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DEPARTMENT OF DEFENSE HANDBOOK

RESISTORS,

SELECTION AND USE OF

This handbook is for guidance only. Do not cite this document as a requirement.

AMSC N/A FSC 5905

FORWARD

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

2. This handbook provides selected standard resistors for use in the design of Department of Defense equipment. This handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply.

a. The application information and performance characteristics contained in this handbook are offered for guidance and are not to be considered as mandatory. Additional application information will be added when coordinated with the Department of Defense.

b. Additional resistor types of this handbook will be developed as standard resistors of a given specification family are selected and coordinated with the Department of Defense.

3. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAM, 3990 East Broad Street, Columbus, Ohio 43213-1199 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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SECTION 1: SCOPE

1.1 Scope. This handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply. This handbook consists of the following:

a. Selected standard resistor types, for use in the design and manufacturer of Department of Defense equipment under the jurisdiction of the Department of Defense.

b. Guides for the choice and application of resistors for use in Department of Defense equipment.

Requirements for resistors listed in this handbook are covered in the applicable specification (see 2.1). When it has been determined that circuit requirements cannot be met by using resistor styles or characteristics listed in the applicable specifications, the design engineer should, with the approval of the cognizant activity, select from the applicable resistor specification styles or characteristics not listed herein.

1.2 Purpose of handbook.

a. To provide the equipment designer with a selection of standard resistors for use in most Department of Defense applications.

b. To control and minimize the variety of resistors used in Department of Defense equipment in order to facilitate logistic support of equipment in the field.

c. To outline criteria pertaining to the use, choice, and application of resistors in Department of Defense equipment.

SECTION 2: APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are the ones that are needed in order to fully understand the information provided by this handbook.

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 issue of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto.

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-19 - Resistor, Variable, Wire-Wound (Low operating Temperature), General Specification For.

MIL-PRF-22 - Resistor, Variable, (Wire-Wound, Power Type), General Specification For.

MIL-PRF-26 - Resistors, Fixed, Wire-Wound (Power Type), General Specification For.

MIL-PRF-29 - Resistors, Fixed, Meter Multiplier, External (High Voltage, Ferrule Terminal Type) General Specification For.

MIL-PRF-94 - Resistor, Variable, Composition, General Specification For.

MIL-PRF-914 - Resistor Networks, Fixed, Film, Surface Mount, Nonestablished Reliability, and Established Reliability, General Specification For.

MIL-PRF-12934 - Resistor, Variable, Precision, General Specification For.

MIL-PRF-18546 - Resistors, Fixed, Wire-Wound (Power Type, Chassis Mounted), General Specification For.

MIL-PRF-22097 - Resistor, Variable, Nonwire-Wound (Adjustment Type), General Specification For.

MIL-PRF-22684 - Resistors, Fixed, Film (Insulated), General Specification For.

MIL-PRF-23285 - Resistors, Variable, Nonwire-Wound, General Specification For.

MIL-PRF-23648 - Resistor, Thermal (Thermistor) Insulated, General Specification For.

MIL-PRF-27208 - Resistor, Variable, Wire-Wound, Nonprecision, General Specification For.

MIL-PRF-39002 - Resistors, Variable, Wirewound, Semi-Precision, General Specification For.

MIL-PRF-39005 - Resistors, Fixed, Wire-Wound (Accurate), Nonestablished Reliability, Established Reliability, General Specification For.

MIL-PRF-39007 - Resistors, Fixed, Wire-Wound (Power Type), Nonestablished Reliability, Established Reliability, and Space Level, General Specification For.

MIL-PRF-39009 - Resistors, Fixed, Wire-Wound (Power Type, Chassis Mounted), Nonestablished Reliability, and Established Reliability, General Specification For.

MIL-PRF-39015 - Resistors, Variable, Wire-Wound, Nonestablished Reliability, and Established Reliability, General Specification For.

MIL-PRF-39017 - Resistors, Fixed, Film (Insulated), Nonestablished Reliability, and Established Reliability, General Specification For.

MIL-PRF-39023 - Resistors, Variable, Nonwire-Wound, Precision, General Specification For.

MIL-PRF-39035 - Resistor, Variable, Nonwire-Wound (Adjustment Type), Nonestablished Reliability, and Established Reliability, General Specification For.

MIL-PRF-49462 - Resistors, Fixed, Film, High Voltage, General Specification for.

MIL-PRF-49465 - Resistors, Fixed, Metal Element (Power Type), (Very Low Resistance Values), General Specification For.

MIL-PRF-55182 - Resistors, Fixed, Film, Nonestablished Reliability, Established Reliability, and Space Level, General Specification For.

MIL-PRF-55342 - Resistors, Fixed, Film, Chip, Nonestablished Reliability, Established Reliability, Space Level, General Specification For.

MIL-PRF-83401 - Resistor Networks, Fixed, Film, and Capacitor-Resistor Networks, Ceramic Capacitor and Fixed Film Resistors, General Specification For.

MIL-PRF-83530 - Resistors, Voltage Sensitive (Varistor, Metal-Oxide), General Specification For.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Defense Automated Printing Service, Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

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

SECTION 3: DEFINITIONS

3.1 Rating and design application terms. A list of common terms used in rating and design application of resistors is as follows:

a. Ambient operating temperature. The temperature of the air surrounding an object, neglecting small localized variations.

b. Contact resistance variation. The apparent resistance seen between the wiper and the resistance element when the wiper is energized with a specified current and moved over the adjustment travel in either direction at a constant speed. The output variations are measured over a specified frequency bandwidth, exclusive of the effects due to roll-on or roll-off of the terminations and is expressed in ohms or percent of total nominal resistance.

c. Critical value of resistance. For a given voltage rating and a given power rating, there is only one value of resistance that will dissipate full rated power at rated voltage. This value of resistance is commonly referred to as the "critical value of resistance." For values of resistance below the critical value, the maximum (element) voltage is never reached and, for values of resistance above critical value, the power dissipated becomes lower than rated. Figure 1 shows this relationship.

