INCH-POUND
MIL-PRF-26H
w/ Amendment 3
24 June 2016
SUPERSEDING
MIL-PRF-26H
w/ Amendment 2
11 December 2015

PERFORMANCE SPECIFICATION

RESISTOR, FIXED, WIREWOUND (POWER TYPE) GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the general requirements for power type, wirewound, fixed resistors for use in electrical, communications, and associated equipment. Included are general purpose styles of 5 percent initial resistance tolerance, with power ratings ranging from 3 watts to 240 watts at 25°C, derated to 0 power at 350°C (characteristics N and V) and precision axial lead types of .1 (B) percent, .5 (D) percent, and 1 (F) percent initial resistance tolerances with power ratings ranging from 1 watt to 10 watts at 25°C, derated to 0 power at 250°C (characteristic U).

1.2 Classification.

1.2.1 Part or Identifying Number (PIN). The PIN with V characteristic is in the following form (see 3.1):

RW56	V	4R9
Style (1.2.1.1)	Characteristic (1.2.1.2)	Resistance (1.2.1.3)

* The PIN with V characteristic and with a center tapped is in the following form (see 3.1):

RW56	V	49R9	T
Style	Characteristic	Resistance	Center tapped

NOTE: Center tapped resistors are inactive for new design.

The PIN with U characteristic is in the following form (see 3.1):

RW80	U	49R9	F
Style (1.2.1.1)	Characteristic (1.2.1.2)	Resistance (1.2.1.3)	Resistance Tolerance (1.2.1.4)

1.2.1.1 Style. The style is identified by the two-letter symbol "RW" followed by a two-digit number; the letters identify power type, wire-wound, fixed resistors, and the number identifies the size, wattage rating, and construction of the resistors (see 3.1).

Comments, suggestions, or questions on this document should be addressed to: DLA Land and Maritime, ATTN: VAT, Post Office Box 3990, Columbus, Ohio 43218-3990 or by email Resistor@dla.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.

1.2.1.2 Characteristic. The characteristic is identified by a single letter that identifies the maximum continuous operating temperature (surface hot spot), the high ambient temperature derating (see 3.1), the minimum insulation resistance value, and the degree of moisture resistance in accordance with the applicable associated specification (see 3.1).

1.2.1.3 Resistance. The nominal resistance expressed in ohms is identified by a three or four digit number; the first two digits (three digits or four digit numbers) represent significant figures and the last digit specifies the number of zeroes to follow. When resistance values less than 10 ohms are required, the letter "R" is substituted for one of the significant digits to represent the decimal point. When the letter "R" is used, succeeding digits of the group represent significant figures as shown in the following example.

R10 = 0.1 ohm
1R0 = 1.0 ohm

Minimum and maximum resistance values are as specified in each specification sheet. The standard values for every decade should follow the sequence demonstrated for the "10 to 100" decade in accordance with table I.

1.2.1.4 Resistance tolerance. The resistance tolerance, when applicable, is identified by a single letter in accordance with the applicable specification sheet (see 3.1).

1.2.2 Power ratings. The nominal power ratings for the various styles and characteristics are as specified (see 3.1).

2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

DEPARTMENT OF DEFENSE SPECIFICATION

MIL-R-26/2	-	Resistor, Fixed, Wire wound (Power Type), Styles RW20, RW21, RW22, RW23, and RW24 (INACTIVE FOR NEW DESIGN).
MIL-PRF-26/3	-	Resistor, Fixed, Wire wound (Power Type), Styles RW29, RW30, RW31, RW32, RW33, RW34, RW35, RW36, RW37 RW38, RW39 and RW47.
MIL-PRF-26/4	-	Resistor, Fixed, Wire wound (Power Type), Styles RW55, RW56, RW67, RW68, and RW69.
MIL-R-26/5	-	Resistor, Fixed, Wire wound (Power Type), Styles RW70, RW74, RW78, and RW79. (INACTIVE FOR NEW DESIGN).
MIL-R-26/6	-	Resistor, Fixed, Wire wound (Power Type), Styles RW80, and RW81 (INACTIVE FOR NEW DESIGN).
MIL-PRF-39007	-	Resistor, Fixed, Wire-wound, (Power Type), Nonestablished Reliability, Established Reliability and Space Level, General Specification for.

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TABLE I. Standard 10 to 100 decade

Tolerance (±%)				Tolerance (±%)				Tolerance (±%)				Tolerance (±%)				Tolerance (±%)			
0.1 (B) 0.5 (D)	1 (F)	5 (J)	10 (K)	0.1 (B) 0.5 (D)	1 (F)	5 (J)	10 (K)	0.1 (B) 0.5 (D)	1 (F)	5 (J)	10 (K)	0.1 (B) 0.5 (D)	1 (F)	5 (J)	10 (K)	0.1 (B) 0.5 (D)	1 (F)	5 (J)	10 (K)
10.0	10.0	10.0	10.0	16.2	1.62	16.0	15.0	26.1	26.1	24.0	22.0	42.2	42.2	39.0	39.0	68.1	68.1	68.0	68.0
10.1				16.4				26.4				42.7				69.0			
10.2	10.2			16.5	1.65			26.7	26.7			43.2	43.2	43.0		69.8	69.8		
10.4				16.7				27.1		27.0	27.0	43.7				70.6			
10.5	10.5			16.9	1.69			27.4	27.4			44.2	44.2			71.5	71.5		
10.6				17.2				27.7				44.8				72.3			
10.7	10.7			17.4	1.74			28.0	28.0			45.3	45.3			73.2	73.2		
10.9				17.6				28.4				45.9				74.1			
11.0	11.0	11.0		17.8	1.78			28.7	28.7			46.4	46.4			75.0	75.0	75.0	
11.1				18.0		18.0	18.0	29.1				47.0		47.0	47.0	75.9			
11.3	11.3			18.2	18.2			29.4	29.4			47.5	47.5			76.8	76.8		
11.4				18.4				29.8				48.1				77.7			
11.5	11.5			18.7	18.7			30.1	30.1	30.0		48.7	48.7			78.7	78.7		
11.7				18.9				30.5				49.3				79.6			
11.8	11.8			19.1	19.1			30.9	30.9			49.9	49.9			80.6	80.6		
12.0		12.0	12.0	19.3				31.2				50.5				81.6			
12.1	12.1			19.6	19.6			31.6	31.6			51.1	51.1	51.0		82.5	82.5	82.0	82.0
12.3				19.8				32.0				51.7				83.5			
12.4	12.4			20.0	20.0	20.0		32.4	32.4			52.3	52.3			84.5	84.5		
12.6				20.3				32.8				53.0				85.6			
12.7	12.7			20.5	20.5			33.2	33.2	33.0	33.0	53.6	53.6			86.6	86.6		
12.9				20.8				33.6				54.2				87.6			
13.0	13.0	13.0		21.0	21.0			34.0	34.0			54.9	54.9			88.7	88.7		
13.2				21.3				34.4				55.6				89.8			
13.3	13.3			21.5	21.5			34.8	34.8			56.2	56.2	56.0	56.0	90.9	90.9	91.0	
13.5				21.8				35.2				56.9				92.0			
13.7	13.7			22.1	22.1	22.0	22.0	35.7	35.7			57.6	57.6			93.1	93.1		
13.8				22.3				36.1		36.0		58.3				94.2			
14.0	14.0			22.6	22.6			36.5	36.5			59.0	59.0			95.3	95.3		
14.2				22.9				37.0				59.7				96.5			
14.3	1.43			23.2	23.2			37.4	37.4			60.4	60.4			97.6	97.6		
14.5				23.4				37.9				61.2				98.8			
14.7	14.7			23.7	23.7			38.3	38.3			61.9	61.9	62.0					
14.9				24.0		24.0		38.8				62.6							
15.0	15.0	15.0	15.0	24.3	24.3			39.2	39.2	39.0	39.0	63.4	63.4						
15.2				24.6				39.7				64.2							
15.4	15.4			24.9	24.9			40.2	40.2			64.9	64.9						
15.6				25.2				40.7				65.7							
15.8	15.8			25.5	25.5			41.2	41.2			66.5	66.5						
16.0		16.0		25.8				41.7				67.3							

* DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202 - Tests Methods for Electronic and Electrical Components Parts.
MIL-STD-202-105 - Test Method Standard Method 105, Barometric Pressure (Reduced).
MIL-STD-202-106 - Test Method Standard Method 106, Moisture Resistance.
MIL-STD-202-108 - Test Method Standard Method 108, Life (At Elevated Ambient Temperature).
MIL-STD-202-204 - Test Method Standard Method 204, Vibration Frequency.
MIL-STD-202-208 - Test Method Standard Method 208, Solderability.
MIL-STD-202-211 - Test Method Standard Method 211, Terminal Strength.
MIL-STD-202-213 - Test Method Standard Method 213, Shock (Specified Pulse).
MIL-STD-202-301 - Test Method Standard Method 301, Dielectric Withstanding Voltage.
MIL-STD-202-302 - Test Method Standard Method 302, Insulation Resistance.
MIL-STD-202-303 - Test Method Standard Method 303, DC Resistance.
MIL-STD-202-304 - Test Method Standard Method 304, Resistance-Temperature Characteristic.

(Copies of these documents are available online at http://quicksearch.dla.mil).

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 cited in the solicitation or contract (see 6.2).

INTERNATIONAL ORGANIZATION for STANDARDS (ISO)

* ISO 10012 - Measurement Management Systems – Requirements for Measurement Processes and Measuring Equipment.

(Copies of this document are available online at http://www.iso.org.)

NATIONAL CONFERENCE OF STANDARDS LABORATORIES (NCSL)

NCSL Z540-3 - Laboratories, Calibration, and Measuring and Test Equipment.

(Copies of this document are available from http://www.ncsli.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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 unless otherwise noted. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specifications sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern (see 6.2).

3.2 Qualification. Resistors furnished under this specification shall be from family of products which are qualified for listing on the applicable QPL at the time set for opening of bids (see 4.4 and 6.3).

3.3 Material. Materials shall be used which will enable the resistors to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.4 Interface and physical dimension requirement. Resistors shall meet the interface and physical dimensions specified (see 3.1). The design of the resistors shall be such as to preclude shorting of turns and to obtain a minimum voltage drop between adjacent turns. Except as required for noninductive performance capability resistors shall be wound with a single layer of resistance wire. For terminal wire and winding symbol ”N” resistors shall be noninductively wound to minimize inductive effects. The Ayrton-Perry method would be one way of achieving this requirement.

3.4.1 Protective coating or enclosure. The resistance element of completed resistors shall be protected by a coating or enclosure which shall completely cover the exterior of the resistance element: Except that resistors wound with wire of 642 circular mils or over shall have the winding securely anchored by a coating which need not completely cover the winding. The protective coating shall be free from holes, fissures, chips, and other faults for units of less than 642 circular mils. The protective coating need not completely cover the junction caused by silver soldering or welding of the resistance element to the terminals, provided that no portion of any resistance element wound with wire of 101 circular mils or less is exposed.

3.4.2 Terminals. All terminals shall be solder-coated or otherwise treated to facilitate soldering. When a coating containing tin is used, the tin content shall range between 40 percent and 70 percent (see 3.9).

3.4.2.1 Solder dip (retinning) leads. Only the manufacturer or his authorized MIL-PRF-39007 category B or category C distributor who has previously been approved may solder dip/retin the leads of product supplied to this specification provided the solder dip/retin process (see appendix A) has been approved by the qualifying activity.

3.4.2.2 Ferrule-terminal resistors. Ferrule-terminal type resistors shall be designed to meet the requirements of this specification and figure 1 herein (see 3.1).

3.4.2.3 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 6.12).

3.4.2.3 Flat (stack mounting) and tubular, tab-terminal resistors. These resistors shall be designed to meet the requirements of this specification (see 3.1).

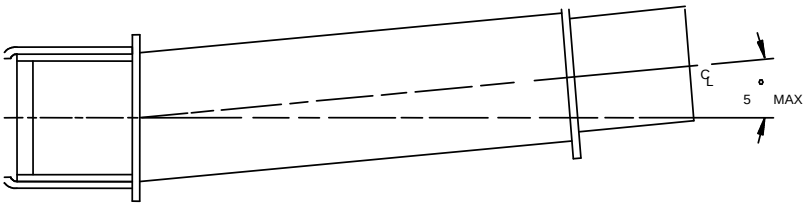

FIGURE 1. Alignment of ferrules.

3.5 Voltage rating. Resistors shall have a rated direct-current (dc), continuous working voltage, or an approximate sine-wave root-mean-square (rms) continuous working voltage at commercial-line frequency corresponding to the power rating (see 3.1), as determined from the following formula:

$$E = \sqrt{PR}$$

Where: E = rated dc or rms continuous working voltage.
P = power rating in watts
R = nominal resistance in ohms

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

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

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

3.7 Thermal shock. When tested as specified in 4.7.3, resistors shall not change in resistance in excess of the value specified (see 3.1), nor show any evidence of mechanical damage. There shall be no change in resistor coating, enclosure or other part which will result in degradation in performance.

