

INCH-POUND
MIL-PRF-39005G
27 September 2013
SUPERSEDING
MIL-PRF-39005F
8 May 2008

PERFORMANCE SPECIFICATION

RESISTORS, FIXED, WIREWOUND (ACCURATE), NONESTABLISHED RELIABILITY, ESTABLISHED RELIABILITY GENERAL SPECIFICATION FOR

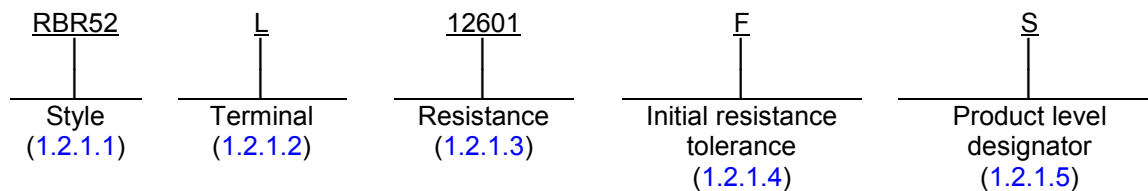
This specification is approved for use by all Departments
and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for nonestablished reliability (non-ER), established reliability (ER), accurate, wire-wound, fixed resistors that have a maximum resistance tolerance of 1 percent and a high degree of stability with respect to time under specified environmental conditions. The resistors are capable for continuous full-load (or voltage) operation at any ambient temperature up to 125°C, and when derated, up to 145°C (see 6.5). They are not capable for application where the alternating current (ac) characteristics are of critical importance. ER resistors have life failure rates (FR) ranging from 1.0 percent to 0.001 percent per 1,000 hours (see 1.2.1.5). These FR are established at 60-percent confidence level on the basis of the life tests. The FR, identified by the appropriate symbol, is referred to operation at full rated voltage and temperature.

1.2 Classification.

1.2.1 Part or Identifying Number (PIN). PINs to be used for resistors acquired to this specification are created as follows (see 3.1 and 6.2):



Comments, suggestions, or questions on this document should be addressed to: US Army Communications-Electronics Command, ATTN: RDER-PRO, Aberdeen Proving Grounds, MD 21015 or emailed to usarmy.apg.cerdec.mbx.standardization-crx@mail.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

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1.2.1.1 Style. The style is identified by the three letter symbol "RBR" followed by a two digit number; the letters identify nonestablished reliability or established reliability, accurate, wire-wound, fixed resistors, and the number identifies the size and power rating of the resistors.

1.2.1.2 Terminal. The terminal is identified by a single letter in accordance with table I.

TABLE I. Terminal.

Symbol	Terminal
L	Solderable
U	Weldable

1.2.1.3 Resistance. The nominal resistance is expressed in ohms and is identified by five digits; the first four digits represent significant figures and the last digit specifies the number of zeros to follow. When the values of resistance are less than 1,000 ohms, or when fractional values of an ohm 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 of the group represent significant figures. The resistance value designations are shown in table II. Minimum and maximum resistance values are as specified (see 3.1). The standard values for every decade are follow the sequence demonstrated for "10 to 100" decade in table III. The resistance values for 0.01-percent (T), 0.02-percent (Q), 0.05-percent (A), and 0.1-percent (B) resistance tolerances may be of any value within the limits of this specification, but it is preferred that the values be chosen from the 192-series decade specified in table III.

TABLE II. Designation of resistance values.

Designation	Resistance value (ohms)		
R1000 to R9880 inclusive	0.10	to	0.988 inclusive
1R000 to 9R880 inclusive	1.00	to	9.88 inclusive
10R00 to 98R80 inclusive	10.00	to	98.80 inclusive
100R0 to 988R0 inclusive	100.00	to	988.00 inclusive
10000 to 98800 inclusive	1,000	to	9,880 inclusive
10001 to 98801 inclusive	10,000	to	98,800 inclusive
10002 to 98802 inclusive	100,000	to	988,000 inclusive
10003 to 98803 inclusive	1,000,000	to	9,880,000 inclusive

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TABLE III. Standard resistance values for the 10 decade to 100 decade.

Resistance tolerance											
Q A	T B	F	Q A	T B	F	Q A	T B	F	Q A	T B	F
10.00	10.00	14.70	14.70	21.50	21.50	31.60	31.60	46.40	46.40	68.10	68.10
10.10	----	14.90	----	21.80	----	32.00	----	47.00	----	69.00	----
10.20	10.20	15.00	15.00	22.10	22.10	32.40	32.40	47.50	47.50	69.80	69.80
10.40	----	15.20	----	22.30	----	32.80	----	48.10	----	70.60	----
10.50	10.50	15.40	15.40	22.60	22.60	33.20	33.20	48.70	48.70	71.50	71.50
10.60	----	15.60	----	22.90	----	33.60	----	49.30	----	72.30	----
10.70	10.70	15.80	15.80	23.20	23.20	34.00	34.00	49.90	49.90	73.20	73.20
10.90	----	16.00	----	23.40	----	34.40	----	50.50	----	74.10	----
11.00	11.00	16.20	16.20	23.70	23.70	34.80	34.80	51.10	51.10	75.00	75.00
11.10	----	16.40	----	24.00	----	35.20	----	51.70	----	75.90	----
11.30	11.30	16.50	16.50	24.30	24.30	35.70	35.70	52.30	52.30	76.80	76.80
11.40	----	16.70	----	24.60	----	36.10	----	53.00	----	77.70	----
11.50	11.50	16.90	16.90	24.90	24.90	36.50	36.50	53.60	53.60	78.70	78.70
11.70	----	17.20	----	25.20	----	37.00	----	54.20	----	79.60	----
11.80	11.80	17.40	17.40	25.50	25.50	37.40	37.40	54.90	54.90	80.60	80.60
12.00	----	17.60	----	25.80	----	37.90	----	55.60	----	81.60	----
12.10	12.10	17.80	17.80	26.10	26.10	38.30	38.30	56.20	56.20	82.50	82.50
12.30	----	18.00	----	26.40	----	38.80	----	56.90	----	83.50	----
12.40	12.40	18.20	18.20	26.70	26.70	39.20	39.20	57.60	57.60	84.50	84.50
12.60	----	18.40	----	27.10	----	39.70	----	58.30	----	85.60	----
12.70	12.70	18.70	18.70	27.40	27.40	40.20	40.20	59.00	59.00	86.60	86.60
12.90	----	18.90	----	27.70	----	40.70	----	59.70	----	87.60	----
13.00	13.00	19.10	19.10	28.00	28.00	41.20	41.20	60.40	60.40	88.70	88.70
13.20	----	19.30	----	28.40	----	41.70	----	61.20	----	89.80	----
13.30	13.30	19.60	19.60	28.70	28.70	42.20	42.20	61.90	61.90	90.90	90.90
13.50	----	19.80	----	29.10	----	42.70	----	62.60	----	92.00	----
13.70	13.70	20.00	20.00	29.40	29.40	43.20	43.20	63.40	63.40	93.10	93.10
13.80	----	20.30	----	29.80	----	43.70	----	64.20	----	94.20	----
14.00	14.00	20.50	20.50	30.10	30.10	44.20	44.20	64.90	64.90	95.30	95.30
14.20	----	20.80	----	30.50	----	44.80	----	65.70	----	96.50	----
14.30	14.30	21.00	21.00	30.90	30.90	45.30	45.30	66.50	66.50	97.60	97.60
14.50	----	21.30	----	31.20	----	45.90	----	67.30	----	98.80	----

1.2.1.4 Initial resistance tolerance. The initial resistance tolerance is identified by a single letter in accordance with table IV.

TABLE IV. Initial resistance tolerance and applicable minimum resistance values.

Symbol	Initial resistance tolerance (at 25°C ±2°C)	Minimum resistance values (see 3.1)
	<u>Percent (±)</u>	<u>Ohms</u>
T	0.01	10.0
Q	0.02	10.0
A	0.05	10.0
B	0.10	10.0
F	1.00	0.10

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1.2.1.5 Product level designator. The product level designator is specified in table V by a single letter which identifies nonestablished reliability or established reliability resistors.

TABLE V. Product level designator.

Product level designator	Product level
C	Non-ER
M	$\frac{1}{1}$ 1.0
P	$\frac{1}{1}$ 0.1
R	$\frac{1}{1}$ 0.01
S	$\frac{1}{1}$ 0.001

$\frac{1}{1}$ Failure rate level (FRL) in percent per 1,000 hours.