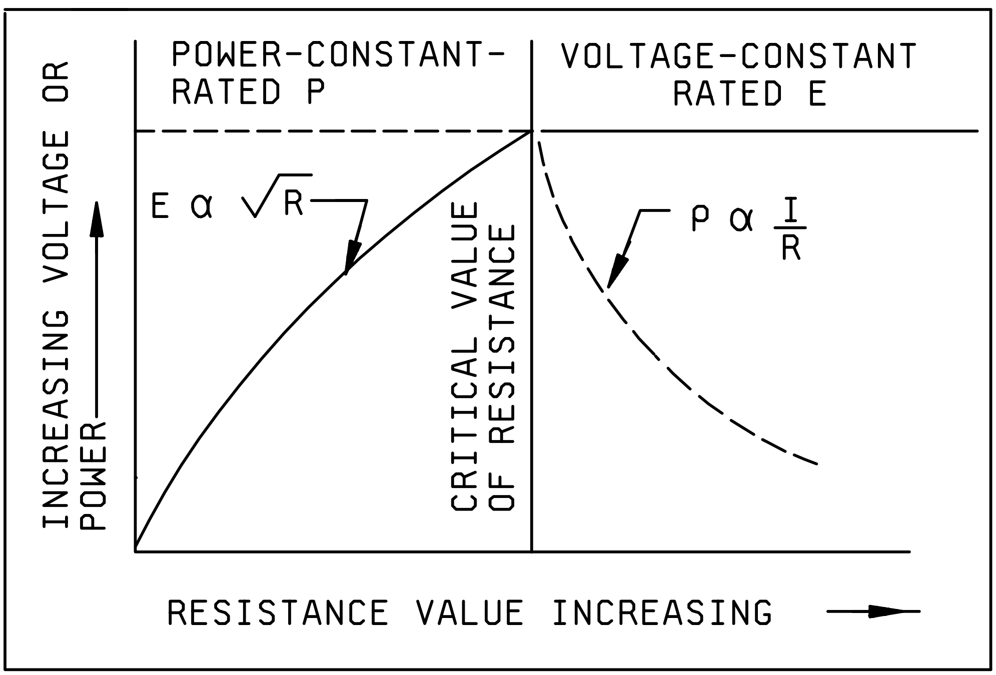

FIGURE 1. Maximum working voltage and critical value of resistance.

d. Dielectric strength. The ultimate breakdown voltage of the dielectric or insulation of the resistor when the voltage is applied between the case and all terminals tied together. Dielectric strength is usually specified at sea level and simulated high altitude air pressures.

e. Hot-spot temperature. As defined in Department of Defense specifications, the maximum temperature measured on the resistor due to both internal heating and the ambient operating temperature. Maximum hot-spot temperature is predicated on thermal limits of the materials and the design. The hot-spot temperature is also usually established as the top temperature on the derating curve at which the resistor is derated to zero power.

f. Insulation resistance. The dc resistance measured between all terminals connected together and the case, exterior insulation, or external hardware.

g. Maximum (element) working voltage ($E = \sqrt{PR}$). The maximum voltage stress (dc or rms) that may be applied to the resistor (resistance element) is a function of (1) the materials used, (2) the required performance, and (3) the physical dimensions. (See figure 1.)

h. Noise. An unwanted voltage fluctuation generated within the resistor. Total noise of a resistor always includes Johnson noise 1/ which is dependent only on the resistance value and temperature of the resistance element. Depending on the type of element and construction, total noise may also include noise caused by current flow, and noise caused by cracked bodies and loose end caps or leads. For variable resistors, noise may also be caused by jumping of contact over turns of wire and by an imperfect electrical path between the contact and resistance element.

i. Resistance temperature characteristic (temperature coefficient). The magnitude of change in resistance due to temperature, usually expressed in percent per degree Celsius or parts per million per degree Celsius (ppm/°C). If the changes are linear over the operating temperature range, the parameter is known as “temperature coefficient”.

j. Resistance tolerance. The permissible deviation of the manufactured resistance value (expressed in percent) from the specified nominal resistance value at standard (or stated) environmental conditions.

k. Stability. The overall ability of a resistor to maintain its initial resistance value over extended periods of time when subjected to any combination of environmental conditions and electrical stresses.

1/ Johnson, J. B., “Thermal Agitation of Electricity in Conductors,” Physical Review, volume 32 (July, 1928, 97-109).

SECTION 4: GENERAL REQUIREMENTS

4.1 Choice of resistor types. The variety of resistor types used in any particular equipment should be the minimum necessary to obtain satisfactory performance. Where more than one type of resistor may be used in a given application (such as, fixed, film, insulated versus fixed, film, insulated (high stability)), consideration should be given to cost and availability (use of strategic materials, multiple sources). The resistors identified in this handbook meet all the criteria for standard types (see 1.1 and 4.4).

4.1.1 Reliability. Where quantitative reliability requirements specified as part of the equipment requirements are such that the use of parts with established reliability is dictated, such parts should be selected from the established reliability specification.

4.1.2 Qualified sources. After a preliminary selection of the desired resistor has been made, reference should be made to the applicable qualified products list for listing of qualified sources.

4.2 Item identification. A type designation for any resistor referenced herein may be constructed as indicated in the example given in the applicable section. The Part Identification Number (PIN) designations are depicted in the applicable specification.

4.3 Conflict of requirements. This handbook provides selected standard resistors for use in the design of Department of Defense equipment. This handbook is for guidance only. This handbook can not be sited as a requirement.

4.4 Criteria for inclusion in this handbook. The criteria for the inclusion of resistor types in this handbook are as follows:

a. The resistor should be the best type available for general use in military equipment.

b. Coordinated Department of Defense specifications should be available (see 2.1).

c. Resistors should be in production, or should have been in production.

SECTION 5: DETAILED REQUIREMENTS

5.1 Detailed requirements. The detailed requirements for standard resistor types are contained in the applicable specification of this handbook.

SECTION 6: NOTES

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

6.1 Intended use. General application notes are as indicated in the appendix.

6.2 Subject term (key work) listing.

Adjustable
Chip
Established reliability
Film
Fixed
Lead-screw
Network
Nonestablished reliability
Nonwirewound
Resistance-temperature characteristic
Resistor
Space level
Surface mount
Thermistor
Trimmer
Variable
Varistor
Wirewound

APPENDIX

GENERAL APPLICATION INFORMATION

SECTION 1: SCOPE

1.1 Scope. The application information in this handbook is designed to help in the selection of specified resistors (application information pertaining to specific resistors types is contained in the applicable sections). As with other types of components, the most important thing a user must decide is which of the numerous types of resistors will be best for use in the military equipment being designed. Proper selection in its broadest sense is the first step in building reliable equipment. To properly select the resistors to be used, the user must know as much as possible about the types from which to choose. The advantages and disadvantages should be known, as well as their behavior under various environmental conditions, their construction, and their effect on circuits and the effect of circuits on them, and a knowledge of what makes resistors fail. This appendix is not a mandatory part of the handbook. The information contained herein is intended for guidance only.

1.1.1 Resistor types. All variable and fixed resistors, of the types widely used in electronic equipment, can be grouped into one of three basic types. They are “composition” types, “film” types, or “wirewound” types. As the name indicates, the “composition” type is made of a mixture of resistive material and a binder which are molded into the proper shape and resistance value. The “film” type is composed of a resistive film deposited on, or inside of, an insulating cylinder or filament. The “wirewound” type is made up of resistance wire, wound on an insulated form. These basic types differ from each other in size, cost, resistance range, power rating, and general characteristics. Some are better than others for particular purposes; no one type has all of the best characteristics. The choice among them, therefore, depends on the requirements, both initial and long-term; the environment in which they must exist; and numerous other factors which the designer must understand. The designer must realize that the summaries of the requirements of a particular application must be taken into consideration and compared with the advantages and drawbacks of each of the several types, before a final choice is made. Tables I, II, III, IV, V and VI provide a selection guide for fixed and variable resistors included in this handbook.

The Department of Defense resistor specification categories are shown in figure 2.