3.8 Short-time overload. When resistors are tested as specified in 4.7.4, there shall be no evidence of arcing, burning, or charring; the change in resistance shall not exceed the value specified (see 3.1).

3.9 Solderability (when applicable). When resistors are tested as specified in 4.7.5, the dipped surface of the lead shall be at least 95 percent covered with continuous new solder coating. The remaining 5 percent of the lead surface may show only small pinholes or voids. These shall not be concentrated in one area. Bare base metal, and areas where the solder dip failed to cover the original coating are indications of poor solderability, and shall be cause for failure.

3.10 Terminal strength. When resistors are tested as specified in 4.7.6, there shall be no evidence of breaking or loosening of terminals from the resistor form, or chipping of coating or other evidence of mechanical damage. Chipping of the coating on the leads is permissible as long as the end caps are not exposed. The change in resistance shall not exceed the values specified (see 3.1).

3.11 Resistance-temperature characteristic. When resistors are tested as specified in 4.7.7, the resistance temperature characteristic referred to an ambient temperature of 25°C shall not exceed the values specified (see 3.1).

3.12 Dielectric withstanding voltage. When resistors are tested as specified in 4.7.8, there shall be no evidence of flashover, mechanical damage, arcing, or insulation breakdown. The change in resistance shall not exceed the values specified (see 3.1).

3.13 Insulation resistance. When resistors are tested as specified in 4.7.9, the insulation resistance shall be not less than 1,000 megohms.

3.14 High-temperature exposure. When resistors are tested as specified in 4.7.10, there shall be no damage or loosening under a mounting bolt. The change in resistance shall not exceed the values specified (see 3.1).

3.15 Moisture resistance. When resistors are tested as specified in 4.7.11, there shall be no evidence of breaking or loosening of terminals from the resistor form or chipping of coating or other evidence of mechanical damage. The change in resistance shall not exceed the values specified (see 3.1). The insulation resistance shall be 100 megohms, minimum.

3.16 Low-temperature storage. When resistors are tested as specified in 4.7.12, there shall be no evidence of mechanical damage. The change in resistance between the initial and final resistance measurements at 25°C ±5°C shall not exceed the values specified (see 3.1).

3.17 Mechanical strength (not applicable to axial-terminal resistors). When tested as specified in 4.7.13, resistors shall show no mechanical damage.

3.18 Shock, specified pulse (applicable to axial-lead resistors, only). When resistors are tested as specified in 4.7.14, there shall be no evidence of mechanical or electrical damage. The change in resistance shall not exceed the values specified (see 3.1). There shall be no electrical discontinuity during the test.

3.19 Vibration, high frequency (applicable to axial-lead resistors, only). When resistors are tested as specified in 4.7.15, there shall be no evidence of mechanical damage. The change in resistance shall not exceed the values specified (see 3.1). There shall be no electrical discontinuity during the test.

3.20 Life.

3.20.1 Qualification inspection. When resistors are tested as specified in 4.7.16, there shall be no evidence of mechanical damage. The change in resistance between the initial measurement and any of the succeeding measurements shall not exceed the values specified (see 3.1).

3.20.2 Conformance inspection. When resistors are tested as specified in 4.7.16, there shall be no evidence of mechanical damage. The change in resistance between the initial measurement and the final measurement shall not exceed the values specified (see 3.1).

3.21 Marking. Resistors shall be marked as specified in 3.21.1 to 3.21.4, inclusive. Marking shall remain legible at the end of all tests.

3.21.1 All resistors except ferrule and edgewise-wound styles. The type designation and the manufacturer's name or trademark, or both, shall be marked on the body of the resistor, parallel to the longitudinal axis. There shall be no space between the symbols that comprise the PIN (see 3.1). If lack of space requires it, the PIN may appear on two lines. In this event, the PIN shall be divided between the style, and the characteristic designation, as shown in the following example:

RW20
V100

For the RW70 and RW80 series, the PIN shall be as follows:

RW70U
1002F

For resistor style RW81, the following reduced marking is optional:

ABCD - manufacturer's name or trademark
W81F - abbreviated PIN and resistance tolerance
1000 - resistance designation

In any case, full marking shall be included on the resistor package.

For resistors having a body more than 2 inches long, the resistance value in ohms preceded by the abbreviation for "Resistance", and the power rating value in watts, followed by the abbreviation for the word "Nominal", shall also be marked as shown in the following example:

RW33V162
Res 1600
26 W Nom
Manufacturer’s name or trademark, or both.

3.21.2 Edgewise-wound or heavy round wire styles of 642 circular mils or over. These resistors shall be marked with the PIN, manufacturer's name or trademark, or both, the resistance value in ohms, preceded by the abbreviation for "Resistance" and power rating in watts, followed by the abbreviation for the word "Nominal", on the periphery of the portion of the resistor body ends, not covered by wire. The PIN and the manufacturer's name or trademark, or both, shall be marked on one end and the remaining information shall be marked on the other end as shown in the following example:

RW29V161	Res 160
Manufacturer's name	11W Nom
or trademark, or both	

All markings shall be approximately centered on a common longitudinal axis. If lack of space requires it, only the PIN may be marked, divided as shown in 3.21.1.

3.21.3 Ferrule-terminal resistors. The PIN, manufacturer's name or trademark, or both, the resistance value in ohms, preceded by the abbreviation for "Resistance" and the power rating value in watts, followed by the abbreviation for the word "Nominal", shall be marked on the periphery of the ferrules. Considering the resistors as mounted vertically, the PIN and the manufacturer's name or trademark, or both shall be marked on the lower ferrule and the remaining information shall be marked on the upper ferrule, as shown in the following example:

Lower ferrule
RW16V161
Manufacturer's name or trademark, or both.

Upper ferrule
Res. 160
20 W. Nom.

All markings shall be approximately centered on a common longitudinal axis.

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

3.22 Soldering. Where soldering is employed, only noncorrosive flux shall be used unless it can be shown that corrosive elements have been satisfactorily removed after soldering. Solder shall not be used for obtaining mechanical strength. Electrical connections shall be mechanically secure before soldering and electrically continuous after soldering. Except for solder used to coat terminals, the solder used shall in no case start to melt at a temperature of less than 360°C, or at the maximum temperature reached when the resistor is operating at rated wattage, whichever is higher.

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

3.24 Workmanship. Resistors shall be manufactured and processed in a careful and workmanlike manner, in accordance with good design and sound practice.