2. APPLICABLE DOCUMENTS

- * 2.1 General. The documents listed in this section are specified in sections 3, 4 and 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 3, 4 and 5 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

(See [supplement 1](#) for a list of associated specifications.)

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](#) - Standard Practice for Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specifications.
- [MIL-STD-810](#) - Environmental Engineering Considerations and Laboratory Tests.
- [MIL-STD-1276](#) - Leads for Electronic Component Parts.
- [MIL-STD-1285](#) - Marking of Electrical and Electronic Parts.

- * (Copies of these documents are available online at <http://quicksearch.dla.mil> or from the DLA Document Services, 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 the documents which are those listed in the solicitation or contract.

* TECHAMERICA

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

* (Copies of these documents are available online at www.techamerica.org or from TechAmerica, 601 Penn NW, North Building, Suite 600, Washington DC, 20004-2650.)

* 2.4 Order of precedence. Unless otherwise noted herein or in the contract, or 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 (see [6.2](#)).

3.2 Qualification. The resistors furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable Qualified Products List (QPL) at the time of award of contract (see [4.4](#) and [6.3](#)). In addition, the manufacturer shall obtain certification from the qualifying activity that the reliability and quality requirements of [4.2](#) have been met and are being maintained. Authorized distributors that are approved to [MIL-STD-790](#) distributor requirements by the QPL manufacturer are listed in the QPL.

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 establish 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 formation of resistance elements, weld strength, trimming, and termination. In addition, the manufacturer shall demonstrate resistance temperature characteristic (RTC) control in the process.

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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.

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 guaranty of the acceptance of the finished product.

3.5 Interface and physical dimension requirements. Resistors shall meet the interface and physical dimensions as specified (see 3.1). The resistor assembly shall be protected by a coating or enclosure of moisture resistant insulation material which shall withstand exposure to the humidity and temperature conditions specified herein. In order to minimize inductance, resistors shall be wound by reverse pi-winding, bifilar, or equivalent method.

3.5.1 Terminals. Terminals shall be made of a solid conductor of the length and diameter specified (see 3.1). The terminals shall be solderable in accordance with method 208 of MIL-STD-202.

3.5.1.1 Solderable terminals. Solderable terminals shall be treated to meet the requirements of solderability (see 3.10).

3.5.1.2 Weldable terminals. Weldable terminals shall be as specified in table I. The manufacturer shall verify by certification that the weldable leads meet all the applicable requirements of MIL-STD-1276 (see 3.1). The solderability requirement of 3.10 is not applicable to weldable terminals.

3.5.2 Pure tin. The use of pure tin, as an underplate or final finish is prohibited both internally and externally. Tin content of resistor components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see 6.11).

3.5.3 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 appendix A) has been approved by the qualifying activity.

3.5.4 Protective coating or enclosure. Resistor assemblies shall be protected by a coating or enclosure of moisture resistant insulating material which shall completely cover the exterior of the resistance element, including connections or terminations. The coating shall not crack, craze, drip, run, or form globules of any temperature up to and including 145°C, regardless of the mounting position of the resistor. This material shall afford protection against the effects of prolonged exposure to high humidities. The protective coating or enclosure shall be such as to minimize the establishment of leakage paths between the terminals resulting from collection of moisture film on the external surface of the resistor.

3.5.5 Flux. The flux shall be of such a quality as to enable the resistors to meet the requirements of this specification.

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

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3.5.7 Power rating. Resistors shall have a power rating based on continuous full-load operation at an ambient temperature of 125°C (see 3.1). This power rating is dependent on the ability of resistors to meet the life requirements of 3.21. For temperatures in excess of 125°C, the load shall be derated in accordance with figure 1 (see 6.5).

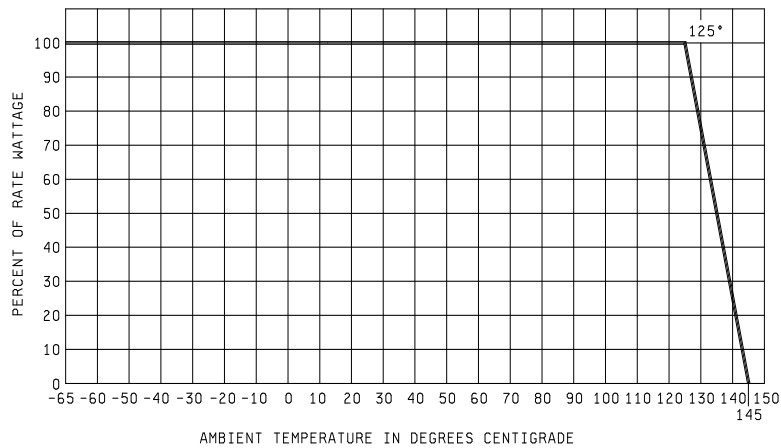


FIGURE 1. Derating curve for high ambient temperatures.

3.5.8 Voltage rating. Resistors shall have a rated direct current (dc) continuous working voltage or an approximately 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 = rated dc or rms continuous working voltage.
- P = power rating (see 3.1).
- R = nominal resistance.

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

3.6 Conditioning. When resistors are tested as specified in 4.8.2, there shall be no mechanical damage. The change in resistance shall not exceed ± 0.01 percent for resistance values of 10 ohms and above, and $\pm(0.01$ percent +.01 ohm) for resistance values less than 10 ohms.

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3.7 Short time overload. When resistors are tested as specified in 4.8.3, there shall be no evidence of arcing, burning, or charring. The change in resistance shall not exceed 0.01 percent for resistance values of 10 ohms and above, and $\pm(0.01 \text{ percent} + 0.01 \text{ ohm})$ for resistance values less than 10 ohms.

3.8 Thermal shock. When resistors are tested as specified in 4.8.4, there shall be no evidence of mechanical damage. The change in resistance shall not exceed ± 0.05 percent for resistance values of 10 ohms and above, and $\pm(0.05 \text{ percent} + 0.01 \text{ ohm})$ for values less than 10 ohms.

3.9 DC resistance. When resistors are tested as specified in 4.8.5, the dc resistance shall be expressed in absolute ohms (see 1.2.1.3), and shall be within the specified initial tolerance of the nominal resistance (1.2.1.4).

3.9.1 Resistance value deviations. All maximum deviations as specified in this section are to be considered absolute limits with the exception of the contact resistance adjustments.

3.10 Solderability (applicable to "L" terminal only). When resistors are tested as specified in 4.8.6, they shall meet the criteria for wire lead terminal evaluation in the test method.

3.11 Dielectric withstanding voltage. When resistors are tested as specified in 4.8.7, there shall be no evidence of flashover, mechanical damage, arcing, or insulation breakdown. The change in resistance shall not exceed ± 0.01 percent for resistance values of 10 ohms and above, and $\pm(0.01 \text{ percent} + 0.01 \text{ ohm})$ for values less than 10 ohms.

3.12 Terminal strength. When resistors are tested as specified in 4.8.8, there shall be no break in the wire-lead terminals, the resistance element shall remain securely connected mechanically and electrically to the terminals in such a manner that the normal movement of the terminals shall not result in strain, wear, or damage to the element, coating, or enclosure. The change in resistance shall not exceed ± 0.01 percent for resistance values of 10 ohms and above, and $\pm(0.01 \text{ percent} + 0.01 \text{ ohm})$ for values less than 10 ohms.

3.13 Insulation resistance. When resistors are tested as specified in 4.8.9, the insulation resistance shall not be less than 1,000 megohms.

3.14 Moisture resistance. When resistors are tested as specified in 4.8.10, there shall be no evidence of breaking, cracking, spalling, or loosening of terminals or mounting hardware. The final insulation resistance shall be not less than 100 megohms. The change in resistance shall not exceed ± 0.1 percent for resistance values of 10 ohms and above and $\pm(0.1 \text{ percent} + 0.01 \text{ ohm})$ for values less than 10 ohms; for style RBR71 the change in resistance shall not exceed ± 0.4 percent for resistance values of 10 ohms and above, and $\pm(0.4 \text{ percent} + 0.01)$ for values less than 10 ohms.