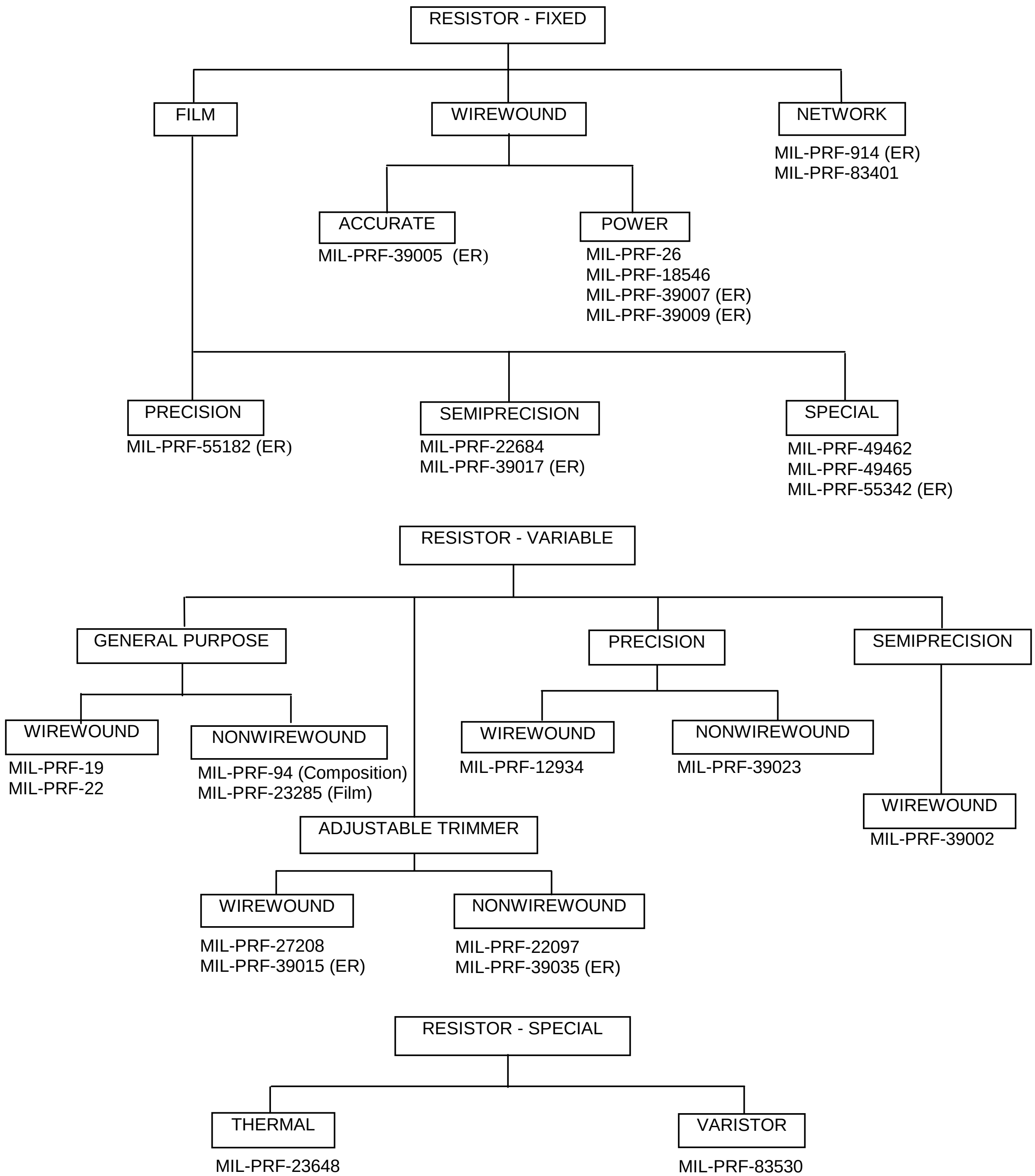

FIGURE 2 Military resistor specification categories.

APPENDIX

SECTION 2: APPLICABLE DOCUMENTS.

This section is not applicable to this appendix.

SECTION 3: GENERAL CHARACTERISTICS OF RESISTORS

3.1 General characteristics of fixed resistors.

3.1.1 Fixed, Film Resistors. See table I.

3.1.1.1 MIL-PRF-22684, RL42..TX, Resistors, Fixed Film (Insulated). These fixed, film, resistors have semi-precision characteristics and small sizes. The sizes and wattage rating are comparable to those of MIL-R-39008 (cancelled) and stability is between MIL-R-39008 and MIL-PRF-55182. Design parameter tolerances are looser than those of MIL-PRF-55182 but good stability makes them desirable in most electronic circuits. These resistors are capable of full load operation at an ambient temperature of +70^{o}C and have a resistance-temperature characteristic of ±200 parts per million per degree Celsius (ppm/^{o}C). See also MIL-PRF-39017.

3.1.1.2 MIL-PRF-39017, RLR, Resistors, Fixed Film (Insulated), Nonestablished Reliability and Established Reliability. These fixed, film, resistors have semi-precision characteristics and small sizes. The sizes and wattage rating are comparable to those of MIL-R-39008 (cancelled) and stability is between MIL-R-39008 and MIL-PRF-55182. Design parameter tolerances are looser than those of MIL-PRF-55182 but good stability makes them desirable in most electronic circuits. These resistors are capable of full load operation at an ambient temperature of +70^{o}C and have a resistance-temperature characteristic of ±100 ppm/^{o}C and ±350 ppm/^{o}C. The resistors have product levels ranging from Non-ER, and a life failure rate (FR) 1.0 percent to 0.001 percent per 1,000 hours. The FR levels are established at a 60 percent confidence level on basis of life tests. Replaces MIL-PRF-22684.

3.1.1.3 MIL-PRF-49462, RHV, Resistors, Fixed, Film, High Voltage. These resistors are intended for use in electronic circuits where high voltages and high resistance values are used.

3.1.1.4 MIL-PRF-49465, RLV, Resistor, Fixed, Metal Element (Power Type), (Very Low Resistance Value). These are power type, very low resistance values (1 ohm and below), fixed resistors (2 terminal and 4 terminal) for use in electrical, electronic, communications, and associated equipment. Included are precision resistors of 1, 3, and 5 percent, and 5 and 10 percent initial resistance tolerances with power ratings ranging from 2 watts to 10 watts at +25^{o}C derated to 0 watts at +275^{o}C

3.1.1.5 MIL-PRF-55182, RNC, RNN, or RNR, Resistor, Fixed, Film, Nonestablished Reliability, Established Reliability, and Space Level. These fixed, film resistors including both hermetically and nonhermetically sealed types possess a high degree of stability, with respect to time, under server environmental conditions, with an established reliability. Use in circuits requiring higher stability than provided by composition resistors or film, insulated, resistors, and where ac frequency requirements are critical. Operation is satisfactory from dc to 100 megahertz (MHz). Metal films are characterized by low temperature coefficients and are usable for ambient temperatures of +125°C or higher with small degradation. Replaces MIL-R-10509, RN, fixed, film (high stability). The resistors have product levels ranging from Non-ER, and a life failure rate (FR) 1.0 percent to 0.001 percent per 1,000 hours. The FR levels are established at a 60 percent confidence level on basis of life tests.