4. VERIFICATION

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

a. Qualification inspection (see 4.4)

b. Retention of qualification (see 4.5)

c. Conformance inspection (see 4.6)

* 4.2. Test equipment and inspection facilities. The supplier shall establish and maintain a calibration system in accordance with ISO 10012, NCSL Z540-3 or equivalent system as approved by the qualifying activity.

4.3 Inspection conditions and precautions.

4.3.1 Inspection conditions. Unless otherwise specified herein, all inspections shall be in accordance with the test conditions specified in the "GENERAL REQUIREMENT" of MIL-STD-202.

4.3.2 Precautions. Adequate precautions shall be taken during inspection to prevent condensation of moisture on resistors, except during moisture-resistance test.

4.4 Qualification. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample size. The number of sample units comprising a sample of resistors to be submitted for qualification inspection shall be as specified in the appendix to this specification.

4.4.2 Inspection routine. Sample units shall be subjected to the qualification inspection specified in table II, in the order shown. All coated or enclosed sample units, except those for the solderability test in group II and the uncoated or unenclosed for group VI, shall be subjected to the inspection of group I. The 30 tab-terminal sample units, 15 of the highest resistance value and 15 of the lowest resistance value or 10 ohms, whichever is higher, 50 axial-terminal units of the critical value, 10 each for groups II through group V (when applicable) (see A.2.1.2), and 50 axial-terminal sample units, 25 of the highest resistance value and 25 of the lowest resistance value or 10 ohms, whichever is higher, shall then be divided as specified in table II, for groups II to group V, inclusive, and subjected to the inspection of their particular group. The two uncoated or unenclosed sample units shall then be subjected to the visual and mechanical examination of group VI inspection only.

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

4.5 Retention of qualification. Every 12 months, the manufacturer shall compile a summary of the results of conformance inspections, in the form of retention of qualification report and forward it to the qualifying activity, within 30 days from the end of the reporting period as the basis of continued qualification approval. In addition, the manufacturer shall immediately notify the qualified activity whenever the group B inspection data indicates failure of the qualified product to meet the requirements of the specification. Retention shall be based on evidence that over the 1-year period, the following has been met:

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

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

c. Lot rejection for group A inspection does not exceed the group A sampling plan.

d. The requirements for group B inspection are met.

When group B requirements are not met and the manufacturer has taken corrective action satisfactory to the government, group B retesting shall be instituted.

4.5.1 Alternate inspection. For the purpose of retention of qualification and conformance inspection (see 4.5 and 4.6); test data on identical items covered by MIL-PRF-39007 may be used.

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery. 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 V).

4.6.1.1 Inspection lot. An inspection lot, as far as practical, shall include resistors of any style without regard to resistance value or resistance tolerance, produced under essentially uniform conditions and offered for inspection at one time. Resistors that differ in design, construction, materials, and terminal type shall not be included in one lot.

4.6.1.1.1 Production lot. A production lot consists of parts manufactured from the same basic raw materials, processed under the same specifications and procedures, and produced with the same equipment. Each production lot of parts should be a group identified by a common manufacturing record through all significant manufacturing operations.

TABLE II. Qualification inspection.

Inspection	No. of sample units for inspection	Requirement paragraph	Method paragraph	Number of defectives allowed 1/
Group I				
Visual and mechanical inspection 2/	All sample units except groups II and VI 5/	3.1, 3.3 to 3.4.1 incl., 3.21 to 3.24 incl.	4.7.1	1
DC resistance		3.6	4.7.2	
Thermal shock		3.7	4.7.3	
Short-time overload		3.8	4.7.4	
Group II				
Solderability (when applicable) 4/	5 high 5 low	3.9	4.7.5	1
Terminal strength		3.10	4.7.6	
Group III				
Resistance temperature characteristics 3/	5 high 5 low	3.11	4.7.7	1
Dielectric withstanding voltage 3/		3.12	4.7.8	
Insulation resistance 3/		3.13	4.7.9	
High temperature exposure		3.14	4.7.10	
Moisture resistance		3.15	4.7.11	
Low temperature storage		3.16	4.7.12	
Mechanical strength (not applicable to axial-terminal resistors)		3.17	4.7.13	
Group IIIA				
High temperature exposure	5 high 5 low 10 critical (as applicable)	3.14	4.7.10	1
Group IV (Applicable to axial-terminal resistors only)				
Shock, medium impact	5 high 5 low	3.18	4.7.14	1
Vibration, high frequency		3.19	4.7.15	
Group V				
Life	5 high 5 low	3.20	4.7.16	1
Group VI				
Visual and mechanical Inspection	2 unenclosed or uncoated units	3.1, 3.3 to 3.4.1 incl., 3.21 to 3.24 incl.	4.7.1	0

1/ Failure of an individual resistor in one or more tests in groups I to V inclusive, shall be charged as a single failure. Failures for each resistance value shall be permitted as specified in each group, but not more than one failure shall be permitted in groups I through V combined.
2/ Marking shall be considered defective only if the marking or any portion thereof is illegible. Marking shall remain legible at the end of all tests.
3/ Nondestructive examinations and tests.
4/ This test applicable to both leads.
5/ The exception shall apply only to the solderability test in group II.

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

4.6.1.2.1 Sampling plan.

4.6.1.2.1.1 Subgroup 1. A sample of parts from each inspection lot shall be randomly selected in accordance with table IV, if one or more defects are found; the lot shall be rescreened and defects removed. After screening and removal of defects, a new sample of parts shall be randomly selected in accordance with table IV, if one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification. Resistance values in the samples shall be representative, and where possible, in proportion to the resistors in the inspection lot.

4.6.1.2.1.2 Subgroup 2. A sample of parts from each inspection lot shall be randomly selected in accordance with table III, if one or more defects are found, the lot shall be rescreened and defects removed. After screening and removal of defects, a new sample of parts shall be randomly selected in accordance with table IV, if one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

4.6.1.2.1.3 Subgroup 3 (solderability).

4.6.1.2.1.3.1 Sampling plan. Five samples shall be selected randomly from each inspection lot and subjected to the subgroup 3 solderability test. If there are one or more defects, the lot shall be considered to have failed.

4.6.1.2.1.3.2 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 4.7.5. 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 4.6.1.2.1.3.2b.

b. The manufacturer submits the failed lot to a 100 percent solder dip using an approved solder dip process in accordance with 3.4.2.1. Following the solder dip the electrical measurements required in group A, subgroup 1 tests shall be repeated on 100-percent of the lot. Lot acceptance for the electrical measurements shall be as for the subgroup 1 tests. Five additional samples shall then be selected 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 be 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.

4.6.1.2.1.3.3 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.