3.15 Resistance to soldering heat. When resistors are tested as specified in 4.8.11, there shall be no evidence of mechanical damage. The change in resistance shall not exceed ± 0.01 percent for resistance values of 10 ohms and above, and $\pm(0.01 \text{ percent} + 0.01 \text{ ohm})$ for values less than 10 ohms.

3.16 Shock, specified pulse. When resistors are tested as specified in 4.8.12, there shall be no evidence of mechanical or electrical damage. The change in resistance shall not exceed ± 0.01 percent for resistance values of 10 ohms and above, and $\pm(0.01 \text{ percent} + 0.01 \text{ ohm})$ for values less than 10 ohms.

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3.17 Vibration, high frequency. When resistors are tested as specified in 4.8.13, there shall be no evidence of mechanical or electrical damage. The change in resistance shall not exceed ± 0.01 percent for resistance values of 10 ohms and above, and $\pm(0.01$ percent +0.01 ohm) for values less than 10 ohms.

3.18 Resistance temperature characteristic. When resistors are tested as specified in 4.8.14, the resistance temperature characteristic, referred to an ambient temperature of 25°C, shall not exceed the value specified in table VI.

TABLE VI. Maximum RTC.

Resistance	Percent/°C	Parts/million/°C
Less than 1 ohm	± 0.009	± 90
1 ohm to less than 10 ohms	± 0.003	± 30
10 ohms to less than 100 ohms	± 0.0015	± 15
100 ohms and above	± 0.0010	± 10

3.19 Low temperature storage. When resistors are tested as specified in 4.8.15, there shall be no evidence of mechanical damage. The change in resistance between initial and final measurements at 25°C $\pm 5^\circ\text{C}$ shall not exceed ± 0.01 percent for resistance values of 10 ohms and above, and $\pm(0.01$ percent +0.01 ohm) for values less than 10 ohms.

3.20 Low temperature operation. When resistors are tested as specified in 4.8.16, there shall be no evidence of mechanical damage. The change in resistance between initial and final measurements at 25°C $\pm 5^\circ\text{C}$ shall not exceed ± 0.01 percent for resistance values of 10 ohms and above, and $\pm(0.01$ percent +0.01 ohm) for values less than 10 ohms.

3.21 Life.

3.21.1 Qualification. When resistors are tested as specified in 4.8.17, there shall be no evidence of mechanical damage to the resistance element, coating, or enclosure. The change in resistance between the initial and any succeeding measurement shall not exceed $\pm(0.1$ percent +0.01 ohm).

3.21.2 FRL determination (extended FR test) (ER only). When resistors are tested as specified in 4.8.17, there shall be no evidence of mechanical damage to the resistance element, coating, or enclosure. The change in resistance between initial and any succeeding measurement shall not exceed $\pm(0.2$ percent +0.01 ohm). This single failure criterion shall be applicable as a parallel requirement to all measurements during the life test for purposes of determining FRL qualification.

3.22 Fungus. All external materials shall be nonnutrient to fungus growth or shall be treated to retard fungus growth. The manufacturer shall certify that all external materials are fungus resistant, or shall perform the test specified in 4.8.18. There shall be no evidence of fungus growth on the external surfaces.

3.23 Resistance to solvents. When resistors are tested as specified in 4.8.19, there shall be no evidence of mechanical damage and the markings shall remain legible.

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3.24 High temperature exposure. When resistors are tested as specified in 4.8.20, there shall be no evidence of mechanical damage. The change in resistance shall not exceed ± 0.1 percent for resistance values of 10 ohms and above, and $\pm(0.10$ percent $+0.01$ ohm) for values less than 10 ohms. The material used for marking of the resistor shall not be electrically conductive.

3.25 Marking. Resistors shall be marked with the PIN (see 1.2.1 and 3.1), "JAN" marking, date code, source code, and manufacturer's production lot code. Date and source codes shall be in accordance with MIL-STD-1285. At the option of the manufacturer, the PIN may appear on two lines. In that case, the PIN shall be divided between the terminal designation and the first digit of the resistance value. The material used for marking of the resistor shall not be electrically conductive. The following is an example of the complete marking:

12345	=	Source code
7333J	=	Date code and JAN marking
RBR52L	=	Type designation
12601FM	=	Type designation
XXXXXX	=	Manufacturer's production lot code

The date code shall be the date of the final assembly operation for the production lot as defined in 4.6.2.2. The common manufacturing record shall include the same date code as that placed on the parts covered by the record. When the physical size of the resistor style precludes the marking of all the above information, the minimum marking required shall be as specified (see 3.1). Marking shall remain legible at the end of all tests. In those cases where full marking requirements are not on the resistor body, the full marking shall be marked on the unit package.

3.25.1 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 a 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 an item fails to meet the requirements of this specification and the applicable specification, sheets, 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 Certification of Registration Number 504,860 for the certification mark "JAN" and Registration Number 1,586,261 for the certification mark "J".

3.25.1.1 Designation marking of resistance values for resistance tolerances A, B, Q, and T. The designated marking of resistance values for resistance tolerances A, B, Q, and T when used with nonstandard decade resistance values shall be as follows:

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- a. The nominal ohmic value shall be marked below the broken line as shown.

JRBR52L-----AM
1123550

- b. If two lines are used, the nominal ohmic value shall be marked below the last line of the PIN as shown.

JRBR52L
-----AM
1123550

NOTE: Standard marking procedure as shown (see 3.25), where applicable.

3.25.2 Alternate marking. When the physical size of the resistor precludes the marking of the above in 3.25, the alternate method will be as specified in the associated specification sheet (see 3.1).

3.26 Product level substitution. A manufacturer may supply to all higher FRL's than that to which he is qualified. Parts qualified and marked to lower FRL's are substitutable, with acquiring agency approval, for higher FRL parts, and shall not be remarked unless specified in the contract or order (see table VII).

TABLE VII. Product level substitution.

Product level	Product level substitute
S	---
R	S
P	S, R
M	S, R, P
C (non-ER)	S, R, P, M

3.26.1 Resistance tolerance substitution. A manufacturer may supply to all higher resistance tolerances than that to which he is qualified. Parts qualified and marked to lower resistance tolerances are substitutable, with acquiring agency approval, for higher tolerance parts and shall not be remarked unless specified in the contract or order (see table VIII).

TABLE VIII. Resistance tolerance substitution.

Resistance tolerance	Resistance tolerance substitute
T	---
Q	T
A	T, Q
B	T, Q, A
F	T, Q, A, B

3.27 Soldering. Electrical connections shall be mechanically secure before and electrically continuous after soldering.

3.28 Recycled, 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.

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3.29 Workmanship. Resistors shall be processed in such a manner as to be uniform in quality and free from any 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 establish and maintain a QPL system as described in 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 shall be verified by the qualifying activity of this specification as prerequisite for qualification and continued 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 also be 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.

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 A](#) to this specification. The sample shall be taken at random from a production run and shall be produced with equipment and procedures normally used in production. Each resistor style shall be qualified separately.

4.4.2 Test routine. Sample units shall be subjected to the qualification inspection specified in [table IX](#), in the order shown. All 324 sample units shall be subjected to the inspection of group I and group IA. The 324 sample units shall then be divided as specified in [table IX](#) for group II through group VI inclusive and group VIII, and subjected to the inspection for their particular group. An additional 10 to 20 sample units, as applicable, and 19 additional sample units shall be subjected to the inspection of group IB and group VII, respectively.

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

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4.4.4 FR qualification (ER only). 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 FRL. Level M (1.0 percent) of FRSP-60 shall apply. Sample units shall be subjected to the qualification inspection specified in group VI, [table IX](#) (see [4.4.2](#)). Entire life test sample shall continue on test to 10,000 hours as specified in [4.8.17](#), upon completion of the 2,000 hour qualification.
- b. Procedure II: Extension of qualification to lower FRL. To extend qualification to the R (0.01 percent) and S (0.001 percent) FRL's, data from two or more styles of similar construction may be combined.
- c. Procedure III: Maintenance of FRL qualification. Maintenance period A of FRSP-10 of MIL-STD-690 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 [4.7.1](#), group C inspection).