3.1.1.6 MIL-PRF-55342, RM, Resistor, Fixed, Film, Chip, Nonestablished Reliability, Established Reliability, and Space Level. These chip resistors are primarily intended for incorporation into hybrid microelectronic circuits. They are designed for use in critical circuitry where stability, long life, reliable operation, and accuracy are of prime importance. These resistors are uncased, leadless chip devices and possess a high degree of stability with respect to time, under severe environmental conditions. These resistors provide life failure rates ranging from 1.0 percent to 0.001 percent per 1,000 hours. The failure rates are established at 60 percent confidence level on the basis of life tests. The resistors have product levels ranging from Non-ER, and a life failure rate (FR) 1.0 percent to 0.001 percent per 1,000 hours. The FR levels are established at a 60 percent confidence level on basis of life tests.

TABLE I. Fixed film resistor selection guidance table.

Specification	Styles available	Power and max voltage ratings	Resistance tolerance (± percent)	Resistance range	Resistance temperature coefficient (ppm/°C)	Maximum body size (inches) and Configuration (see figure 3)
MIL-PRF-22684 (Insulated)	RL42…TX	2 W 500 V	2.0, 5.0	10 to 1.5 M	±200	.728 x .336 A
MIL-PRF-39017 (Insulated, nonestablished and established reliability)	RLR05	.125 W/ 200 V	1.0, 2.0 2.0, 5.0, 10.0	2.7 to 1 M 1.1 M to 22 M	±100 ±350	.170 x .074 A
	RLR07	.25 W/ 250 V	1.0, 2.0 2.0, 5.0, 10.0	1 to 10 M 11 M to 22 M	±100 ±350	.281 x .098 A
	RLR20	.5 W/ 350 V	1.0, 2.0 2.0, 5.0, 10.0	1 to 3.01 M 3.3 M to 22 M	±100 ±350	.416 x .161 A
	RLR32	1 W/ 500 V	1.0, 2.0 2.0, 5.0, 10.0	1 to 2.7 M 3.0 M to 22 M	±100 ±350	.593 x .205 A
	RLR62	2 W/ 500 V	1.0, 2.0 2.0, 5.0, 10.0	10 to 2.7 M 3.0 M to 22 M	±100 ±350	.593 x .245 A
MIL-PRF-49462 (High voltage)	RHV30 RHV31 RHV32 RHV33 RHV34 RHV35	.25 W/ 750 V .5 W/ 1.5 kV 1.0 W/ 3.0 kV 2.0 W/ 5.0 kV 3.0 W/ 10.0 kV 5.0 W/ 20.0 kV	1.0, 2.0, 5.0	100 k to 100 M 100 k to 392 M 49.9 k to 499 M 100 k to 499 M 200 k to 1 G 330 k to 1 G	R < 500 MΩ RTC ≤ 200 ppm R ≥ 500 MΩ RTC ≤ 500 ppm	.306 x .098 .431 x .154 .752 x .328 1.124 x .328 2.124 x .328 3.124 x .328 A
MIL-PRF-49465 (Metal element, power type, very low resistance values)	RLV10	5 W	1.0, 3.0, 5.0	.01 to .0249 .025 to .0499 .05 to .0749 .075 to .099 .1 to .5	±150 ±125 ±100 ±50 ±50	.999 x .406 O
	RLV30	3 W	1.0, 3.0, 5.0	.01 to .0249 .025 to .0499 .05 to .0749 .075 to .099 .1 to .2	±350 ±200 ±125 ±75 ±50	.591 x .236 A
	RLV31	5 W	1.0, 3.0, 5.0	.01 to .0249 .025 to .0499 .05 to .0749 .075 to .099 .1 to .3	±250 ±150 ±100 ±75 ±50	.956 x .361 A

TABLE I. Fixed film resistor selection guidance table - Continued

Specification	Styles available	Power and max voltage ratings	Resistance tolerance (± percent)	Resistance range	Resistance temperature coefficient (ppm/°C)	Maximum body size (inches) and Configuration (see figure 3)
MIL-PRF-55182 (Film, nonestablished and established reliability, space level)	RNR/N/C50	.05 W/ 200 V	0.1,0.5, 1.0	10 to .796 M	±25, ±50, ±100	.180 x .080 A
	RNR/N/C55	.1 W/ 200 V	0.1,0.5, 1.0	10 to 2.0 M	±25, ±50, ±100	.281 x .140 A
	RNR/N/C60	.125 W/ 250 V	0.1,0.5, 1.0	1.0 to 4.02 M	±25, ±50, ±100	.437 x .165 A
	RNR/N/C65	.25 W/ 300 V	0.1,0.5, 1.0	1.0 to 8.06 M	±25, ±50, ±100	.656 x .250 A
	RNR/N/C70	.5 W/ 350 V	0.1,0.5, 1.0	1.0 to 15 M	±25, ±50, ±100	.875 x .328 A
	RNR/C75	1 W/ 750 V	0.1,0.5, 1.0	10 to 20 M	±25	1.24 x .437 A
	RNR/C77	1W /750 V	0.1,0.5, 1.0	1.0 to 20 M	±25, ±50, ±100	1.124 x .255 A
	RNC90	.3 W/300 V	.005, .01, .05, .1, .5, 1.0	4.99 to 200k	±5 ±10	.320 x .336 x .120 K
MIL-PRF-55342 (Film, chip nonestablished and established reliability, space level)	RM0502	.01 W/ 40 V .02 W/ 40 V	0.1, 1.0, 2.0 5.0, 10.0	5.6 to 1 M	±25, ±50 ±100, ±300	.055 x .035 x .010/.030 T
	RM0505	.025W/ 40 V .05 W/ 40 V	0.1, 1.0, 2.0 5.0, 10.0	5.6 to 1 M	±25, ±50 ±100, ±300	.05 x .05 x .012/.033 T
	RM0705	.05 W/ 50 V .10 W/ 50 V	0.1, 1.0, 2.0 5.0, 10.0	5.6 to 1 M	±25, ±50 ±100, ±300	.075 x .05 x .015/.033 T
	RM1005	.05 W/ 40 V .1 W/ 40 V	0.1, 1.0, 2.0 5.0, 10.0	5.6 to 1 M	±25, ±50 ±100, ±300	.10 x .05 x .015/.033 T
	RM1010	.25 W .4 W (fiber) .5 W (ceramic) 75 V	0.1, 1.0, 2.0 5.0, 10.0	5.6 to 5.62 M	±25, ±50 ±100, ±300	.100 x .100 .015/.033 T
	RM1206	.125 W/ 100V .25 W/ 100V	0.1, 1.0, 2.0 5.0, 10.0	5.6 to 5.62 M	±25, ±50 ±100, ±300	.126 x .063 x .015/.033 T
	RM1505	.1 W/ 40V .150 W/ 40 V	0.1, 1.0, 2.0 5.0, 10.0	5.6 to 4.75 M	±25, ±50 ±100, ±300	.15 x .05 x.015/.033 T

