage. 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 initial measurement and any succeeding measurement up to and including 2,000 hours shall not exceed ±(1.0 percent +0.01 ohm).

3.19.2 FRL determination. 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 of the succeeding measurements shall not exceed ±(2.0 percent +0.01 ohm). This single failure criteria shall be applicable to all measurements during the life test for purposes of determining FRL qualification and is applicable as a parallel requirement with 3.19.1 to the measurements made during the life test 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 ±(1.0 percent +0.05 ohm).

3.21 Solderability. When resistors are tested as specified in 4.8.15, the flat portion of the terminal shall be considered as the solderable area, and must meet the criteria for lug or tab terminal evaluation of 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 ±(0.3 percent +0.01 ohm).

3.23 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 though 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).

3.23.1 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 so marked or identified are manufactured to, and meet all the requirement of specifications. Accordingly, items acquired to and meeting all of the criteria specified herein and in applicable associated specifications shall bear the certification mark "JAN" except that resistors 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 and in applicable specifications shall not bear "JAN" or "J". In the event item sample fails to meet the requirements of this specification and the applicable specification sheets or associated specifications, 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 drawings 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 Supplying to higher product 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 6.2) (see table V).

TABLE V. Product level substitution.

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

3.25 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.

3.26 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.

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

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

4. VERIFICATION

4.1 Classification of inspection. The inspection requirements specified here 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 establish and maintain a QPL system (see 3.3). Evidence of such compliance is a prerequisite for qualification and retention 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 retention 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 the moisture-resistance temperature cycling tests. 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).

4.4.1 Sample. The number of sample units comprising a sample of resistors to be submitted for qualification inspection shall be as specified in the appendix to this specification. The 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 VI, 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 VI for group II to group V inclusive, and subjected to the inspection for their particular group. In addition, 10 sample units shall be subjected to group VI.

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

4.4.4 FRL and quality level verification (ER only).

4.4.4.1 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 table VI group IV, (see 4.4.2). Entire life test sample shall be continued 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 combination shall be as described for lot formation (see 4.6.2).

c. Procedure III: Maintenance of FR levels 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).

TABLE VI. Qualification inspection.

Inspection	Requirement paragraph	Method paragraph	Number of sample units 1/	Defects allowed 2/
Group I 3/ Conditioning DC resistance	 3.7 3.8	 4.8.2 4.8.3	All sample units	N/A 4/
Group IA Visual and mechanical inspection 5/	3.1, 3.3 to thru 3.4.5 incl. 3.20 and 3.22 to thru 3.23.1	4.8.1	All sample units	0
Group II Resistance temperature characteristic 6/ Low temperature storage Dielectric withstanding voltage 6/ Insulation resistance Low temperature operation Short-time overload 6/ Moisture resistance Terminal strength	 3.9 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
Group III 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	
Group IV Life	 3.19	 4.8.13	102 34 highest value, 34 1,000-ohm, and 34 1-ohm or lowest value, whichever is greater	1
Group V 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
Group VI Solderability 7/	 3.21	 4.8.15	10 both leads, any value	0

1/ See appendix 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.

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 does not exceed 5 percent or one lot, whichever is greater.

e. Periodic group C inspection.

f. FRL.

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 FRL 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 is not required when the qualifying activity has allowed group B testing to be performed annually (see table X).

4.6.2 Inspection and production lot.

4.6.2.1 Inspection lot. An inspection lot, as far as practical, shall consist of all 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. 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 level lots shall be kept separate.

4.6.2.2 Production lot. A production lot consists 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 level lots shall be kept separate.

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 inspection, and solderability requirements. In-line or process control may be part of such system. 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 FRL assessment, this product is still expected to meet the environmental qualification type requirements (e.g., moisture resistance, shock, vibration, etc.).

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

4.6.3.2.1 Subgroup 1. Subgroup 1 tests shall be performed on a production lot basis on 100 percent of the product supplied under this 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. 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 production inspection. If the manufacturer performs tests similar to those specified in group A, subgroup 1, as the final step of the manufacturing process, group A, subgroup 1 tests may be eliminated when approved by the qualifying activity. The following criteria shall be complied with:

a. Production tests that are identical to, or more stringent than, those specified for subgroup 1 tests.

b. 100 percent of the product supplied to these tests.

c. Failure criteria that are identical to, or more stringent than, those specified for subgroup 1 tests.

d. Lot rejection criteria that are identical to, or more stringent than, those specified for subgroup 1 tests.

e. Once approved, future changes require approval from the qualifying activity.