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

- a. [MIL-STD-790](#) program.
- b. The manufacturer has not modified the design of the item.
- c. The specification requirements for the item have not been amended so far as to affect the character of the item.
- d. Lot rejection for group A inspection does not exceed 15 percent or one lot, whichever is greater.
- e. Lot rejection for group B inspection does not exceed 5 percent or one lot, whichever is greater. (Subgroup 2, group B, not included in reject rate).
- f. The requirements for group C inspection are met.
- g. The records of FR tests combined substantiate that the "M" (1.0 percent), or "P" (0.1 percent) FRL has been maintained, or that the manufacturer continues to meet the "R" (0.01 percent), and "S" (0.001 percent) FRL for which qualified, although the total component hours of testing does not, as yet, meet the requirements of [4.4.4c](#).
- h. Continued qualification to the non-ER level (C) shall be based on continued maintenance of qualification for the ER part (minimum "P" FRL maintenance).

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TABLE IX. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units for inspection	Number of failures permitted <u>1/</u>	
Certification requirements: <u>2/</u>					
Weldable terminals Flux	3.5.1.2 3.5.5			N/A	
<u>Group I</u> Conditioning <u>3/ 4/</u> DC resistance	3.6 3.9	4.8.2 4.8.5	All sample units (except groups IB and VII)	0	
<u>Group IA</u> Visual and mechanical examination <u>3/ 5/</u>	3.1, 3.4, 3.5 to 3.5.6 inclusive, 3.25, 3.27 to 3.29 inclusive	4.8.1			
Short time overload <u>3/</u> Thermal shock <u>3/</u>	3.7 3.8	4.8.3 4.8.4			
<u>Group IB</u> Solderability ("L" terminal only)	3.10	4.8.6	10 sample units both leads; 20 sample units single leads	1	1
<u>Group II</u> Dielectric withstanding voltage <u>6/</u> Terminal strength	3.11 3.12	4.8.7 4.8.8	30 sample units high value	1	
<u>Group III</u> Insulation resistance Moisture resistance Dielectric withstanding voltage <u>6/</u> Terminal strength	3.13 3.14 3.11 3.12	4.8.9 4.8.10 4.8.7 4.8.8	30 sample units high value	1	
<u>Group IV</u> Resistance to soldering heat Shock, specified pulse Vibration, high frequency	3.15 3.16 3.17	4.8.11 4.8.12 4.8.13	30 samples units high value	1	
<u>Group V</u> Resistance temperature characteristic <u>3/</u> Low temperature storage Low temperature operation	3.18 3.19 3.20	4.8.14 4.8.15 4.8.16	10 high value 10 - 10,000 ohms or nearest 30 10 low value	1	
<u>Group VI</u> Life	3.21	4.8.17	34 high value 102 34 - 10,000 ohms 34 low value	1	
<u>Group VII</u> Fungus <u>7/</u> Resistance to solvents	3.22 3.23	4.8.18 4.8.19	10 19 any value 9	0	
<u>Group VIII</u> High temperature exposure	3.24	4.8.20	34 high value 102 34 - 10,000 ohms 34 low values	1	

See footnotes at top of next page.

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TABLE IX. Qualification inspection - Continued.

- 1/ Failure of a resistor in one or more tests of a group shall be charged as a single defective.
- 2/ The manufacturer shall verify by certification that these requirements have been met in fabricating resistors furnished to this specification.
- 3/ Nondestructive tests.
- 4/ Test shall not be performed if manufacturer presents certified data proving test has been performed on the qualification sample.
- 5/ Marking shall be considered defective if marking is illegible or incorrect.
- 6/ This test shall be performed not less than 10 minutes nor more than 30 minutes after the preceding test.
- 7/ Test shall not be performed if manufacturer certifies that all external materials are fungus resistant.

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

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

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery.

4.6.1.1 Non-ER resistors. Inspection of product for delivery shall consist of the requirements in [4.6.3.1](#).

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

4.6.2 Inspection and production lot.

4.6.2.1 Inspection lot. The total number of pieces in any given lot submitted for conformance inspection shall not exceed the number of pieces accumulated from 1-month production. Provided the same materials, methods, and production lines are used, the manufacturer may combine styles, resistance values, and resistance tolerances for lot formation. However, test data on each style shall be kept separate.

4.6.2.2 Production lot (ER only). A production lot shall consist of all resistors of the same style, nominal resistance value, resistance tolerance 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 examination, and solderability requirements. In-line or process controls may be part of such a 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 FRL assessment, this product is still expected to meet the environmental qualification type requirements of the ER part, such as moisture resistance, shock, and vibration..

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

TABLE X. Group A inspection (ER only).

Inspection	Requirement paragraph	Test method paragraph	Number of samples
<u>Subgroup 1</u> ^{1/} Conditioning DC resistance	3.6 3.9	4.8.2 4.8.5	100 percent
<u>Subgroup 2</u> Visual and mechanical inspection Body Lead dimension Marking Workmanship	3.1, 3.4, 3.5 to 3.5.6 incl., 3.25, 3.27 to 3.29 incl.	4.8.1	See 4.6.3.2.3
<u>Subgroup 3</u> Solderability (applicable to "L" terminal only) ^{2/}	3.10	4.8.6	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/} The manufacturer may request the deletion of the subgroup 3 solderability test, provided an inline 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 (see [appendix A](#)).

4.6.3.2.1 Subgroup 1 tests. Subgroup I tests shall be performed on 100 percent of the product supplied under this specification. Resistors that are out of resistance tolerance, or which experience a change in resistance greater than that permitted for the test of this group, shall be removed from the lot. Lots having more than 5 percent total rejects, or one resistor, whichever is greater, due to exceeding the specified resistance change limit, shall not be furnished on the contract or order.

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4.6.3.2.2 Manufacturers production inspection. If the manufacturers perform tests equal to, or more stringent than, those specified in subgroup 1, [table X](#) as the final step of this production process, group A, subgroup 1 inspection may be waived and the data resulting from the manufacturers production tests may be used instead. Authority to waive the subgroup I inspection shall be granted by the qualifying activity only. The following criteria must be complied with:

- a. Tests conducted by the manufacturer during production shall be clearly identical to, or more stringent than, that specified for subgroup 1. Test conditions shall be equal to, or more stringent than, those specified for subgroup 1.
- b. Manufacturer subjects 100 percent of the product supplied under this specification to their production tests.
- c. The parameters measured and the failure criteria shall be the same as, or more stringent than, those specified herein.
- d. The lot rejection criteria is the same as, or more stringent than, that specified herein.
- e. The manufacturer shall make available all information concerning the test procedures and instrumentation used in their production tests. This data shall be provided as part of the evaluation required for [MIL-STD-790](#). The manufacturer shall also make available to the Government all records of all detail test data resulting from production tests.
- f. Once approved, the manufacturer shall not change the test procedures or criteria without prior notification and concurrence by the qualifying activity.

4.6.3.2.3 Subgroup 2. A sample of parts shall be randomly selected in accordance with [table XI](#). If one or more defects are found, the lot shall be screened and defects removed. After screening and removal of defects, a new sample of parts shall be randomly selected in accordance with [table XI](#). If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

TABLE XI. Sampling plan for subgroup 2.

Lot size	Sample size for subgroup 2
1 to 13	100%
14 to 150	13
151 to 280	20
281 to 500	29
501 to 1,200	34
1,201 to 3,200	42
3,201 to 10,000	50
10,001 to 35,000	60
35,001 to 150,000	74
150,001 to 500,000	90
500,001 and over	102

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4.6.3.2.4 Subgroup 3.

4.6.3.2.4.1 Sampling plan. Thirteen samples shall be selected randomly from each inspection lot and subjected to the subgroup 3 solderability test. The manufacturer may use electrical rejects from subgroup 1 screening tests for all or part of the samples to be used for solderability testing. If there are one or more defects, the lot shall be considered to have failed.

4.6.3.2.4.2 Rejected lots. In the event of one or more defects, the inspection lot is rejected. The manufacturer may use one of the following options to rework the lot.

- a. Each production lot that was used to form the failed inspection lot shall be individually submitted to the solderability test as required in 4.8.6. Production lots that pass the solderability test are available for shipment. Production lots failing the solderability test can be reworked only if submitted to the solder dip procedure in 4.6.3.2.4.2b.
- b. The manufacturer submits the failed lot to a 100 percent solder dip using an approved solder dip process (see [appendix A](#)) in accordance with 3.5.3. Following the solder dip, the electrical measurements required in group A, subgroup 1 tests shall be repeated on 100 percent of the lot. The PDA for the electrical measurements shall be as for the subgroup 1 tests. Additional samples shall be selected in accordance with table XII and subjected to the solderability test with zero defects allowed. If the lot fails this solderability test, the lot may be reworked a second time and retested. If the lot fails the second rework, the lot shall be considered rejected and shall not be furnished against the requirements of this specification.