4.6.1.3 Group B inspection. Group B inspection shall consist of the tests specified in table V, in the order shown. They shall be performed on sample units that have been subjected to and have passed the group A inspection, unless the Government considers it more practical to select a separate sample from the lot for group B inspection.

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

4.6.1.3.2 Disposition of sample units. Sample units that have passed all the group B inspection may be delivered on the contract or order, at the option of the supplier.

TABLE III. Group A inspection.

Test	Requirement Paragraph	Method paragraph	Number of Samples
Subgroup 1 DC resistance	3.6	4.7.2	4.6.1.2.1.1
Subgroup 2 Visual and Mechanical inspection	3.1, 3.4, 3.21, 3.24	4.7.1	4.6.1.2.1.2
Subgroup 3 1/ Solderability	3.9	4.7.5	4.6.1.2.1.3

1/ The manufacturer may request the deletion of the subgroup 3 solderability test, provided an in-line or process control system for assessing and assuring the solderability of terminations 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.

TABLE IV. Group A sampling plan.

Lot Size	Subgroup 1 sample size	Subgroup 2 sample size
2 to 13	100%	100%
14 to 125	100%	13
123 to 150	125	13
151 to 280	125	20
281 to 500	125	29
501 to 1,200	125	34
1,201 to 3,200	125	42
3,201 to 10,000	192	50
10,001 to 35,000	294	60
35,001 to 150,000	294	74
150,001 to 500,000	345	90
500,000 and over	435	102

TABLE V. Group B inspection. 1/

Test	Requirement paragraph	Method paragraph
Thermal shock	3.7	4.7.3
Short-time overload	3.8	4.7.4

1/ If the manufacturer can demonstrate that these tests have been performed five consecutive times with zero failures, the frequency of these tests, 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.

4.7 Methods of examination and test.

4.7.1 Visual and mechanical inspection. Resistors shall be inspected to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3 to 3.4.1 inclusive, and 3.21 to 3.24 inclusive).

* 4.7.2 DC resistance (see 3.6). Resistors shall be tested in accordance with MIL-STD-202-303. The following details and exceptions shall apply:

a. Measuring apparatus: Different type 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 of error of measuring apparatus: One-fourth of the specified initial-resistance tolerance or 0.1 percent, whichever is less, +0.002 ohm.

c. Test voltage: Measurements of resistance shall be made by using a dc potential resulting in not more than 5 percent of rated wattage. This same voltage shall be used whenever a subsequent resistance measurement is made.

d. Points of application of test voltage for initial-resistance-tolerance measurement: For axial-lead resistors of 20 ohms or less, .375 ±.062 inch (9.53 ±1.57 mm) from the end of the body. For tab-terminal resistors of 20 ohms or less, locate on tab in line of hole parallel to resistor body. For all resistors above 20 ohms locate wherever practical on lead or tab.

4.7.3 Thermal shock (see 3.7). Resistance shall be measured as specified in 4.7.2. The resistors shall then be mounted on a rack of low-heat conducting material, and rated power shall be applied until thermal stability has been reached. The power shall then be removed and within 8 seconds to 12 seconds, the resistors shall be subjected to an air temperature of -55°C +0°C, -5°C for a period of not less than 15 minutes. Measurement of resistance shall be made not less than 2 hours after final exposure (see 4.7.2).

4.7.4 Short-time overload (see 3.8). DC resistance shall be measured as specified in 4.7.2. The resistors shall then be mounted by means other than soldering and shall be subjected to an overload voltage that will result in 10 times rated wattage for 5 seconds or as specified (see 3.1). In no case shall this voltage exceed the value specified (see 3.1). DC resistance shall again be measured after the resistors have cooled to room temperature.

* 4.7.5 Solderability (applicable to axial leads only) (see 3.9). Resistors shall be tested in accordance with MIL-STD-202-208. The following details shall apply: Both leads shall be tested. The leads shall be dipped within .062 inch (1.57 mm) of the body.

* 4.7.6 Terminal strength (see 3.10). Tests shall be in accordance with MIL-STD-202-211 with the following exceptions:

a. Test condition letters A and D (pull test and twist test, respectively) for axial lead styles only.

b. Measurement before test: DC resistance as specified in 4.7.2.

c. Method of holding (A): Resistors shall be clamped by one terminal lead.

d. Applied force (A): Ten pounds (or as specified) (see 3.1).

e. For tab terminals, the resistors shall be firmly clamped and a direct pull of 10 pounds shall be applied at the hole to each terminal, one at a time, for at least 30 seconds, in a direction away from the resistor and parallel to the longitudinal axis.

f. Measurement after test: DC resistance as specified in 4.7.2.

g. Inspection after test: Resistors shall be inspected for evidence of breaking and loosening of terminals and chipping of coating or other evidence of mechanical damage.

* 4.7.7 Resistance-temperature characteristic (see 3.11). Resistors shall be tested in accordance with MIL-STD-202-304. The following detail shall apply. Test temperature: In accordance with table VI.

4.7.8 Dielectric withstanding voltage (see 3.12).

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

a. Special preparations:

(1) Tab terminals: Flat (stack mounting) resistors shall be completely equipped with mounting hardware, but without supplementary mounting insulation.

(2) Tab terminals: Tubular resistors shall be mounted without supplementary insulation, between two metal plates normal to the longitudinal axis of the resistor, one plate at each end, held firmly against the end of the resistor core by a through-bolt. These plates shall be of sufficient size to extend beyond the resistor terminal extremities.

(3) Axial lead terminals: Resistors shall be placed in a conductive material which will conform to the resistor surface so that at least 90 percent of the outer periphery is contacted.

b. Initial measurement: DC resistance shall be measured as specified in 4.7.2.

c. Magnitude of test voltage: 1,000 volts rms for all styles except RW70, RW80, and RW81; for styles RW70, RW80, and RW81, the potential shall be 500 volts rms.

d. Nature of potential: 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 1,000 (500 for RW70, RW80, and RW81) volts rms, as uniformly as practicable, at a rate of approximately 100 volts rms per second.

g. Points of application of test voltage: Between the resistor terminals connected together and the mounting hardware, or the conductive material on the axial-lead resistors, as applicable.

h. Measurement after test: DC resistance shall be measured as specified in 4.7.2.

i. Inspections after test: Resistors shall be inspected for evidence of flashover, mechanical damage, arcing, and insulation breakdown.

