U S A S
C83.6-1968
Approved July 26, 1968
USA STANDARDS INSTITUTE

EIA RS-344

EIA STANDARD

Low Power, Insulated Fixed Wirewound Resistors

RS-344
(Revision of REC-117)

January 1968

Engineering Department

ELECTRONIC INDUSTRIES ASSOCIATION

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Published by

ELECTRONIC INDUSTRIES ASSOCIATION

Engineering Department

2001 Eye Street, N.W., Washington, D. C. 20006

PRICE $2. 20

Printed in U.S.A.

LOW POWER, INSULATED FIXED WIREWOUND RESISTORS

(From EIA Standard REC-117 and Standards Proposal No. 951, formulated under the cognizance of Subcommittee P-1.4 on Wirewound Resistors)

SCOPE

This standard covers low power, axial lead, insulated, fixed wirewound resistors. Power ratings of 1 watt through 15 watts with resistance tolerances of ±5% and ±10% are covered.

1. RESISTOR STYLES

1.1 Style CRU1 and CRU2 see page 2.

1.2 Styles CRU2A, CRU3, CRU5, CRU7, CRU10, CRU15, see page 3.

2. ELECTRICAL CHARACTERISTICS

2.1 *TYPE DESIGNATION*

The type designation shall be in the following form:

CRU2	A	2R7	J
Style	Characteristic	Resistance	Tolerance

2.1.1 *Style* – The style is identified by a three-letter symbol "CRU" followed by a one or two digit number; the letters identify low power insulated, wirewound, fixed resistors and the number identifies the power rating of the resistor.

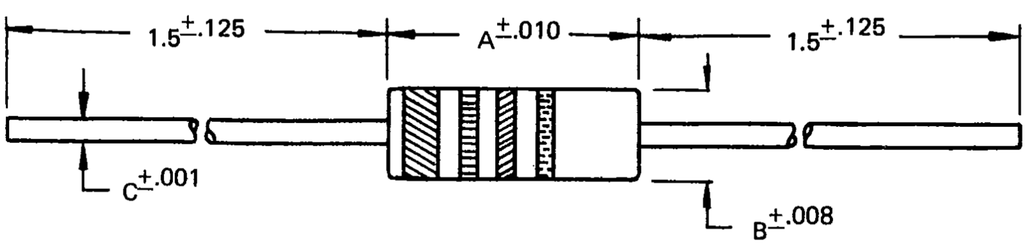
2.1.2 *Characteristic* – The characteristic designation is a one-letter symbol which identifies the maximum ambient operating temperature in accordance with Table I.

TABLE I – CHARACTERISTIC

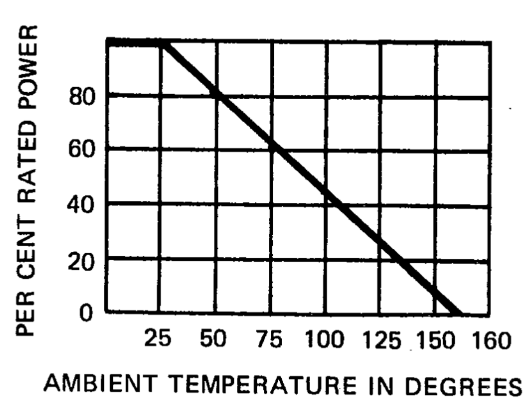
MAXIMUM AMBIENT TEMPERATURE		A 160°C	B 275°C
Temperature Coefficient		0 ±800 PPM Below 1 ohm 0 ±400 PPM 1 ohm & Above	0 ±800 PPM Below 1 ohm 0 ±400 PPM 1 ohm & Above
*Max. Percent resistance change during test.	Momentary Overload	±4	±4
	Low Temp. Operation	±3	±3
	Temp. Cycling	±5	±5
	Humidity	±5	±5
	Load Life	±10	±10
	Terminal Strength	±2	±2
	Res. to Solder Heat	±4	±4
	Dielectric Strength	±2	±2

*An additional +0.05Ω is added to the percent change in each test to allow for resistance measurement error.