TABLE XII. Solderability sampling 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

4.6.3.2.4.3 Disposition of samples. The solderability test is considered a destructive test and samples submitted to the solderability test shall not be supplied on the contract.

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 plans. Minimum sample sizes for inspection lots shall be selected in accordance with table XI. 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 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](#).

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4.6.5 Group B inspection. Group B inspection shall consist of the inspections specified in table XIII, in the order shown, and shall be made on samples from lots which have been subjected to and passed the group A inspection. Sample units selected for subgroup 1 shall be of the highest resistance value; subgroup 2 sample units shall be of any value.

4.6.5.1 Sampling plan.

4.6.5.1.1 Subgroup 1. A sample of 13 parts (highest value) shall then be randomly selected. If one or more defects are found, the lot shall be rescreened and defects removed. If one or more defects are found, a new sample of 13 parts (highest value) shall then be randomly selected. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

TABLE XIII. Group B inspection (ER only).

Inspection	Requirement paragraph	Test method paragraph	Number of samples	Number of failures
<u>Subgroup 1</u> 1/ Resistance temperature characteristic	3.18	4.8.14	13 (highest value)	0
<u>Subgroup 2</u> 1/ Resistance to solvents	3.23	4.8.19	12 (any value)	4.6.5.1.2

1/ 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.

4.6.5.1.2 Subgroup 2. A sample of 12 parts (any value) shall then be randomly selected. If one or more defects are found, the lot shall be rescreened and defects removed. If one or more defects are found, a new sample of 12 parts (any value) shall then be randomly be selected. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

4.6.5.1.3 Disposition of sample units. Sample units which have been subjected to group B inspection may be delivered on the contract provided they are within resistance tolerance and meet requirements for visual and mechanical inspection.

4.7 Periodic group C inspection (ER only). Periodic inspection shall consist of group C 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 the periodic inspections.

4.7.1 Group C inspection (ER only). Group C inspection shall consist of the inspections specified in table XIV, in the order shown. Group C inspection shall be made on sample units selected from inspection lots which have passed the group A and group B inspections.

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TABLE XIV. Group C inspection (ER only).

Inspection	Requirement paragraph	Test method paragraph	Number of sample Units for inspection	Number of failures allowed
<u>Monthly Subgroup 1</u> Life	3.21	4.8.17	See 4.7.2	See 4.7.2
<u>Subgroup 2</u> Moisture resistance	3.14	4.8.10	18 any value	1
<u>Quarterly 1/</u> Dielectric withstanding voltage Insulation resistance Low temperature storage Low temperature operation Terminal strength	3.11 3.13 3.19 3.20 3.12	4.8.7 4.8.9 4.8.15 4.8.16 4.8.8	18 highest value	1
<u>Semiannually 1/</u> Short time overload Thermal shock Resistance to soldering heat Shock, specified pulse Vibration, high frequency	3.7 3.8 3.15 3.16 3.17	4.8.3 4.8.4 4.8.11 4.8.12 4.8.13	6 any value	0
<u>Annual</u> High temperature exposure	3.24	4.8.20	34 high 102 34 10 kohm 34 low	1

1/ If the manufacturer can demonstrate that these tests have been performed 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 requirements in case of dispute.

4.7.1.1 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 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.

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4.7.2 Monthly (subgroup 1). Samples shall be accumulated from each inspection lot and placed on extended life test of 4.8.17 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 with, 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 3.21.2).

4.7.2.1 Monthly (subgroup 2). The 18 sample units of any resistance value shall be selected during the two week period prior to the monthly testing specified in table XIV.

4.7.3 Quarterly. The 18 sample units of the highest resistance value shall be selected during the month prior to the quarterly testing specified in table XIV.

4.7.4 Semiannually. The 6 sample units of any resistance value shall be selected during the month prior to the semiannual testing specified in table XIV.

4.7.5 Annual. The 102 sample units shall be selected during the quarter prior to the annual testing specified in table XIV.

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

4.7.6 Noncompliance. If a sample fails to pass group C inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such a failure and take corrective action on the materials or processes, or both, as warranted, and on all units of production which can be corrected and which were manufactured under essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity, has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed, at the option of the qualifying activity). Group A and group B inspections may be reinstated; however, final acceptance and shipment shall be withheld until the group C inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.8 Methods of inspection.

4.8.1 Visual and mechanical inspection. Resistors shall be examined to verify that the materials, design, construction, physical dimensions, marking and workmanship are in accordance with the applicable requirements (see 3.1, 3.4, 3.5 to 3.5.6 inclusive, and 3.25, and 3.27 to 3.29 inclusive).

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4.8.2 Conditioning (see 3.6). Resistors shall be conditioned in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

- a. Method of mounting: Resistors shall be supported by their terminal leads. 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 circulation of air over the resistors other than that caused by heat of the resistors.
- b. Temperature and tolerance: 125°C +15°C, -0°C
- c. Initial measurements: At the manufacturer's option, measurements may be made inside or outside the chamber.
 - (1) Inside the chamber: When measurements are to be made inside the chamber, the initial dc resistance shall be measured after mounting at the applicable test temperature, after temperature stabilization and within 8 hours of exposure of the resistors to the test temperature. This initial measurement shall be used as the reference temperature for all subsequent measurements under the same conditions.
 - (2) Outside the chamber: When measurements are to be made outside the chamber, the initial dc resistance shall be measured after mounting at the room temperature. This initial measurement shall be used as the reference temperature for all subsequent measurements under the same conditions.
- d. Operating conditions: Rated dc continuous working voltage or rated continuous working voltage from an ac supply at commercial line frequency and waveform, intermittently, 1 hour 30 minutes "on" and 30 minutes "off" for 100 hours +16 hours, -4 hours. Each resistor shall dissipate wattage equal to the wattage rating of the resistor, but shall not exceed maximum voltage.
- e. Measurement after conditioning: Leads may be cleaned before measurement:
 - (1) Inside the chamber: While resistors are still in oven, dc resistance shall be measured as specified in 4.8.5 at the end of 100 hours +16 hours, -4 hours.
 - (2) Outside the chamber: When measurements are made outside the chamber, resistors shall be stabilized before measurement.
- f. Examination after conditioning: Resistors shall be examined for evidence of mechanical damage.

4.8.3 Short time overload (see 3.7). DC resistance shall be measured as specified in 4.8.5. Each resistor shall be subjected to a dc test potential equivalent to that calculated for twice the rated wattage, but not to exceed twice the maximum voltage (see 3.1), for 10 minutes under the following conditions:

- a. In free air space, predicated on horizontal mounting with the resistor mounted in a minimum of .5 inch (12.7 mm) from any other resistor or the mounting base.
- b. In still air, with no circulation other than that created by the heat of the resistors being operated.

Thirty minutes +15 minutes, -0 minutes after removal of the test potential, the dc resistance shall again be measured as specified in 4.8.5. Resistors shall then be examined for evidence of arcing, burning, and charring.

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4.8.4 Thermal shock (see 3.8). Resistors shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:

- a. Mounting: In such a manner as 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 the resistors are placed in the chamber.
- b. Measurement before cycling: DC resistance shall be measured as specified in 4.8.5.
- c. Test condition: B.
- d. Measurement after cycling: Not less than 1 hour, but within a 24 hour period after the last cycle, dc resistance shall be measured as specified in 4.8.5.
- e. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.8.5 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. Measurement 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. Limit or error of measuring apparatus: The maximum error of the measuring instrument shall not exceed the lesser of:
 - (1) One-fourth the initial resistance tolerance +0.002 ohm.
 - (2) One-tenth percent of the measured resistance +0.002 ohm.
- c. 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.
- d. Test voltage for bridges: Measurements of resistance shall be made by using the test voltages specified in table XV. The test voltage chosen, whether it is the maximum or a lower voltage which would still provide the sensitivity required, shall be applied across the terminals of the resistor. This same voltage shall be used whenever a subsequent resistance measurement is made.
- e. Points of application of test voltage for initial resistance tolerance measurement (see 3.1): Resistors of 10 ohms and less: .375 inch \pm .0625 inch (9.53 mm \pm 1.588 mm) from the end of the body.
- f. Temperature: The dc resistance test specified in group I of table IX shall be measured at 25°C \pm 2°C. For all other tests, unless otherwise specified herein, the temperature at which subsequent and final resistance measurements are made in each test shall be within 2°C of the temperature at which the first resistance measurement was made.