* 4.7.8.2 Barometric pressure (reduced) (as applicable, see 3.1). Resistors shall be tested in accordance with MIL-STD-202-105. The following details and exceptions shall apply:

a. Method of mounting: As specified in 4.7.8.1.

b. Initial measurements: DC resistance shall be measured as specified in 4.7.2.

c. Test condition D (100,000 feet).

d. Test voltage during subjection to reduced pressure: As specified (see 3.1).

e. Nature of potential: As specified in 4.7.8.1d.

f. Duration of test: 1 minute.

g. Points of application of test voltage: As specified in 4.7.8.1g.

h. Final measurements: DC resistance shall be measured as specified in 4.7.2.

i. Inspection after test: As specified in 4.7.8.1i.

TABLE VI. Temperature for resistance-temperature-characteristic test.

Temperature ^{O}C				
Sequence	For qualification inspection		For conformance Inspection 1/	
1	25	2/	25	2/
2	-15		---	
3	-55		-55	
4	25	2/	25	2/
5	125		125	
6	200		---	
7	250		250	
8	350	3/	350	3/

1/ At the option of the manufacturer the reverse sequence may be used as shown below:
2/ This temperature shall be considered the reference temperature for each of succeeding temperatures.
3/ For characteristic N and V only (see 3.1).

1	-	25	1/
2	-	350	3/
3	-	250	
4	-	125	
5	-	25	1/
6	-	55	

* 4.7.9 Insulation resistance (see 3.13). Resistors shall be tested in accordance with MIL-STD-202-302. The following details shall apply:

a. Test condition letter A.

b. Special preparation: In accordance with 4.7.8.1a.

c. Points of measurement: In accordance with 4.7.8.1g.

4.7.10 High-temperature exposure (see 3.14).

4.7.10.1 Mounting. Resistors shall be mounted by their normal mounting means and no soldering shall be used.

4.7.10.2 Procedure. DC resistance shall be measured as specified in 4.7.2 at room ambient temperature. Resistors shall be exposed to an ambient temperature of 250°C ± 7°C (for characteristic U) and 350°C ± 7°C (for characteristic N and characteristic V) for a period of 250 hours ± 8 hours. Not less than 2 hours after the end of the exposure period, the dc resistance shall again be measured as specified in 4.7.2 at room ambient temperature. For axial-terminal resistors, the wire leads may be cleaned before the resistance measurement.

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

a. Mounting: For resistors under load a space of 1 inch minimum shall be maintained for axial-terminal resistors and 2-1/2 inches minimum for all other resistors between test parts and as follows:

(1) Tab-terminal, flat (stack-mounting) resistors: By means of mounting bolts or screws as in normal service.

(2) Tab-terminal, tubular resistors: Four (two high and two low) of the specimens, by means of their associated mounting hardware and supplementary insulation; the remaining six (three high and three low), as specified in 4.7.8.1a.(2).

(3) Axial-terminal resistors: 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. Six (three high and three low) of the sample units shall be covered with a V-shaped metal strap whose width is equal to the length of the resistor body as indicated on figure 2. The strap shall be made of a corrosion-resistant metal and shall be kept in contact with the resistor body by supporting the body as indicated on figure 2, with a nonconducting, noncorrosive, support whose width is less than that of the body and which shall not act as a moisture trap. The mounting straps may be individual for each resistor or continuous for all resistors. These resistors with strapping shall be subjected to the polarization voltage.

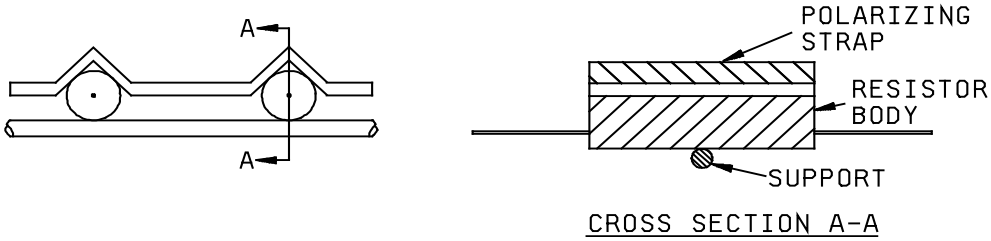

FIGURE 2. Mounting straps for moisture-resistance test.

b. Initial measurement: Immediately following the initial drying period, dc resistance shall be measured as specified in 4.7.2 at test conditions specified in 4.3.1.

c. Polarization and loading voltage: Three units of highest resistance value and three units of lowest resistance value shall be subjected to polarization and two units of highest resistance value and two units of lowest resistance value shall be subjected to loading voltage as follows:

(1) Polarization: During steps 1 to 6 inclusive, a 100 volt dc potential shall be applied with the positive lead connected to the resistor terminals tied together, and the negative lead connected to the mounting hardware or polarizing straps as applicable. This procedure is applicable to 6 of the sample units mounted as follows:

(a) Tab-terminal, tubular resistors: Mounted as specified in 4.7.8.1a (2).

(b) Axial terminal resistors: Mounted with V-shaped metal straps as specified in 4.7.11a (3).

(c) All others mounted as specified in 4.7.11a.

(2) Loading voltage: During the first 2 hours of steps 1 and 4, a dc potential equivalent to 85 percent of rated wattage, shall be applied between the terminals of each resistor. The negative terminal shall be electrically grounded. This procedure is applicable to four of the sample units mounted as follows:

(a) Tab-terminal tubular resistors mounted with supplementary insulation as specified in 4.7.11a (2).

(b) Axial terminal resistors mounted without V-shaped metal straps as specified in 4.7.11a (3).

(c) All others mounted as specified in 4.7.11a.

(d) Subcycle: Step 7b shall not be applicable. Step 7a shall be performed during any five of the first nine cycles only.

(e) Final measurements: On completion of step 6 of the final cycle, the resistors shall be held at the high-humidity condition and a temperature of 25°C ±2^{O}C for a period of 1.5 hours to 3.5 hours. The same straps used for polarizing the resistors may also be used for the insulation resistance tests. To perform these tests, the resistors shall be removed from the chamber and within .5 hour the insulation resistance, and dc measurement tests shall be performed as specified in 4.7.9 and 4.7.2, respectively.

(f) Inspection after test: Resistors shall be inspected for evidence of mechanical damage.

4.7.12 Low-temperature storage (see 3.16).

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

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

4.7.13 Mechanical strength (not applicable to axial-terminal resistors). Resistors shall be supported .125 inch (3.18 mm) from each end. All except tab-terminal, stack-mounting resistors shall then be subjected to a transverse load of not less than 50 pounds; tab-terminal, stack-mounting resistors shall be subjected to a load of 25 pounds. For all except tab-terminal, stack-mounting resistors, the load shall be applied at the center of the resistor through a fulcrum having a radius of not less than .25 inch (3.2 mm); for tab-terminal, stack-mounting resistors the load shall be applied normal to the wide surface of the resistor (see 3.17).