TABLE I. Fixed film resistor selection guidance table - Continued

Specification	Styles available	Power and max voltage ratings	Resistance tolerance (± percent)	Resistance range	Resistance temperature coefficient (ppm/°C)	Maximum body size (inches) and Configuration (see figure 3)
MIL-PRF-55342 (Film, chip nonestablished and established reliability, space level)	RM2010	.4 W .6 W (fiber) .8 W (ceramic) 150 V	0.1, 1.0, 2.0 5.0, 10.0	5.6 to 15 M	±25, ±50 ±100, ±300	.206 x .098 x .015/.033 T
	RM2208	.2 W/ 40 V .225 W/ 40 V	0.1, 1.0, 2.0 5.0, 10.0	5.6 to 15 M	±25, ±50 ±100, ±300	.230 x .085 x .015/.033 T
	RM2512	.5 W .75 W (fiber) 1 W (ceramic) 200 V	0.1, 1.0, 2.0 5.0, 10.0	5.6 to 15 M	±25, ±50 ±100, ±300	.248 x .124 x .015/.033 T

3.1.2 Fixed Wire-wound Resistors. See table II.

3.1.2.1 MIL-PRF-26, RW, Resistors, Fixed, Wirewound (Power Type). These power type, wirewound fixed resistors are for use in electrical, communication 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 and precision axial lead types of 0.1 percent, 0.5 percent, and 1 percent initial resistance tolerance with power ranging from 1 watt to 10 watts at +25°C, derated to 0 power at +275°C. Use where large power dissipation is required and where ac performance is relatively unimportant (such as, when used as voltage divider or bleeder resistors in dc power supplies, or for series dropping). They are generally satisfactory for use at frequencies up to 20 kilohertz (kHz) even though the ac characteristics are controlled. Neither the wattage rating nor the rated continuous working voltage may be exceeded.

3.1.2.2 MIL-PRF-18546, RE, Resistors, Fixed, Wirewound (Power Type, Chassis Mounted). These fixed, wirewound resistors are established reliability chassis mounted, power type units. They utilize the principle of heat dissipation through a metal mounting surface. These resistors are capable of full load operation at an ambient temperature of +25°C when mounted on a specified chassis area. Use where power tolerance and relatively large power dissipation is required for a given unit size than is provided by MIL-PRF-26 resistors, where ac performance is noncritical (such as, voltage divider or bleeder resistors in dc power supplies or series-dropping circuits).

3.1.2.3 MIL-PRF-39005, RBR, Resistors, Fixed, Wirewound, (Accurate), Nonestablished Reliability, Established Reliability. These nonestablished reliability, established reliability, accurate, wirewound 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. These resistors are suitable for continuous full load (or voltage) operation at any ambient temperature up to +125°C, and when properly derated to +145°C. Use in circuits requiring higher stability than provided by composition or film resistors, and where ac frequency performance is not critical. Operation is satisfactory from dc to 50 kHz. The resistors have product levels ranging from Non-ER, and a life failure rate (FR) 1.0 percent to 0.001 percent per 1,000 hours. The FR levels are established at a 60 percent confidence level on basis of life tests. Replaces MIL-R-93.

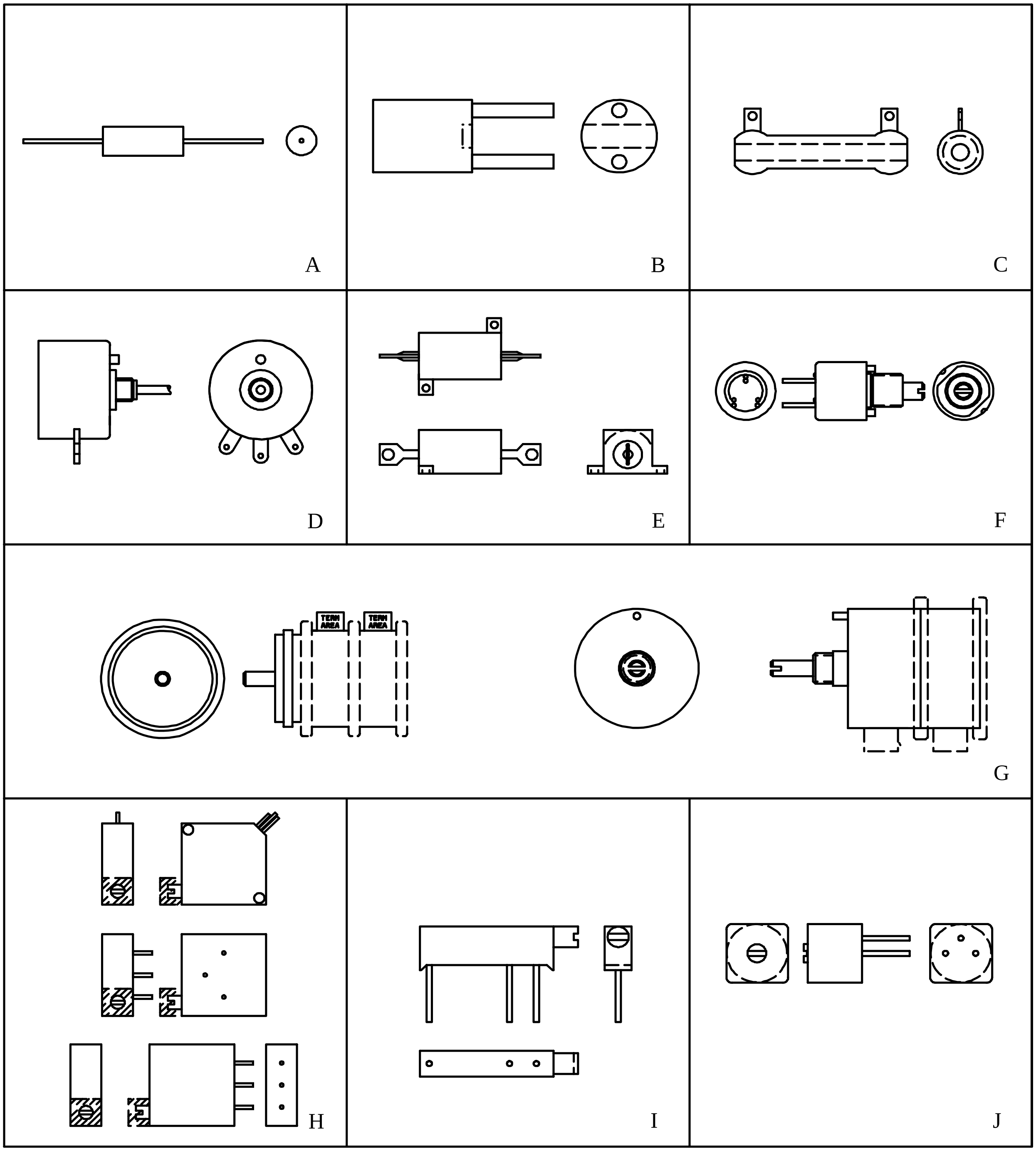

FIGURE 3. Configurations.