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TABLE XV. DC resistance test voltages.

Resistance, nominal	0.5 watt and greater	Less than 0.5 watt
ohms	<u>Maximum test voltages</u>	<u>Maximum test voltages</u>
less than 1 ohm	0.1	0.05
1 to 9.999 inclusive	0.3	0.15
10 to 99.99 inclusive	1.0	1.00
100 to 999.9 inclusive	3.0	3.00
1,000 to 9,999 inclusive	10.0	3.00
10,000 to 99,999 inclusive	30.0	10.00
100,000 and higher inclusive	100.0	30.00

4.8.6 Solderability (applicable to terminal "L" only)(see 3.10). Resistors shall be tested in accordance with method 208 of MIL-STD-202. The following detail shall apply: Either one or two of the leads shall be tested, as applicable (see table IX).

4.8.7 Dielectric withstanding voltage (see 3.11). This test shall be performed not less than 10 minutes, nor more than 30 minutes, after the preceding test.

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

- a. Special preparations: Resistors shall be placed in a conductive material which will conform to the resistor surface so that between 90 percent and 100 percent of the outer periphery is contacted. The conductive material shall be centered on the resistor body. Care should be taken that any part of the resistor lead is as far away from the conductive material as possible.
- b. Initial measurement: DC resistance shall be measured as specified in 4.8.5.
- c. Magnitude of test voltage: 750 V rms.
- d. Nature of potential: An ac supply at commercial line frequency and waveform.
- e. Duration of application of test voltage: 1 minute.
- f. Rate of application of test voltage: The test voltage shall be raised from zero to 750 V rms, as uniformly as practicable, at a rate of approximately 100 volts per second.
- g. Points of application of test voltage: Between resistor terminals connected together and mounting hardware, or the conductive material, as practicable.
- h. Measurement after test: DC resistance shall be measured as specified in 4.8.5.
- i. Examination after test: Resistors shall be examined for evidence of flashover, mechanical damage, arcing, and insulation breakdown.

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4.8.7.2 Barometric pressure (reduced). Resistors shall be tested in accordance with method 105 of MIL-STD-202. The following details and exceptions shall apply.

- a. Method of mounting: As specified in [4.8.7.1a](#).
- b. Initial measurement: DC resistance shall be measured as specified in [4.8.5](#).
- c. Test condition: D.
- d. Test voltages during subjection to reduced pressure: 200 volts.
- e. Nature of potential: As specified in 4.8.7.1d.
- f. Duration of application of test voltage: 5 seconds.
- g. Rate of application of test voltage: 100 volts per second.
- h. Points of application of test voltage: As specified in 4.8.7.1g.
- i. Measurement after test: DC resistance shall be measured as specified in 4.8.5.
- j. Examinations after test: As specified in 4.8.7.1i.

4.8.8 Terminal strength (see 3.12). Resistors shall be tested in accordance with method 211 of MIL-STD-202. The following details and exceptions shall apply.

- a. Test conditions: A and D (pull test and twist test, respectively). Applied force (A): 4.5 pounds. Resistor clamped by 1 lead and force applied to other lead.
- b. Measurement before and after test: DC resistance shall be measured as specified in [4.8.5](#).

4.8.9 Insulation resistance (see 3.13). Resistors shall be tested in accordance with method 302 of MIL-STD-202 with the following exceptions:

- a. Test condition: A or B, whichever is greater.
- b. Special preparation: As specified in [4.8.7.1a](#).
- c. Points of measurement: As specified in 4.8.7.1g.

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4.8.10 Moisture resistance (see 3.14). Resistors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply.

- a. Mounting: Resistors shall be soldered by their leads to rigid mounts or terminal lugs. The spacing of the mounts or terminal lugs shall be such that the length of each resistor lead is approximately .375 inch (9.53 mm) when measured from the edge of the supporting terminal to the resistor body. One half of the specimens shall be covered with a V-shaped strap whose width is such that the resistor shall not extend more than .5 inch (12.7 mm) beyond the edge of the strap. The strap shall be made of a corrosion resistant metal and shall be kept in contact with the resistor body by supporting the resistor body as indicated on figure 2, with a nonconducting, noncorrosive support whose width is less than that of the body and which will not act as a moisture trap. The mounting straps may be individual for each resistor or continuous for all resistors.
- b. Initial measurements: Immediately following the initial drying period, the dc resistance shall be measured as specified in 4.8.5.

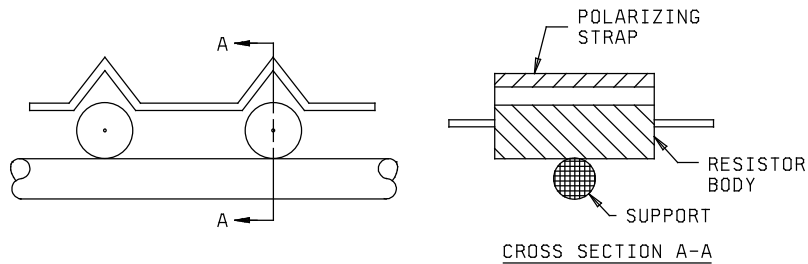


FIGURE 2. Mounting strap for moisture resistance test.

- c. Polarization and loading voltage: The resistors shall be divided into two equal groups; one group shall be subjected to polarization and the other group to load.
 - (1) Polarization: During step 1 to step 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 hardware or polarizing straps, as applicable.
 - (2) Loading voltage: During the first two hours of step 1 and step 4, a dc test potential equivalent to 100 percent rated wattage, but not exceeding the maximum rated voltage shall applied to the resistors. Where potential to ground is over 250 volts, supplementary insulation shall be provided.

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- d. Final measurements: Upon completion of step 6 of the final cycle, the resistors shall be conditioned at a temperature of $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$, and at a relative humidity of 90 percent to 95 percent for a period of 1 hour 30 minutes to 3 hours 30 minutes. After conditioning, the resistors shall be removed from the chamber and within 8 hours, the dc resistance shall be measured as specified in [4.8.5](#). Wiping and forced air drying prior to measurement is not allowed. The subsequent 4-hour to 24-hour conditioning period and measurements do not apply.
- e. Examinations after test: Resistors shall be examined for evidence of breaking, cracking, spalling, and loosening of terminals and mounting hardware.

4.8.11 Resistance to soldering heat (see [3.15](#)). Resistors shall be tested in accordance with method 210 of [MIL-STD-202](#). The following details and exceptions shall apply:

- a. Measurement before test: DC resistance shall be measured as specified in [4.8.5](#).
- b. Sample units shall not have been soldered during any of the previous tests.
- c. Test condition: C.
- d. Measurement after test: After completion of terminal immersion and the parts have returned to room temperature, the dc resistance shall be measured as specified in [4.8.5](#).
- e. Examination after test: Resistor shall be examined for evidence of mechanical damage.

4.8.12 Shock, specified pulse (see [3.16](#)). Resistors shall be tested in accordance with method 213 of [MIL-STD-202](#). The following details and exceptions shall apply:

- a. Special mounting means: Resistors shall be mounted in relation to the test equipment in such a manner that the stress applied is in the direction which would be considered most detrimental. Resistors shall be rigidly mounted on appropriate jig fixtures with their bodies restrained from movement and their leads supported at a distance of $.375 \text{ inch} \pm .0625 \text{ inch}$ ($9.53 \text{ mm} \pm 1.588 \text{ mm}$) from the resistor body. These fixtures shall be constructed in a manner to insure that the points of the resistor mounting supports will remain in a static condition with reference to the shock table.
- b. Test leads: Test leads used during this test shall be no larger than AWG size 22 stranded wire, so that the influence of the test lead on the resistor will be held to a minimum. The test lead length shall be no longer than necessary.
- c. Measurement before shock: DC resistance shall be measured as specified in [4.8.5](#).
- d. Test condition: I.
- e. Number and direction of applied shocks motion: The resistors shall be subjected to five shocks (total of 15 shocks) in each of three mutually perpendicular planes. The initial plane shall pass through the resistor axis and terminals, and the other two planes shall be mutually perpendicular.