TABLE VII. Group A inspection (ER only).

Inspection	Requirement paragraph	Test method paragraph	Sampling procedure
Subgroup 1 1/			
Conditioning	3.7	4.8.2	100 percent inspection
DC resistance 2/	3.8	4.8.3	
Subgroup 2			
Visual examination			
Material	3.4		
Interface and physical dimension	3.5		
Marking 3/	3.23	4.8.1	See 4.6.3.2.3
Soldering	3.26		
Workmanship	3.28		
Subgroup 3			
Solderability 4/	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/ At the manufacturer's option, marking inspection may be performed after group B inspection; however, if this is done, no defects shall be permitted. Marking shall remain legible at the end of all tests.

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.

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 VIII. In 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 VIII 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 a another defect type is found in the second sample, a rescreen for that defect is also permitted).

TABLE VIII. 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

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 IX. 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 in 4.6.3.2.4b.

TABLE IX. 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 solder dip using an approved solder dip process (see 3.5.3.3). 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 established 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 not 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 VIII. 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. 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 this specification.

4.6.4.3 PPM calculations. PPM calculations shall be based on the accumulated results of the initial sample. Calculations and exclusion 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).

4.6.5 Group B inspection (ER only). Group B inspection shall consist of the test specified in table X. The specified number of sample units shall be selected from each lot that has been subjected to group A inspection. Sample units selected shall be of the highest resistance value in the lot.

TABLE X. Group B inspection (ER only).

Inspection	Requirement paragraph	Test method paragraph	Number of samples
Subgroup 1 1/			
Visual and mechanical examination (when applicable)	3.1 and 3.23	4.8.1	13
Subgroup 2 2/			
Resistance temperature characteristic	3.9	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. 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.

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

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

4.6.5.4 Deposition of sample units. Sample units which have been subjected to group B, subgroup 1 inspections may be delivered on the acquisition document provided they are within resistance tolerance and meet requirements for visual and mechanical inspection. Sample units which have been subjected to subgroup 2 inspection shall not be supplied to this specification.

4.7 Periodic group C inspection (ER only). Periodic group C inspection shall consist of group C inspection tests specified in table XI, 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 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, or quarterly 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). Samples shall be accumulated 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 FR requirements is complied within the specified maintenance period. In any event, a minimum of five samples shall be selected from each lot. As far as practicable, the manufacturer shall select the resistance values so that all resistance decades produced during the maintenance period are 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 tests of table XI.

4.7.3 Quarterly (subgroup 1 and subgroup 2). Sample units and tests shall be as specified in table XI.

4.7.4 Annually. Sample units and tests shall be as specified in table XI.

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

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 or products which can be corrected and which were manufactured under essentially the same materials and processes, 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, stop shipment may not be necessary depending on the nature of the failure. After 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 inspections may be reinstituted; however, final acceptance and shipment shall be withheld until the group C reinspection has shown that the corrective action was successful.

TABLE XI. Group C inspection (ER only).

Inspection	Requirement paragraph	Test method paragraph	Number of sample	Number of defects allowed
Monthly Subgroup 1 Life	 3.19	 4.8.13	 See 4.7.2.1	 See 4.7.2.1
Monthly Subgroup 2 Moisture resistance	 3.15	 4.8.9	 18 (highest values)	 1
Monthly 1/ Subgroup 3 Dielectric withstanding voltage Insulation resistance Low temperature operation Low temperature storage Terminal strength	 3.11 3.12 3.13 3.22 3.16	 4.8.5 4.8.6 4.8.7 4.8.16 4.8.10	 18 (highest values)	 1
Quarterly 1/ Short-time overload Shock (specified pulse) Vibration (high frequency)	 3.14 3.17 3.18	 4.8.8 4.8.11 4.8.12	 18 (highest values)	 1
Annually 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 qualifying activity, can be deleted. The manufacturer, however, shall perform these tests every 3 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.