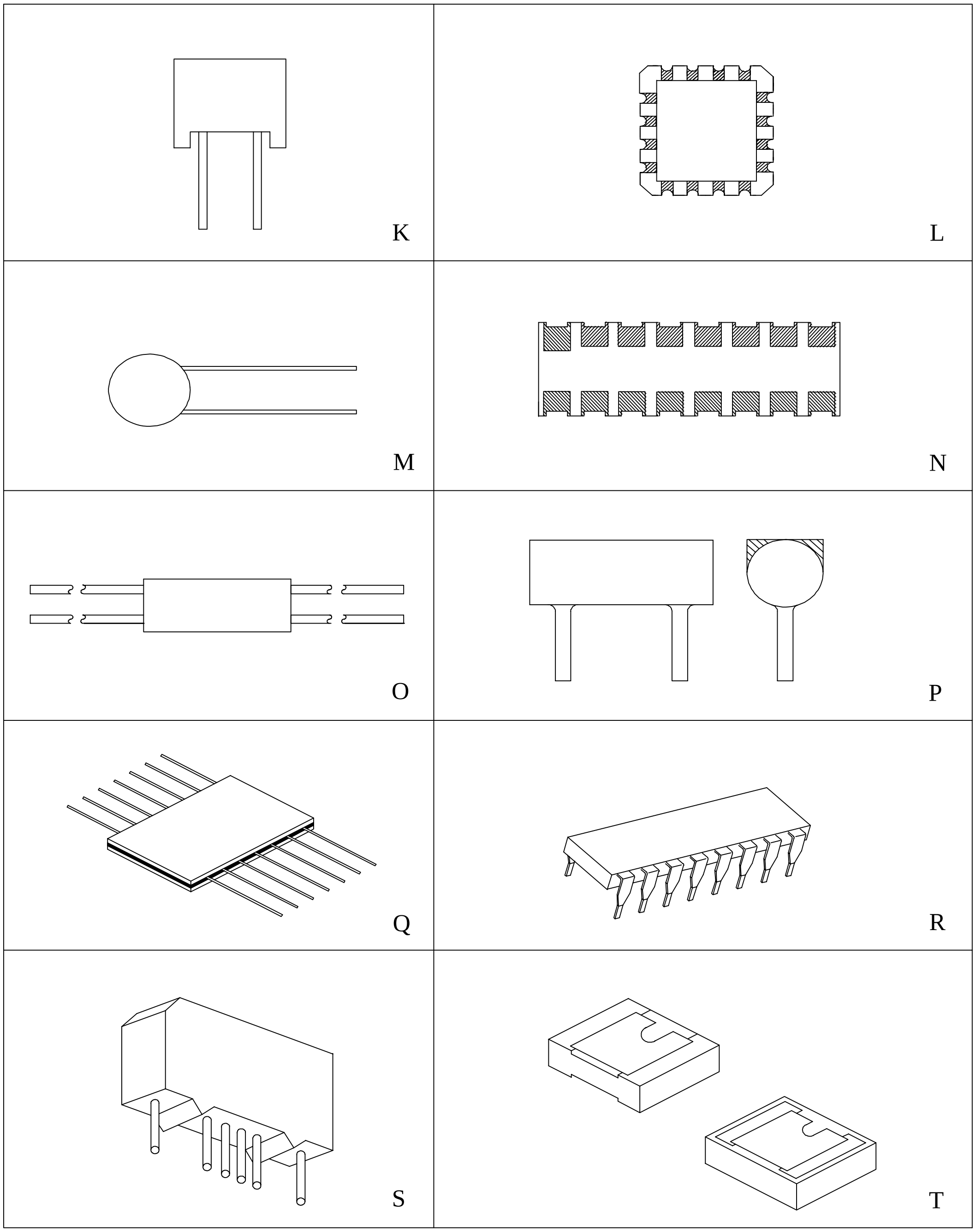

FIGURE 3. Configurations. Continued

3.1.2.4 MIL-PRF-39007, RWR, Resistors Fixed, Wirewound (Power Type), Nonestablished Reliability, Established Reliability, and Space Level. These nonestablished reliability, established reliability, or space level, axial leaded precision power type, wirewound fixed resistors having a +25oC ambient operating temperature derated to 0 load at +250oC. Use where large power dissipation is required and where ac performance is relatively unimportant (such as, when used as voltage divider or bleeder resistors in dc power supplies, or for series dropping). They are generally satisfactory for use at frequencies up to 20 kilohertz (kHz) even though the ac characteristics are controlled. Neither the wattage rating nor the rated continuous working voltage may be exceeded. The resistors have product levels ranging from Non-ER, and a life failure rate (FR) 1.0 percent to 0.001 percent per 1,000 hours. The FR levels are established at a 60 percent confidence level on basis of life tests.

3.1.2.5 MIL-PRF-39009, RER, Resistors, Fixed, Wirewound (Power Type, Chassis Mounted), Nonestablished Reliability, Established Reliability. These fixed, wire-wound resistors are established reliability chassis mounted, power type units. They utilize the principle of heat dissipation through a metal mounting surface with full rated wattage at +25^{o}C. These resistors should not be used in circuits where their ac performance is of critical importance, although provision have be made, in particular styles, to minimize inductance. The resistors have product levels ranging from Non-ER, and a life failure rate (FR) 1.0 percent to 0.001 percent per 1,000 hours. The FR levels are established at a 60 percent confidence level on basis of life tests.

3.1.3 Fixed Film Networks. See table III.

3.1.3.1 MIL-PRF-914, RNS, Resistor, Network, Fixed, Film, Surface Mount, Nonestablished Reliability, and Established Reliability. These networks are primarily intended for use in surface mount applications where space is a major concern. These resistors can either be hermetically or nonhermetically sealed and consist entirely of fixed, film resistors. The resistors have product levels ranging from Non-ER, and a life failure rate (FR) 1.0 percent to 0.001 percent per 1,000 hours. The FR levels are established at a 60 percent confidence level on basis of life tests.

3.1.3.2 MIL-PRF-83401, RZ, Resistor Networks, Fixed Film, and Capacitor-Resistor Networks, Ceramic Capacitor and Fixed Film Resistors. These networks are designed for use in critical circuitry where stability, long life, reliable operation, and accuracy are of prime importance. They are particularly desirable for use where miniaturization is important and ease of assembly is desired. They are useful where a number of resistors of the same resistance value are required in the circuit. The resistors have product levels ranging from Non-ER, and a life failure rate (FR) 1.0 percent to 0.001 percent per 1,000 hours. The FR levels are established at a 60 percent confidence level on basis of life tests.

3.1.4 Variable Wirewound Resistors. (See table IV)

3.1.4.1 MIL-PRF-19, RA, Resistor, Variable, Wirewound (Low Operating Temperature). These variable resistors having a resistance element of wirewound on an insulating strip shaped in an arc, so that a contact bears uniformly on the resistance element when adjusted by a control shaft. These resistors are capable of full load operation at an ambient temperature of +40^{o}C and are suitable for continuous operation when properly derated, at a maximum temperature of +105^{o}C. Use primarily for noncritical, low power, low frequency applications where characteristics of wirewound resistors are more desirable than those of composition resistors.

3.1.4.2 MIL-PRF-22, RP, Resistor, Variable, Wirewound (Power Type). These resistors have a resistance element of wire, wound linearly on an insulted strip shaped in an arc, such that a contact bears uniformly on the resistance element when adjusted by a control shaft. The power ratings cover a range from 6.25 watts to 1,000 watts, inclusive. Use in such applications as motor speed control, generator field control, lamp dimming, heater and oven control, potentiometer uses, and applications where variations of voltage and current are expected.