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- f. Measurement during shock: Each resistor shall be monitored to determined electrical discontinuity by a method which shall at least be sensitive enough to monitor or register, automatically, any electrical discontinuity of 0.1 millisecond or greater duration.
- g. Measurement after shock: DC resistance shall be measured as specified in [4.8.5](#).
- h. Examination after test: Resistors shall be examined for evidence of mechanical and electrical damage.

4.8.13 Vibration, high frequency (see [3.17](#)). Resistors shall be tested in accordance with method 204 of [MIL-STD-202](#). The following details and exceptions shall apply.

- a. Mounting of specimens: Resistors shall be mounted in relation to the test equipment in such a manner that the stress applied is in the direction which would be considered most detrimental. Resistors shall be rigidly mounted on appropriate jig fixtures with their bodies restrained from movement and their leads supported at a distance .375 inch \pm .0625 inch (9.53 mm \pm 1.588 mm) from the resistor body. These fixtures shall be constructed in a manner to ensure that the points of the resistor mounting supports will remain in a static position with reference to the vibration table.
- b. Test leads: Test leads used during this test shall be no larger than AWG size 22 stranded wire, so that the influence of the test lead on the resistor will be held to a minimum. The test lead length shall be no longer than necessary. A shielded cable, which may be necessary because of the field surrounding the vibration table, shall be clamped to the resistor mounting jig.
- c. Measurement before vibration: DC resistance shall be measured as specified in [4.8.5](#).
- d. Test condition: D (.06 inch double amplitude or 20 G, whichever is less, with 10 through 2,000 Hz frequency).
- e. Motion: In each of three mutually perpendicular planes; initial plane shall pass through the resistor axis and terminals, and the other two planes shall be mutually perpendicular.
- f. Measurements during vibration: Each resistor shall be monitored to determine electrical discontinuity by a method that shall at least be sensitive enough to monitor or register, automatically, any electrical discontinuity of 0.1 millisecond or greater duration.
- g. Measurement after vibration: DC resistance shall be measured as specified in [4.8.5](#).
- h. Examination after test: Resistors shall be examined for evidence of mechanical and electrical damage.

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4.8.14 Resistance temperature characteristic (see 3.18). Resistors shall be tested in accordance with method 304 of MIL-STD-202. The following detail shall apply: Test temperature: In accordance with table XVI.

TABLE XVI. Temperatures for resistance temperature characteristic test.

Sequence	Temperature °C 1/	
	Conformance inspection	Qualification inspection
1	<u>2/</u> 25	<u>2/</u> 25
2		0
3		-15
4		-55 +0, -3
5	-65 +0, -3	-65 +0, -3
6	<u>3/</u> 25	<u>3/</u> 25
7		50
8		75
9		105
10	125 +15, -0	145 +15, -0

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

1. Room temperature 2/
2. +125 ±3
3. Room temperature 2/
4. -55 ±3.

2/ This temperature shall be considered the reference temperature for each of the temperatures in sequences 2 through 5 inclusive.

3/ This temperature shall be considered the reference temperature for each of the temperatures in sequences 7 through 10 inclusive.

4.8.15 Low temperature storage (see 3.19).

4.8.15.1 Mounting. Resistors shall be mounted by their normal mounting means, in such a manner that there is at least 1 inch of free air space around each resistor, and is such a position with respect to the air stream that the mounting offers substantially no obstruction to the flow of air across and around the resistors.

4.8.15.2 Procedure. DC resistance shall be measured as specified in 4.8.5. Within 1 hour after this measurement, the resistors shall be placed in a cold chamber at -65°C +0°C, -3°C. Twenty-four hours after the resistors have reached this temperature; the temperature of the chamber shall be gradually increased to room temperature within a period of not more than 8 hours. The resistors shall be removed from the chamber and maintained at a temperature of 25°C ±5°C for a period of approximately 24 hours; the dc resistance shall again be measured as specified in 4.8.5. Resistors shall then be examined for evidence of mechanical damage.

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4.8.16 Low temperature operation (see 3.20). Following the final dc resistance measurement specified in 4.8.5, the resistors, mounted as specified in 4.8.15.1, shall again be placed in a cold chamber at room temperature. The temperature shall be gradually decreased to $-55^{\circ}\text{C} +0^{\circ}\text{C}$, -0°C within a period of not less than 1 hour 30 minutes. For conformance inspection only, and at the option of the manufacturer, the resistors may be placed when the chamber is already at the extreme low temperature. After 1 hour of stabilization at this temperature, full rated continuous working voltage as specified in 3.5.8 shall be applied for 45 minutes. The resistors may be loaded individually or in parallel. Fifteen minutes $+5$ minutes, -0 minutes after removal of voltage, the temperature in the chamber shall be gradually increased to room temperature with a period of not more than 8 hours. The resistors shall then be removed from the chamber and maintained at a temperature of $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for a period of approximately 24 hours. The dc resistance shall then again be measured as specified in 4.8.5. Resistors shall then be examined for evidence of mechanical damage.

4.8.17 Life (see 3.21). Resistors shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply.

- a. Mounting: Resistors shall be mounted on lightweight terminals. The effective length of each terminal shall be $.375$ inch $\pm .0625$ inch (9.53 mm ± 1.588 mm). The method of attaching the resistor leads to the terminals shall be at the option of the manufacturer. Resistors shall be so arranged that the temperature of any one resistor shall not appreciably influence the temperature of any other resistor. Regardless of the mounting and termination method selected, the integrity of the connections to each resistor undergoing test shall be verified periodically to assure that each part is tested with the voltage specified in 4.8.17d.
- b. Test temperature: Qualification inspection and extended life testing: Ambient temperature $125^{\circ}\text{C} +15^{\circ}\text{C}$, -0°C .
- c. Initial measurements: Measurements may be made inside or outside the chamber.
 - (1) Inside the chamber - When measurements are to be made inside the chamber, the initial dc resistance shall be measured after mounting at the applicable test temperature, after temperature stabilization, and within 8 hours of exposure of the resistors to the test temperature. This initial measurement shall be used as the reference temperature for all subsequent measurements under the same conditions.
 - (2) Outside the chamber: When measurements are to be made outside the chamber, the initial dc resistance shall be measured after mounting at the room temperature. This initial measurement shall be used as the reference temperature for all subsequent measurements under the same conditions.
- d. Operating conditions: Rated dc continuous working voltage, or filtered or nonfiltered full wave rectified ac voltage shall be applied intermittently, 1 hour 30 minutes "on" and 30 minutes "off", for the applicable number of hours (see 4.8.17f), and at the applicable test temperature. "On time" shall be 75 percent of the total elapsed time. During the "on" cycle, the voltage shall be regulated and controlled to maintain ± 5 percent of the rated continuous working voltage.
- e. Test condition: Two thousand hours for qualification inspection continued to 10,000 hours. Ten thousand hours for FRL determination of group C.

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f. Measurements during test:

- (1) Qualification inspection: DC resistance 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.
- (2) Extended life testing: DC resistance shall be measured at the end of the 30 minute "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; 4,000 hours +96 hours, -24 hours; 6,000 hours +96 hours, -24 hours; 8,000 hours +96 hours, -24 hours; and 10,000 hours +120 hours, -0 hour have elapsed. Measurements shall be made as near as possible to the specified time but may be adjusted so that measurements need not be made during other than normal work days.
- (3) Measurement outside chamber: When measurements are made outside the chamber, resistors shall be outside the chamber for a minimum of 45 minutes and stabilized before measurements.

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

4.8.18 Fungus (see [3.22](#)). Resistors shall be tested in accordance with method 508 of [MIL-STD-810](#). Resistors shall be examined for evidence of fungus.

4.8.19 Resistance to solvents (see [3.23](#)). Resistors shall be tested in accordance with method 215 of [MIL-STD-202](#). The following details shall apply:

- a. The marked portion of the resistor body shall be brushed.
- b. The number of sample units shall be as specified in [table IX](#) and [table XIII](#), as applicable.
- c. Resistors shall be examined for mechanical damage and legibility of markings.

4.8.20 High temperature exposure (see [3.24](#)).

- a. Mounting: Resistors shall be mounted by their normal mounting means.
- b. Initial measurements: DC resistance shall be measured as specified in [4.8.5](#) at room ambient conditions.
- c. Procedure: Following initial resistance measurements resistors shall be placed in a chamber maintained at $145^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for a period of 2,000 hours with no load applied.
- d. Measurements during test: At 250 hours +48 hours, -0 hours, resistors shall be removed from the chamber and permitted to stabilize at room temperature and within 6 hours after removal, the dc resistance shall be measured as specified in [4.8.5](#). Resistors shall be examined for evidence of mechanical damage.
- e. Final measurements: After removal from 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. The dc resistance shall be measured as specified in [4.8.5](#). Resistors shall be examined for evidence of mechanical damage.