4.8 Methods of inspections.

4.8.1 Visual and mechanical inspections. Resistors shall be examined to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.4 to 3.5.4 inclusive, and 3.23 to 3.28 inclusive).

4.8.2 Conditioning (see 3.7). 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. Temperature and tolerance: +25°C +10°C, -0°C.

c. Initial measurements: Initial resistance shall be measured after mounting at +25°C +10°C, -0°C, as specified in 4.8.3.

d. Operating conditions: Rated dc continuous working voltage or rated continuous working voltage from an ac supply at commercial line frequency and waveform, shall be applied intermittently one and one-half hours "on" and one-half hour "off" for 96 hours +48 hours, -0 hours at a temperature of +25°C +10°C, -0°C. Each resistor shall dissipate a wattage equal to the power rating (free air) of the resistor (see 3.1).

e. Measurement after conditioning: Resistance shall be measured at the end of 96 +48, -0 hours at +25°C +10°C, -0°C, as specified in 4.8.3 after load has been removed and the resistors stabilized.

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

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

a. Measuring apparatus: 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 type, 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: The test voltage shall not exceed 1 percent of rated dc voltage (see 3.6). The voltage used for initial measurement shall be used for all subsequent measurements.

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.

4.8.4 Resistance temperature characteristic (see 3.9).

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 XII.

b. Measurement at the end of each period: Resistance shall be measured as specified in 4.8.3 at the temperature maintained during the period.

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

TABLE XII. Temperature for resistance temperature characteristic test.

Sequence 1/	Test ambient temperature in 2/
	°C ±3°C
1	25 3/
2	-55
3	25 4/
4	125
5	200
6	250

1/ Sequence 3 through 6 can, at the option of the test facility, be performed prior to sequence 1 and 2.
2/ At the option of the manufacturer, the reverse sequence may be as follows:
a. +25°C ±3°C.
b. +250°C ±3°C.
c. +25°C ±3°C.
d. -55°C ±3°C.
3/ This temperature shall be considered the referee temperature for each of the succeeding temperatures.
4/ This temperature shall be considered the reference temperature for those in sequences 4 to 6 inclusive.

4.8.5 Dielectric withstanding voltage (see 3.11).

4.8.5.1 Atmospheric pressure. Resistors shall be tested in accordance with method 301 of MIL-STD-202. The following details 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 in 3.1.

c. Nature of potential: An ac supply at commercial line frequency and waveform.

d. Points of application of test voltage: Between the 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 plate.

e. Measurements and examination: Resistance (see 4.8.3), shall be measured before the test. At the conclusion of the test, resistors shall be examined for evidence of damage, arcing, flashover, 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. Measurements and examination: At the conclusion of the test, resistance shall be measured (see 4.8.3). Resistors shall also be examined for evidence of damage, arcing, flashover, 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 preparations: As specified in 4.8.5.1a.

c. Points of measurement: As specified in 4.8.5.1e.

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 then 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 nor 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 each 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 step 1 to step 6 inclusive, a potential of 100 volts dc shall be applied with the positive side connected to the terminals tied together, and the negative side 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.

4.8.10 Terminal strength (see 3.16). 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). Applied force: As specified (see 3.1). Resistor body firmly clamped and a 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 shall be measured 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) (3.17). Resistors shall be tested in accordance with method 213 of MIL-STD-202. The following details shall apply:

a. Mounting and direction of applied vibration: 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: Resistance, 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: Resistance (see 4.8.3) shall be measured, and the resistors 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 shall apply:

a. Mounting: Resistors shall be mounted by their normal mounting means as specified in 4.8.13a 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 (.06 inch (1.5 mm) double amplitude or 20G).

c. Measurement before vibration: Resistance, 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: Resistance (see 4.8.3) shall be measured and the resistors examined for evidence of mechanical damage. Resistors shall then be subjected to the dielectric withstanding voltage test (atmospheric pressure) as specified in 4.8.5.1.