1.1 STYLE CRU1 and CRU2 CHARACTERISTIC "A"



NOTE: ALL DIMENSIONS IN INCHES.

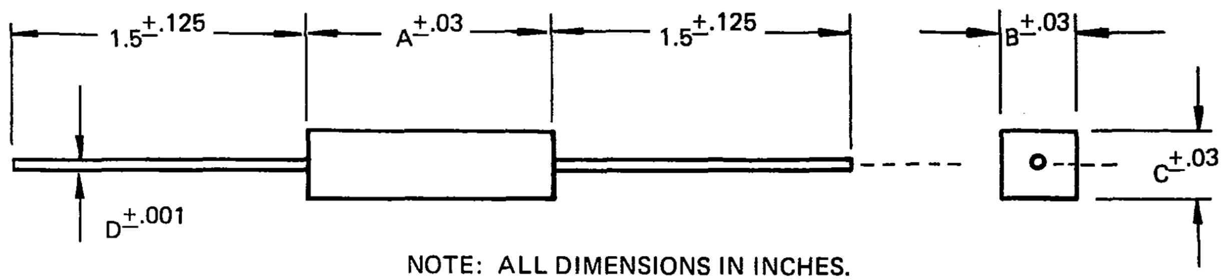


TEMPERATURE-POWER DERATING CURVE

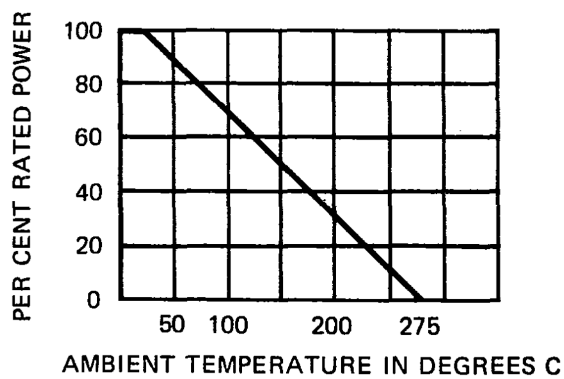
TYPE	POWER RATING	MINIMUM RESISTANCE	MAXIMUM RESISTANCE	A	B	C
CRU1	1.25 Watts	0.1 ohm	1,000 ohm	.390	.140	.032
CRU2	2.5 Watts	0.1 ohm	2,000 ohm	.562	.225	.040

Dielectric Withstanding Voltage 700 V RMS on CRU1, 1,000 V RMS on CRU2.

1.2 STYLE CRU2A THRU CRU15, CHARACTERISTIC "B"



NOTE: ALL DIMENSIONS IN INCHES.



TEMPERATURE-POWER DERATING CURVE

TYPE	POWER RATING	MINIMUM RESISTANCE	MAXIMUM RESISTANCE	A	B	C	D
CRU2A	2 watts	0.18 ohms	2400 ohms	.69	.25	.25	.032
CRU3	3 watts	0.10 ohms	7500 ohms	.88	.31	.31	.036
CRU5	5 watts	0.10 ohms	8200 ohms	.88	.38	.35	.036
CRU7	7 watts	0.10 ohms	18K ohms	1.39	.38	.35	.036
CRU10	10 watts	0.10 ohms	30K ohms	1.88	.38	.35	.036
CRU15	15 watts	0.18 ohms	30K ohms	1.88	.50	.50	.036

Dielectric Withstanding Voltage 900 Volts RMS (All Styles)

2.1.3 *Resistance* – The nominal resistance value expressed in ohms is identified by a three-digit number; the first two digits represent significant figures and the last digit specifies the number of zeros to follow. When values less than 10 ohms are required, the letter "R" shall be substituted for one of the significant digits to represent the decimal point. When the letter "R" is used, succeeding digits of the group represent significant figures as shown in the following example:

2R7 = 2.7 ohms.

2.1.4 *Resistance Tolerance* – The resistance tolerance is identified by a single letter in accordance with Table II.

TABLE II – RESISTANCE TOLERANCE

Symbol	Resistance Tolerance Percent $\pm$
J	5
K	10

3. REQUIREMENTS

3.1 *DESIGN AND CONSTRUCTION* – Resistors shall be of sound design and construction. They shall be capable of meeting the test requirements and the physical dimensions specified for their particular style.