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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 activities within the Military Service 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.

6. NOTES

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

6.1 Intended use. These resistors are designed for use in dc amplifiers, voltmeter multipliers, electronic computers, meters, and laboratory test equipment.

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.

* b. Unless 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. Marking requirements for FRL (see 3.26).

* 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 purchase orders for the products covered by this specification. The activity responsible for the QPL is the US Army Communications - Electronics RDEC, ATTN: RDER-PRO, Aberdeen Proving Ground, Bldg. 6010 K-130, C2/CNT East, MD 21005; however, information pertaining to qualification of products may be obtained from the DLA Land and Maritime, ATTN: VQP, P.O. Box 3990, Columbus, OH 43218-3990. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

6.4 High voltages, high resistance's (or both) and high altitudes. Where voltages higher than 250 volts rms are present between the resistor circuit and grounded surface on which the resistor is mounted, or where the resistance is so high that the insulation resistance to ground is an important factor, precautionary measures should be taken.

6.5 Derating. The intention of this specification in covering temperature rise is to limit the final hot spot temperature to 145°C. However, if it is desired to operate these resistors at ambient temperatures greater than 125°C, the resistors should be derated in accordance with [figure 1](#).

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6.6 Military maintenance. For the purposes of supply standardization and item control of replacement parts, terminal and ΔR performance requirement symbol "L" (solderable leads) is a substitute for symbol "S" (solderable leads), and symbol "U" (weldable leads) is a substitute for symbol "W" (weldable leads). NOTE: Symbol "S" and "W" specified in MIL-R-39005B.

6.6.1 Terminal. Symbol "L" and "U" are substitutable for items identified by symbols "S" and "W" respectively, under MIL-R-39005B.

6.7 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 new equipment design. All application and use information concerning these resistors is also provided in MIL-HDBK-199.

6.8 Power rating. The power rating of these resistors is conservative and are rated approximately 50 percent of the corresponding commercial ratings.

6.9 Retinning leads. If retinning (hot solder dip) of the leads is required, see [3.5.3](#).

6.10 PIN. PIN is a new term encompassing previous terms used in specifications such as part number, type designator, and identification number, (see [1.2.1](#)).

6.11 Tin whisker growth. The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to [ASTM-B545](#) (Standard Specification for Electrodeposited Coatings of Tin).

6.12 Low tolerance resistors. Low tolerance resistors (.005 and .01), exhibiting resistance shifts due to high humidity are normal to precision, fixed resistors. Before being considered out of tolerance, resistors should be conditioned in a dry oven. Users of said resistors should contact suppliers for temperature and drying time. Resistors which continue to be out of tolerance after the above conditioning process should be considered rejects.

* 6.13 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmental Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals and additional information is available on their website at <http://www.epa.gov/osw/hazard/wastemin/priority.htm>. Included in the list of 31 priority chemicals are cadmium, lead, and mercury. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see Section 3).

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6.14 Subject term (key word) listing.

Ohm
High degree of stability
Resistance
Solderable
Weldable

6.15 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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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. This section is not applicable to this appendix.

A.3. SUBMISSION

A.3.1 Product levels. Qualification of the C (non-ER) level is predicated upon meeting the ER qualification requirements for FRL P (see [A.4.2](#)). The procedure for submitting samples to become qualified to the initial FRL M is specified in A.3.2.

A.3.2 Sample. When qualification is sought for a resistance range, a sample consisting of 343 sample units in the same style, tolerance, and terminal type shall be submitted together with 2 unenclosed sample units of the same style for group IA of [table IX](#) and a statement indicating the lowest resistance value manufactured. The number of sample units in group II and group VIII inclusive, of [table IX](#), and the applicable resistance value, shall be as specified in [table A-I](#). A minimum of 10 additional sample units shall be submitted for group IB tests. When terminal type "L" in a style is submitted, qualification for terminal type "U" shall be granted with the submission of 60 additional types "U" to group I, group IA, group III, and group V of [table IX](#). Samples shall be divided as indicated by [table IX](#) for the applicable test group. When terminal type "U" in a style is submitted, qualification for type "L" shall be granted with submission of 70 additional type "L" samples to group I, group IA, group IB, group III, and group V of [table IX](#). Samples shall be divided as indicated by [table IX](#) for the applicable test group.

A.3.3 Description of items. The manufacturer shall submit a detailed description of the resistors being submitted for inspection, including material used for the protective coating or enclosure and the type of wire used in the resistance element. After qualification has been granted, no changes shall be made in materials, design, or construction without prior notification to the qualifying activity.

A.4. EXTENSION OF QUALIFICATION

A.4.1 Extent of qualification by tolerance. The resistance range included in the qualification of any one resistor style shall be between the highest resistance value tested and 0.1 ohm, provided the same materials are used within the range qualified. Qualification of resistors by initial resistance tolerance shall qualify resistors of the same style and resistance range in any of the other initial resistance tolerances as listed in [table A-II](#), provided the same coating, enclosure, and materials are used.

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TABLE A-I. Number of sample units and resistance value.

Group number of table IX	Number of sample units <u>1/</u>	Resistance value
II	30	Highest
III	30	Highest
IV	30	Highest
V	30 10 10 10	Highest 10,000 ohms or value nearest 10,000 ohms 10 ohms <u>2/</u>
VI	102 34 34 34	Highest 10,000 ohms (wound with same type of wire as highest resistance value) 10 ohms <u>2/</u>
VII	19	Any value
VIII	102 34 34 34	Highest 10,000 ohms (wound with same type of wire as highest resistance value) 10 ohms <u>2/</u>
Uncoated or unenclosed IA (visual and mechanical)	2	Highest

1/ If the same coatings and materials are not used for all resistance values and tolerances with the same style an additional submission shall be made for each coating and material. The term "material" in this specification does not apply to the resistance wire element.

2/ Ten ohms or a higher value. The higher value is the minimum value for which approval is sought.

TABLE A-II. Extent of qualification by tolerance.

Symbol	Initial resistance tolerance	Will qualify resistance tolerance
T	0.01 percent	Q, A, B, F
Q	0.02 percent	A, B, F
A	0.05 percent	B, F
B	0.1 percent	F
F	1.0 percent	

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A.4.1.1 Additional samples for extension of tolerances qualification. Where qualification to a lower resistance tolerance is desired (such as .02 percent, .01 percent), ten additional sample units each of the highest value and lowest or 10 ohms, whichever is higher, in the lowest resistance tolerances for which qualification is sought, shall be submitted and subjected to the inspection of group I, IA of [table IX](#).

A.4.2 Extent of qualification by product level. The extension of qualification between failure rate levels shall be as specified in table A-III.

TABLE A-III. Extent of qualification by product level.

Product level	Will qualify product level
S	R, P, M
R	P, M
P	M
M	
C (non-ER)	

A.4.3 Extent of qualification by terminal. The extension of qualification between terminal types shall be as specified in table A-IV.

TABLE A-IV. Extent of qualification by terminal.

Terminal symbol	Will qualify symbol
L	U (with 60 additional U submitted, see A.3.2)
U	L (with 70 additional L submitted, see A.3.2)

A.5 SOLDER DIP (RETNING) 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](#) of this appendix) or an equivalent process has been approved by the qualifying activity.

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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 reflowing 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 manufacturing 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.

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

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

- a. After the 100 percent group A screening tests. Following the solder dip/reflowing 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/reflow 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 reflowed no more than two times. The lot after reflowing shall be 100 percent screened for group A electrical requirements (dc resistance) and parts failing (lot not exceeding PDA for group A, subgroup 1 (see 4.6.3.2.1)) these screens shall not be supplied to this specification, if electrical failures are detected after the second reflowing operation exceeding 1 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/reflowing 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 4.8.6.

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Custodians:

Army - CR
Navy - EC
Air Force - 85
DLA - CC
NASA - NA

Preparing activity:

Army - CR

Agent:

DLA - CC

(Project 5905-2013-043)

Review activities:

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

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 <https://assist.dla.mil>.