* 4.7.14 Shock, specified pulse (applicable to axial-lead resistors only) (see 3.18). Resistors shall be tested in accordance with MIL-STD-202-213. The following details and exceptions shall apply:

a. Special mounting means: Resistors shall be mounted on appropriate jig fixtures with their bodies restrained from movement and their leads supported at a distance of .250 inch (3.18 mm) from the resistor body. These fixtures shall be constructed in a manner to insure that the points of the resistor-mounting supports shall have the same motion as the shock table. Test leads used during this test shall be no longer than AWG size 22 stranded wire, so that the influence of the test lead on the resistor shall be held to a minimum. The test-lead length shall be no longer than necessary. In all cases, the resistor shall be mounted in relation to the test equipment in such a manner that the stress applied is in the direction that would be considered most detrimental.

b. Measurement before shock: DC resistance shall be measured as specified in 4.7.2.

c. Test condition letter I.

d. Number and direction of applied shocks: The resistor shall be subjected to a total of 10 shocks in each of two mutually perpendicular planes, one perpendicular and one parallel to the longitudinal axis of the resistor.

e. Measurement during shock: Each resistor shall be monitored to determine electrical discontinuity by a method which shall at least be sensitive enough to monitor or register, automatically, any electrical discontinuity of 0.1 millisecond or greater duration.

f. Measurement after shock: DC resistance shall be measured as specified in 4.7.2.

g. Inspection after test: Resistors shall be inspected for evidence of mechanical and electrical damage.

* 4.7.15 Vibration, high frequency (applicable to axial-lead resistors only) (see 3.19). Resistors shall be tested in accordance with MIL-STD-202-204. The following details and exceptions shall apply:

a. Mounting of specimens: Resistors shall be mounted on appropriate jig fixtures with their bodies restrained from movement, and their leads supported at a distance of .25 inch (3.2 mm) from the resistor body. These fixtures shall be constructed in a manner to insure that the points of the resistor mounting supports shall have the same motion as the vibration test table. The fixtures shall also be of a construction that shall preclude any resonance in the fixture when subjected to vibration within the test frequency range, and the fixture shall be monitored for these features on the vibration table. Test leads used during this test shall be no larger than AWG size 22 stranded wire, so that the influence of the test lead on the resistor shall be held to a minimum. The test lead length shall be no greater than is absolutely necessary. A shielded cable that may be necessary because of the field surrounding the vibration table shall be clamped to the resistor mounting jig.

b. Initial measurement: DC resistance shall be measured as specified in 4.7.2.

c. Test condition D.

d. Direction of motion: In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistor. Six hours in each direction for a total of 12 hours.

e. Measurement during test: Each resistor shall be monitored to determine electrical discontinuity by which shall at least be sensitive enough to monitor or register, automatically, any electrical discontinuity of 0.1 millisecond or greater duration.

f. Measurement after vibration: DC resistance shall be measured as specified in 4.7.2.

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

* 4.7.16 Life (see 3.20). Resistors shall be tested in accordance with MIL-STD-202-108. The following details and exceptions shall apply:

a. Method of mounting: Resistors shall be mounted by their normal mounting means except that axial-terminal resistors shall be mounted on light-weight terminals with an effective minimum lead length of 5/16 inch (7.94 mm). Resistors shall be so arranged that the temperature of any one resistor shall not appreciably influence the temperature of any other resistor.

b. Initial measurement: DC resistance shall be measured as specified in 4.7.2.

c. Test temperature: This test shall be conducted at an ambient temperature of 25°C +10°C, -5°C.

d. Operating conditions: Rated dc continuous working or ac rms equivalent voltage shall be applied intermittently, 1.5 hours “on” and .5 hours “off.” Each resistor shall dissipate rated wattage. Adequate precautions shall be taken to maintain constant voltage on the resistor.

e. Test condition: 2,000 hours.

f. Measurement during test: Resistance shall be measured at the end of one-half hour “off” periods, after, 250 hours +72 hours, -24 hours; 500 hours +72 hours, -24 hours; 1,000 hours + 72 hours, -24 hours; 2,000 hours +96 hours, -24 hours, and compared to the similar reading taken in 4.7.16b. Measurement shall be made as near as possible to the specified time but may be adjusted so that measurement need not be made during other than normal working days.

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

5. PACKAGING.

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point’s packaging activity within the Military Service or Defense Agency, or within the military services 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. The film resistors described herein are intended to be used in electronic circuits where semiprecision characteristics and small sizes are required. These resistors are unique due to the fact that they must be able to operate satisfactorily in military systems under the demanding conditions such as 20 Gs of high frequency vibration, moisture resistance test, salt corrosion test, and are verified under a qualification system. Commercial components are not designed to withstand these military environmental conditions.

6.2 Ordering data. Acquisition documents must specify the following:

a. Title, number, and date of this specification, the applicable associated specification, and the complete PIN. (see 1.2).

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 instructions (see 5.1).

d. Whether bracket assembly is required (see 6.5).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Product List QPL-26 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DLA Land and Maritime, ATTN: VQP, 3990 East Broad Street, 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 Derating. The intention of this specification is to cover resistors capable of full-load operation at any ambient temperature up to and including 25°C. However, if it is desired to operate these resistors at ambient temperatures greater than 25°C, the resistors should be derated in accordance with the applicable specification sheet (see 3.1). For efficient and long-life operation, resistors should be derated by more than 50 percent.

6.5 Mounting. Under conditions of severe shock or vibration, or a combination of both, resistors of all sizes described in this specification should be mounted in such a fashion that the body of the resistor is restrained from movement with respect to the mounting base. It should be noted that if clamps are used, certain electrical characteristics of the resistor may be altered. The heat-dissipation qualities of the resistor may be enhanced or retarded depending upon whether the clamping material is a good or poor heat conductor. Under less severe vibration conditions, axial lead styles may be supported by their leads only. The lead lengths should be kept as short as possible, .25 inch (6.4 mm) or less preferred, but not longer than .625 inch (15.88 mm). The longer the lead is the more likely that a mechanical failure will occur.

6.6 High frequency. Resistors should not be used in circuits where their ac performance is of critical importance in the operation of such circuits.

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

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

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

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

a. In the maximum specified ambient temperature.

b. Under conditions producing maximum temperature rise in each resistor.

c. For a sufficient length of time to produce maximum temperature rise, or for the maximum specified time.

d. With all enclosures in place.

e. With natural ventilation only. (This should permit the use of any special ventilating provisions included as a standard part of the equipment).

f. At high altitude.