PROTECTIVE COATING OR ENCLOSURE – The resistor assembly shall be completely covered with a protective coating or enclosure. The protective coating shall be free from holes, cracks, chips and other faults. The color of the protective coating may be any color, providing the identification markings are legible.

3.2 *TERMINALS* – All leads shall be suitably treated to facilitate soldering and to meet the requirements of the latest issue of RS-178, Test Condition 1.

3.3 *WINDING*

3.3.1 *Resistance Element* – The resistors shall be wound with a single layer of resistance wire. The design shall be such as to preclude shorting of turns and to obtain a minimum voltage drop between adjacent turns.

3.3.2 *Wire* – The wire shall have no joints, welds, or bonds, except at the end terminals. The wire shall possess a uniform cross section of conductor and insulation (if employed) and shall be as free as practicable from particles or impurities.

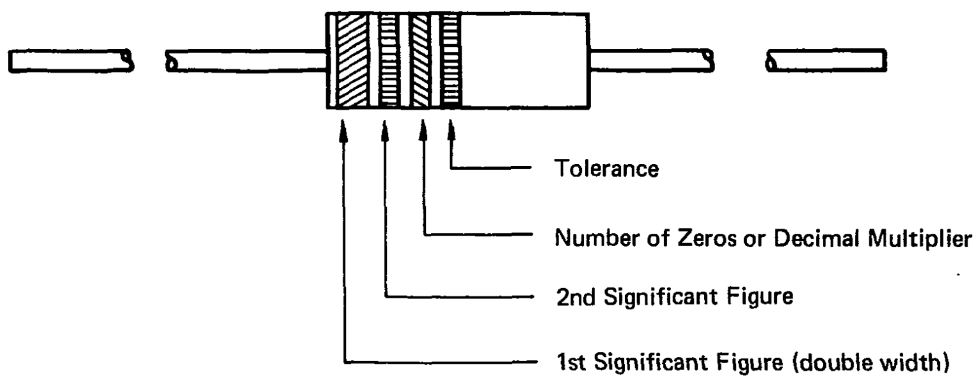
3.3.3 *Power Rating* – Resistors shall have a power rating based on full load operation at the ambient temperature as specified. This power rating is dependent on the ability of resistors to meet the load life requirements. Resistors operated at ambient temperatures in excess of those specified shall be derated accordingly.

3.4 *MARKING* – Resistors shall be legibly and permanently marked with color coding or by stamping or printing. The marking shall remain legible at the end of all tests. Resistance value decimal multiplier, if applicable, and resistance tolerance shall be indicated in accordance with Figure 1.

3.4.1 *Color Coding* – Colors shall be in accordance with the latest issue of EIA Standard GEN-101.

3.4.2 *Stamping and Printing* – Stamped or printed resistors shall include the complete type designation and the Manufacturers Code or Trademark.

FIGURE 1 – STANDARD COLOR CODING



4. STANDARD TESTS

Parts described by this specification shall be capable of passing the tests as follows:

4.1 *STANDARD TEST CONDITIONS* – Unless otherwise specified the atmospheric conditions at which tests are to be made or referred to are as follows:

Temperature 25°C ±5°C
Barometric Pressure 30 ±2 inches of Hg.
Relative Humidity less than 60%

4.2 *TEST REQUIREMENTS* – When tests are conducted the samples should be divided into groups as shown in Table III and the groups given the tests in the order specified.

TABLE III

TEST	TEST PARAGRAPH
GROUP I	
Visual and Mechanical Examination	4.2.1
D.C. Resistance	4.2.2
GROUP II	
Temperature Coefficient	4.2.3
Dielectric-Withstanding Voltage	4.2.4
Short-Time Overload	4.2.5
GROUP III	
Low-Temperature Operation	4.2.6
Temperature Cycling	4.2.7
Humidity	4.2.8
GROUP IV	
Life	4.2.9
GROUP V	
Terminal Strength	4.2.10
Resistance to Soldering Heat	4.2.11
GROUP VI	
Solderability	4.2.12

4.2.1 *Visual and Mechanical Examination* – Resistors shall be examined to verify that the physical dimensions, construction, and marking are in accordance with the applicable detail requirements.