3.1.4.3 MIL-PRF-12934, RR, Resistor, Variable, Wirewound, Precision. These precision, wirewound, variable resistors whose electrical output (in terms of percent of applied voltage) are linear or nonlinear with respects to the angular position of the shaft. These resistors are capable of full-load operation at maximum ambient temperatures of +70°C and +85°C and are suitable for continuous operation, when properly derated, to maximum temperatures of +125°C and +150°C. Use in servo mounting applications requiring precise electrical and mechanical output and performance. Used in computer, antenna, flight control, and bomb navigation systems.

3.1.4.4 MIL-PRF-27208, RT, Resistor, Variable, Wirewound, Nonprecision. These wirewound variable resistors with a contact bearing uniformly over the entire surface of the entire resistive element, wound linearly, when positioned by an multiturn lead screw actuator. These resistors are capable of full-load operation at maximum ambient temperatures of +85°C and are suitable for continuous operation, when properly derated, to maximum temperatures of +150°C. Use for matching, balancing, and adjusting circuit variables in computers, telemetering equipment, and other critical applications.

3.1.4.5 MIL-PRF-39002, RK, Resistor, Variable, Wirewound, Semi-Precision. These semi-precision, wirewound, variable resistors have a resistance element of wire, wound linearly on an insulated form shaped in an arc, so that a contact bears uniformly on the resistance element when adjusted by a contact shaft. The electrical output (in terms of percent of applied voltage) is linear with respect to angular position of the contact arm. These resistors are capable of full-load operation at maximum ambient temperatures of +85°C and are suitable for continuous operation, when properly derated, to maximum temperatures of +135°C. Use for matching, balancing, and adjusting circuit variables in computers, telemetering equipment, and other critical applications.

3.1.4.6 MIL-PRF-39015, RTR, Resistor, Variable, Wirewound (Lead Screw Actuated), Nonestablished Reliability and Established Reliability. These nonestablished and established reliability lead screw actuated, wirewound variable resistors with a contact bearing uniformly over the surface of the entire resistive element, wound linearly, when position by a multiturn lead screw actuator. These resistors are capable of full load operation (when the maximum resistance is engaged), at maximum ambient temperature of +85°C and are suitable for continuous operation, when properly derated, at a maximum ambient temperature of +150°C. Use for matching, balancing, and adjusting circuit variables in computers, telemetering equipment, and other critical applications. The resistors have product levels ranging from Non-ER, and a life failure rate (FR) 1.0 percent to 0.001 percent per 1,000 hours. The FR levels are established at a 60 percent confidence level on basis of life tests.

TABLE II. Fixed wirewound resistor selection guidance table.

Specification	Styles available	Power and max voltage ratings	Resistance tolerance (± percent)	Resistance range	Resistance temperature coefficient (ppm/°C)	Maximum body size (inches) and Configuration (see figure 3)
MIL-PRF-26 (Power type)	RW29 RW31 RW33 RW35 RW37 RW38 RW47	11 W 14 W 26 W 55 W 113 W 159 W 210 W	5.0, 10.0 5.0, 10.0 5.0, 10.0 5.0, 10.0 5.0, 10.0 5.0, 10.0 5.0, 10.0	0.1 to 5.6 k 0.1 to 6.8 k 0.1 to 18 k 0.1 to 43 k 0.1 to 91 k 0.1 to .15 M 0.1 to .18 M	±650 (.1 ≤ R < .499) ±500 (.499 ≤ R < 1) ±400 (1 ≤ R < 20) ±10 (R ≥ 20)	1.812 x .500 1.562 x .594 3.062 x .594 4.062 x .906 6.062 x 1.312 8.062 x 1.312 10.562 x 1.312 C
	RW56	14 W	5.0, 10.0	0.1 to 9.1 k	±400 (R < 20Ω) ±260 (R ≥ 20Ω)	2.094 x .563 A
MIL-PRF-18546 (Power type, chassis mounted)	RE77 RE80	75 W 120 W	1.0	.05 to 29.4 k .1 to 35.7 k	±30 (R ≥ 2k) ±50 (R < 2k)	3.594 x 1.781 x 2.843 4.594 x 2.219 x 3.031 E
MIL-PRF-39005 (Accurate, nonestablished and established reliability)	RBR52	.5 W/ 600 V	.01, .02, .05, .1, 1.0	.1 to 1.21 M	±90 (R < 1) ±30 (1 ≤ R < 10) ±15 (10 ≤ R < 100) ±10 (R ≥ 100)	1.020 x .390 A
	RBR53	.33 W/ 300 V	.01, .02, .05, .1, 1.0	.1 to 1.1 M		.770 x .390 A
	RBR54	.25 W/ 300 V	.01, .02, .05, .1, 1.0	.1 to .562 M		.770 x .265 A
	RBR55	.15 W/ 200 V	.01, .02, .05, .1, 1.0	.1 to .332 M		.520 x .265 A
	RBR56	.125 W/ 150 V	.01, .02, .05, .1, 1.0	.1 to .220 M		.364 x .265 A
	RBR57	.75 W/ 600 V	.01, .02, .05, .1, 1.0	.1 to 6.42 M		1.020 x .515 A
	RBR71	.125 W/ 150 V	.01, .02, .05, .1, 1.0	.1 to .15 M		.343 x .281 B
	RBR74	.125 W/ 150 V	.1	100, 681, 806, 909, 6,520		.520 x .203 A
	RBR75	.125 W/ 150 V	.01, .02, .05, .1, 1.0	.1 to 316 k		.315 x .265 A

TABLE II. Fixed wirewound resistor selection guidance table - Continued

Specification	Styles available	Power and max voltage ratings	Resistance tolerance (± percent)	Resistance range	Resistance temperature coefficient (ppm/°C)	Maximum body size (inches) and Configuration (see figure 3)
MIL-PRF-39005 (Accurate, nonestablished and established reliability) (continued)	RBR76	.5 W/ 300 V	.1, 1.0	18.36, 50, 118.20, 130, 232, 400, 487.1 560, 583, 619, 662, 681, 825, 923, 930, 937, 944, 951, 958, 972, 3,344.00	±90 (R < 1) ±30 (1 ≤ R < 10) ±15 (10 ≤ R ≤ 100) ±10 (R ≥ 100)	.832 x .327 A
	RBR80 RBR81	.1 W/ 100 V	.01, .02, .05, .1, 1.0	10 to .120 M 10 to .250 M	±10 (R < 100) ±5 (R ≥ 100)	.325 x .160 P
MIL-PRF-39007 (Power type, nonestablished and established reliability, space level)	RWR78	10 W	.1, .5, 1.0	.1 to 39.2 k	±650 (.1 ≤ R ≤ .499) ±400 (.499 < R ≤ 1) ±50 (1 < R ≤ 10) ±20 (R >10)	1.842 x .406 A
	RWR80	2 W	.1, .5, 1.0	.1 to 3.16 k		.437 x .125 A
	RWR81	1 W	.1, .5, 1.0	.1 to 1 k		.281 x .105 A
	RWR82	1.5 W	.1, .5, 1.0	.1 to .1.3 k		.328 x .101 A
	RWR84	7 W	.1, .5, 1.0	.1 to 12.4 k		.937 x .343 A
	RWR89	3 W	.1, .5, 1.0	.1 to 4.12 k		.622 x .218 A
MIL-PRF-39009 (Power type, chassis mounted, nonestablished and established reliability)	RER40 RER45 RER50 RER55	5 W 10 W 20 W 30 W	1.0	1 to 1.65 k 1 to 2.80 k 1 to 6.04 k 1 to 19.6 k	±100 (R < 1) ±50 (1 ≤ R < 19.6) ±30 (R ≥ 20)	.662 x .677 x .351 .812 x .843 x .437 1.124 x 1.125 x .593 2.000 x 1.187 x .656 E
	RER60 RER65 RER70 RER75	5 W 10 W 20 W 30 W	1.0	.1 to 3.32 k .1 to 5.62 k .1 to 12.1 k .1 to 39.2 k	±100 (R < 1) ±50 (1 ≤ R < 19.6) ±30 (R ≥ 20)	.662 x .677 x .351 .812 x .843 x .437 1.124 x 1.125 x .593 2.000 x 1.187 x .656 E

APPENDIX

TABLE III. Fixed film network resistor selection guidance table.