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 dc, ac line, or true rms rated continuous working voltage. Resistors shall be so arranged that the temperature of any one resistor shall not appreciably influence the temperature of any other resistor. There shall be no undue draft over the resistors.

b. Test temperature: +25°C ±5°C.

c. Initial measurements: Initial resistance shall be measured after mounting at +25°C ±5°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 rated dc continuous working voltage or an ac rated continuous working voltage from an ac supply at commercial line frequency and waveform, intermittently, one and one-half hour, "on" and one-half hour "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; and 10,000 hours for FR determination.

f. Measurements during test:

(1) Qualification inspection: Resistance (see 4.8.3) shall be measured at the end of the one-half hour "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 one-half hour "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.

4.8.14 High temperature exposure (see 3.20).

a. Mounting: No special mounting required.

b. Initial measurements: 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°C ±7°C for a period of 2,000 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 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 reached within 4 minutes after the resistors are placed in the 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°C ±2°C for a period of 24 hours ±4 hours. The resistors shall then be removed from the chamber and maintained at a temperature of +25°C ±5°C for a period of 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 actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite 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 Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

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

6.1 Intended use. 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. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).

c. Packaging requirements (see 5.1).

d. Allowable substitution (see 3.24).

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 the 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 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), 3990 East Broad Street, Columbus, OH 43216-5000.

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

6.5 MIL-R-18564 substitution data. Resistors of this specification, regardless of their FR designation, are substitutes for resistors of the same resistance value as follows:

Substitution specification	Inactivated specification and characteristic
MIL-PRF-39009/1	MIL-R-18546/1 characteristic G
MIL-PRF-39009/2	MIL-R-18546/1 characteristic N

6.6 Retinning leads. If retinning (hot solder dip) of the leads is required, see 3.5.3.3.

6.7 Tin plated finishes. Tin plating is prohibited (see 3.27) 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 Coatings of Tin).

6.8 Subject term (key word) listing.

Enclosure
Heat dissipation
Metal mounting surface
Solderable
Weldable

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

APPENDIX

PROCEDURE FOR QUALIFICATION INSPECTION

1. SCOPE

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 this specification. The information contained herein is intended for compliance.

2. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

3. SUBMISSION

3.1 Product levels. Qualification of the C (non-ER) level, is predicated upon meeting the ER qualification requirements for FRL "P" (see appendix 4.1). The procedure for submitting samples to become qualified to the initial failure level M is specified in appendix 3.2.

3.2 Sample. A sample consisting of 252 units in each style shall be subjected to the qualification inspection specified in table VI, 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 VI for group II to group V. In addition, ten sample units shall be subjected to group VI.

4. EXTENT OF QUALIFICATION

4.1 Qualification extension of FRL. Qualification of a particular style and resistance value shall qualify a range of resistance values between the lowest value manufactured or tested (see table VI), and the highest value tested. The extent of qualification between FRL shall be as specified in table XIII.

TABLE XIII. Extension of qualification of failure rate levels.

FRL	Will qualify FRL
S	R, P, M, C
R	P, M, C
P	M, C
M	
C	

APPENDIX

4.2 Qualification extension between styles. Noninductive type styles will qualify corresponding inductive type styles as specified in table XIV.

TABLE XIV. Extension of qualification of terminal types.

Noninductive style 1/	Will qualify style
RER40	RER60
RER45	RER65
RER50	RER70
RER55	RER75

1/ 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.

Custodians
Army - CR
Navy - EC
Air Force -85

Review activities:
Army - AR, AV, CR4, MI
Navy - AS, CG, MC, OS
Air Force - 19, 80

Preparing activity:
Army - CR

Agent:
DLA - CC

(Project 5905-1441)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

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I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-PRF-39009D	**2. DOCUMENT DATE (YYMMDD)** 3 July 1997

3. DOCUMENT TITLE RESISTORS, FIXED, WIRE WOUND (POWER TYPE, CHASSIS MOUNTED), NONESTABLISHED RELIABLITY, AND ESTABLISHED RELIABILITY, GENERAL SPECIFICATION FOR.

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME US Army Communications-Electronics Command	b. TELEPHONE (Include Area Code) (1) Commercial (908) 427-3441 (2) AUTOVON 987-3441
c. ADDRESS (Include Zip Code) ATTN: AMSEL-LC-LEO-E-EP Fort Monmouth, NJ 07703-5023	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340