4.2.2 *Resistance* – D.C. Resistance shall be measured using a resistance bridge with a calibrated accuracy of 0.1% or closer. The application of voltage shall be such that less than 10% of rated wattage is applied. The period of application of the measurement voltage shall be 5 seconds or less. Resistors below 20 ohms shall be measured at a point on the lead 3/8 ±1/16 inch from the resistor body.

All resistance reading for any single test shall be made on the same bridge, but the same bridge need not be used on all tests.

4.2.3 *Temperature Coefficient* – Resistance shall be measured at the temperature specified in the Table ±2°C. The resistors shall then be maintained for 30 to 45 minutes, within ±2°C, at each of the ambient temperatures in the order listed in Table IV.

TABLE IV – TEMPERATURE COEFFICIENT AMBIENT TEMPERATURES

°C
-55
1) 25
160
2) 275

Notes: [1]This temperature shall be considered the reference temperature for each of the extreme temperatures.

[2]Applicable to Characteristic B only.

At the end of each period, the resistance shall be measured at the temperature maintained during the period. The temperature coefficient of resistance, referred to a reference temperature of 25°C, shall then be computed as follows:

$$\text{Where: T.C.} = \frac{(R - r)\,100}{(t_R - t_r)\,R}$$

TC = Temperature Coefficient in percent per degrees C.
R = Resistance at reference temperature (25 ±2°C).
r = Resistance at test temperature.
t_R = Reference temperature in degrees C.
t_r = Test temperature in degrees C.

4.2.3 *(Continued)*

Resistors shall not exceed the temperature coefficient that is specified in Table I.

4.2.4 *Dielectric-Withstanding Voltage* – The resistors shall be placed or wrapped in conductive material which will conform to the resistor surface so that at least 90% of the outer periphery is contacted.

An alternating current potential of 900 volts (except for the CRU1 which shall be 700 volts and the CRU2 which shall be 1000 volts) RMS commercial line frequency shall be applied for one minute between the terminals connected together and the hardware or conductive materials.

Resistors shall not flash over or show any evidence of breakdown, and the change of resistance shall not exceed that specified in Table I.

4.2.5 *Momentary Overload* – Resistance shall be measured. The resistors shall then be mounted by their normal mounting means and shall be subjected to an overload voltage which will result in 3 times rated wattage, based on nominal resistance, for 5 seconds. Resistance shall again be measured after the resistors have cooled to room temperature.

The resistors shall not arc, burn or char and the change in resistance shall not exceed that specified in Table I.

4.2.6 *Low-Temperature Operation* – Following the resistance measurement, resistors shall be placed in a cold chamber maintained at a temperature of -65°C + 0°C -5°C. After one hour of stabilization at this temperature, full rated working voltage shall be applied for 45 minutes. Resistors may be loaded individually or in parallel. (15 +5 -0) minutes after the removal of voltage, the specimens shall be removed from the chamber and maintained at a temperature of 25°C ±5°C for a period of 24 hours, after which resistance measurements shall again be made.

Resistors shall show no mechanical damage and the resistance change shall not exceed that specified in Table I.

4.2.7 *Temperature Cycling* – Resistors shall be subjected to the temperature cycle shown in Table V for a total of 5 cycles performed continuously. The temperature shall be maintained at each of the extreme temperatures by means of circulating air. The hot and cold chamber shall be of such capacity that the air at the resistors will reach the temperature specified in Table V within 2 minutes after the resistors have been transferred to the appropriate chamber. Resistors shall not be subjected to circulating air for the 10 to 15 minute periods at room temperature (25 +5°C). Measurements of resistance shall be made before the first cycle and within 24 hours after the fifth cycle.