6.11 Soldering. A solder with a minimum melting temperature of 350°C should be used in soldering characteristic V resistors.

6.12 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).

6.13 Caution. Certain coating materials used in fabricating resistors to this specification may be subjected to "outgassing" of volatile material when operated at surface temperatures over 200°C. This phenomenon should be taken into consideration for equipment design.

6.14 Subject term (key word) listing.

Axial leaded
Ferrule terminal
Flat tab terminal
Tubular tab terminal

6.15 Amendment notations. The margins of this specification are marked with asterisks to indicate modifications generated by this amendment. 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.

APPENDIX A

PROCEDURE FOR QUALIFICATION APPROVAL

A.1. SCOPE

* A.1.1 Scope. This appendix details the procedure for submission of samples for qualification testing and approval of resistors covered by this specification. The procedure for extending qualification of the required sample to other resistors covered by this specification is also outlined herein. This Appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2. APPLICABLE DOCUMENTS

A.2.1 Government documents.

A.2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-790	-	Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specifications
MIL-STD-1276	-	Leads for Electronic Component Parts.

(Copies of these documents are available online at http://quicksearch.dla.mil).

A.2.2 Order of precedence. Unless otherwise noted herein or in the contract, 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 unless otherwise noted. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

A.3. SUBMISSION

A.3.1 Sample.

A.3.1.1 All characteristics. A sample consisting of 15 or 20 sample units, as applicable, each of the highest and lowest or 10 ohms, whichever is higher, values within the resistance range for which qualification is sought, of coated or enclosed resistors shall be submitted in accordance with A.4 and table A-I. The resistance tolerance for characteristic V shall be ±5 percent, and for characteristic U, ±1 percent or the lowest for which qualification is sought. If 1 (F) percent resistance tolerance is submitted and lower resistance tolerance qualification is also sought, then 10 sample units each of the highest resistance value and lowest or 10 ohms, whichever is higher, in the lower resistance tolerance for which approval is sought shall be submitted and subjected to the inspection of groups I and III. If the same coating and materials are not used, a separate submission shall be furnished in each characteristic in lieu of characteristic submission outlined in A.4. Two uncoated or unenclosed resistors (one of the highest value and one of the lowest or 10 ohms, whichever is higher) shall be submitted in each style. If enclosures are used in lieu of coatings, two enclosures shall also be furnished. All submitted samples shall be representative of the supplier's normal production.

A.3.1.2 Critical value. If the lowest resistance value (see A.2.1.1) is below the critical value specified (see 3.1) and the highest resistance value is above the critical value (see 3.1), then 50 sample units of the critical value shall also be submitted and shall consist of 10 each for group II through group V.

APPENDIX A

TABLE A-I. Sample of qualification.

Style	Will qualify styles in	
	Characteristic N and V	Characteristic U
RW24	RW20 to RW24 inclusive	---
RW35	RW29 to RW35 inclusive	---
RW36	RW29 to RW36 inclusive	---
RW37	RW29 to RW37 inclusive	---
RW38	RW29 to RW38 inclusive	---
RW39	RW29 to RW39 inclusive and RW47	---
RW47	RW29 to RW38 inclusive and RW47	---
RW56	RW55 and RW56	---
RW68	RW67 to RW69 inclusive	---
RW78	---	RW78 and RW74
RW79	---	RW70 and RW79
RW80	---	RW80 and RW81

A.4 EXTENT OF QUALIFICATION

A.4.1 All characteristics. Approval of characteristics shall be in accordance with table A-II.

TABLE A-II. Extent of approval of characteristics.

Characteristic	Will qualify characteristic
V	V
U	U
N	V and N

A.4.1.1 Characteristic U. The resistance range included in the qualification of any one resistor style shall be between any two adjacent resistance values which pass the qualification inspection. Also, qualification of the lower resistance tolerances shall qualify the higher resistance tolerances in accordance with table A-III.

TABLE A-III. Extent of approval of resistance tolerances.

Resistance tolerance submitted	Will qualify resistance tolerances
B	B, D, F
D	D, F
F	F

APPENDIX A

A.5 SOLDER DIP (RETINNING) LEADS

A.5.1 Solder dip (retinning) leads. The manufacturer may solder dip/retin the leads of product supplied to this specification provided the solder dip process has been approved by the qualifying activity.

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

a. When the original lead finish qualified was hot solder dip lead finish 52 of MIL-STD-1276 (NOTE: The 200 microinch maximum thickness is not applicable). The manufacturer shall use the same solder dip process for retinning as is used in the original manufacture of the product.

b. When the lead originally qualified was not hot solder dip lead finish 52 of MIL-STD-1276 as prescribed in a., approval for the process to be used for solder dip shall be based on the following test procedure:

(1) Thirty samples of any resistance value for each style and lead finish are subjected to the manufacturer's solder dip process. Following the solder dip process, the resistors are subjected to the dc resistance test and other group A electrical inspection.

(2) Ten of the thirty 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.

c. The manufacturers may designate and authorize a MIL-STD-790, category B or category C distributor listed under the MIL-PRF-39007 QPL to solder dip/retin resistors as long as the procedure is one qualified in A.5.2a or A.5.2b above and is identified and approved by the manufacturer.

A.5.3 Solder dip/retinning options. The manufacturer may solder dip/retin as follows:

a. After the 100 percent group A screening tests: Following the solder dip/retinning process, the electrical measurements required in group A, subgroup 1 shall be repeated on the lot. The group A, subgroup 1, lot rejection criteria shall be used. Following this test, the manufacturer shall submit the lot to the group A solderability test as specified in 4.7.5.

b. As a corrective action, if the lot fails the group A solderability test, the lot may be retinned no more than two times. The lot after retinning shall be 100 percent screened for group A electrical requirements (dc resistance) and parts failing (lot not exceeding PDA for group A, subgroup 1, see 4.6.1.2.1.1) these screens shall not be supplied to this specification. If electrical failures are detected after the second retinning operation exceeding 1 percent of the lot, the lot shall not be supplied to this specification.

c. After group A inspection has been completed: Following the solder dip/retinning process, the electrical measurements required in group A, subgroup 1, 100 percent dc resistance shall be repeated on 100 percent of the lot. The PDA for the electrical measurements shall be as for the subgroup 1 tests (see 4.6.1.2.1.1). Following these tests, the manufacturer shall submit the lot to the group A solderability test as specified in 4.7.5.

Custodians:
Army - CR
Navy - EC
Air Force - 85
DLA - CC

Review activities:
Army - EA, MI
Navy - AS
Air Force - 19

Preparing activity:
DLA - CC

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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.