4.2.7 *(Continued)*

TABLE V – TEMPERATURE CYCLE

Sequence	Temperature °C	Time-Minutes
Start at	+25 ±5	10 to 15
Reduce to	- 55 +0 -3	30
Return to	+25 ±5	10 to 15
Raise to	1) +160 +3 -0 2) +275 +3 -0	30
Return to	+25 ±5	10 to 15

1) For Characteristic A
2) For Characteristic B

Resistors shall be mounted by their terminals so that there will be at least 1" of free air space around each resistor, and with the mounting in such a position with respect to the air stream that it offers substantially no obstruction to the flow of air across and around the resistors.

Resistors shall not show any evidence of mechanical damage. The resistance change shall not exceed that specified in Table I.

4.2.8 *Humidity* – Following measurement of resistance in a dry atmosphere of 25°C ±5°C, resistors shall be placed in an atmosphere of 75 ±2°C and 90% to 100% relative humidity for 240 ±8 hours, air dried for 1 hour ±15 minutes, and final resistance measured.

The resistors shall show no visual damage. The resistance change shall not exceed that specified in Table I.

4.2.9 *Load Life* – This test shall be conducted at the ambient temperature as specified on the individual specification sheets. Resistors shall be mounted and soldered or clipped to terminals. The effective length of each lead shall be 1" ±3/16". Resistors shall be so arranged that the temperature of any one resistor will not appreciably influence the temperature of any other resistor. A AC or DC voltage sufficient to cause rated wattage to be dissipated shall be applied intermittently one and one half hours on and one half hour off.

Resistance measurements shall be made at the end of the 1/2 hour "off" periods after 50 ±8, 200 ±8, 500 ±12, 750 ±12, 1000 ±12 hours have elapsed. Resistance measurements may be made inside or outside of the chamber, providing all measurements are made under the same conditions.

4.2.9 *(Continued)*

As a result of this test, there shall be no mechanical damage. The change in resistance between the initial and any succeeding reading shall not exceed that specified in Table I.

4.2.10 *Terminal Strength* – Resistance shall be measured before the testing specified in A and after testing per B.

A. *Direct Load* – Resistors shall be held by one terminal and the load shall be gradually applied in the direction of the longitudinal axis of the resistor until the applied load reaches 5 pounds. The load shall be held for 30 seconds.

B. *Twisting* – Leads shall be bent through 90^o at a point 1/4 inch from the body of the resistor, with a radius of curvature at the bend approximately 1/32 inch. The leads shall be clamped to within 3/64 + 1/64 inch of the bend on a side between the bend and the remaining portion of the lead. The body of the resistor shall then be rotated about the original axis of the bend lead through 360 degrees in alternate directions for 3 360^o rotations at the rate of approximately 5 seconds per rotation.

There shall be no evidence of lead breakage or mechanical damage to the resistor body. The resistance change shall not exceed that specified in Table I.

4.2.11 *Resistance to Soldering Heat* – Following a measurement of resistance, resistor terminals shall be immersed, one at a time, for 3 $\pm$1/2 seconds each in a pot of molten solder at a point 1/8 to 3/16" from the resistor body (except for the CRU1 style which shall be dipped to a point 1/4 to 5/16" from the resistor body). Resistor measurements shall be made 24 $\pm$4 hours after immersion.

There shall be no mechanical damage. The resistance change shall not exceed that specified in Table I.

4.2.12 *Solderability* – Both leads shall be subjected to Test Condition 1 of RS-178. The failure criteria shall be as defined in RS-178.

5. APPLICATION NOTES

5.1 *EXCESSIVE VOLTAGES* – Application of the nominal rated continuous working voltage to a resistor having less than the nominal resistance because of a wide resistance tolerance will result in application of more than rated power with probable shortening of resistor life.

5.2 *PEAK VOLTAGE* – When nonsinusoidal peak voltages in excess of 1.4 times the rated sine wave continuous RMS voltage are applied to the resistors, care should be taken to determine the suitability of resistors for use in such applications.

5.3 *SOLDERING* – Care should be taken in soldering resistors, since the properties of a resistor may be seriously affected when soldering irons are applied too close to resistor body or for too long a period. The length of lead left between resistor body and soldering point should be not less than 1/4 inch, nor should the required soldering time exceed 3 seconds.

5.4 *HIGH FREQUENCY* – These resistors should not be used in very high frequency circuits where inductance may affect circuit operation.