Specification	Styles available	Schematic	Power ratings Characteristics K and M	Power ratings Characteristics C, R, H, and V	Resistance tolerance (± percent)	Resistance range	Resistance temperature coefficient (ppm/°C)	Maximum body size (inches) and Configuration (see figure 3)
MIL-PRF-914 (Resistor networks, surface mount, nonestablished and established reliability)	RNS030	W M E S	.10/.80 .05/.75 .10/.80 .05/.70	.050/.40 .025/.40 .050/.40 .025/.35	.1, .5, 1.0, 2.0, 5.0	10 to 2.2 M	±25, ±50, ±100, ±300	.300 x .300 x .050 .300 x .300 x .085 .300 x .300 x .090 L
	RNS040	P M E S	.10/1.0 .05/.95 .10/1.0 .05/1.0	.050/.50 .025/.475 .050/.50 .025/.50	.1, .5, 1.0, 2.0, 5.0	10 to 2.2 M	±25, ±50, ±100, ±300	.350 x .350 x .050 .350 x .035 x .085 .350 x .350 x .090 L
	RNS050	A B C J	.10/.80 .055/.80 .050/.80 .030/.80	.050/.40 .025/.375 .100/.40 .015/.40	.1, .5, 1.0, 2.0, 5.0	10 to 2.2 M	±25, ±50, ±100, ±300	.150 x .410 x.035 N

Specification	Styles available	Schematic	Power ratings Characteristics H, K and M	Power ratings Characteristics C and V	Resistance tolerance (± percent)	Resistance range	Resistance temperature coefficient (ppm/°C)	Maximum body size (inches) and Configuration (see figure 3)
MIL-PRF-83401 (Resistor networks)	RZ010	A B J	0.2/1.4 0.1/1.3 0.050/1.2	0.1/0.7 0.05/0.65 0.025/0.6	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.785 x .305 x .200 R
	RZ020	A B J	0.2/1.6 0.1/1.5 0.050/1.4	0.1/0.8 0.05/0.75 0.025/0.7	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.876 x .305 x .200 R
	RZ030	A B J	0.05/0.35	0.025/0.325 0.015/0.35	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.385 x .305 x .075 Q
	RZ040	C G H	0.2/1.0 0.2/0.6 0.11/0.88	0.1/0.5 0.1/0.3 0.06/0.48	1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.598 x .098 x .350 S
	RZ050	C G H	0.2/1.4 0.2/0.8 0.11/1.32	0.1/0.7 0.1/0.4 0.06/0.72	1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.798 x .098 x .350 S

TABLE III. Fixed film network resistor selection guidance table - Continued

Specification	Styles available	Schematic	Power ratings		Resistance tolerance (± percent)	Resistance range	Resistance temperature coefficient (ppm/°C)	Maximum body size (inches) and Configuration (see figure 3)
			Characteristics					
			H, K and M	C and V				
	RZ060	C G H	0.2/1.8 0.2/1.0 0.11/1.8	0.1/0.9 0.1/0.5 0.06/0.9	1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.998 x .098 x .352 S
	RZ070	C G H	0.12/0.6 0.12/0.36 0.07/0.6	0.06/0.3 0.06/0.18 0.04/0.3	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.598 x .098 x .197 S
	RZ080	C G H	0.12/0.84 0.12/0.48 0.07/0.84	0.06/0.42 0.06/0.24 0.04/0.42	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±1+00, ±300	.798 x .098 x .197 S
MIL-PRF-83401 (Resistor networks – continued)	RZ090	C G H	0.12/1.08 0.12/0.60 0.07/1.08	0.06/0.54 0.06/0.30 0.04/0.54	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.798 x .098 x .197 S
	RZ100	A B J	0.05/0.4 0.025/0.375 0.015/0.42		.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.410 x .305 x .075 Q
	RZ130	A B J	0.2/1.4 0.1/1.3 0.050/1.2	0.1/0.7 0.05/0.65 0.025/0.6	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.785 x .305 x .200 R
	RZ140	A B J	0.2/1.6 0.1/1.5 0.050/1.4	0.1/0.8 0.05/0.75 0.025/0.7	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.876 x .305 x .200 R
	RZ150	A B J	0.05/0.35 0.025/0.325 0.015/0.35		.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.385 x .305 x .075 Q
	RZ160	C G H	0.2/1.0 0.2/0.6 0.11/0.88	0.1/0.5 0.1/0.3 0.06/0.48	1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.595 x .098 x .350 S
	RZ170	C G H	0.2/1.4 0.2/0.8 0.11/1.32	0.1/0.7 0.1/0.4 0.06/0.72	1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.798 x .098 x .350 S
	RZ180	A001 A002	0.10 0.10	0.40 0.50	2.0	See Schematics	±50, ±100, ±300	.598 x .098 x .350 S
	RZ190	A001 to A006, A011, A012 A007 to A009 A010	0.10/0.60 0.10/0.50 0.10/0.40		2.0	See Schematics	±50, ±100, ±300	.798 x .098 x .197 S

TABLE III. Fixed film network resistor selection guidance table - Continued

Specification	Styles available	Schematic	Power ratings H, K and M	Characteristics C and V	Resistance tolerance (± percent)	Resistance range	Resistance temperature coefficient (ppm/°C)	Maximum body size (inches) and Configuration (see figure 3)
MIL-PRF-83401 (Resistor networks – continued)	RZ200	C G H	0.2/1.8 0.2/1.0 0.11/1.8	0.1/0.9 0.1/0.5 0.06/0.9	1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.998 x .098 x .352 S
	RZ210	C G H	0.12/0.6 0.12/0.36 0.07/0.6	0.06/0.3 0.06/0.18 0.04/0.3	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.598 x .098 x .197 S
	RZ220	C G H	0.12/0.84 0.12/0.48 0.07/0.84	0.06/0.42 0.06/0.24 0.04/0.42	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.798 x .098 x .197 S
	RZ230	C G H	0.12/1.08 0.12/0.60 0.07/1.08	0.06/0.54 0.06/0.30 0.04/0.54	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.998 x .098 x .197 S
	RZ240	C G H	0.12/1.08 0.12/0.60 0.07/1.08	0.06/0.54 0.06/0.30 0.04/0.54	.1, .5, 1.0, 2.0, 5.0	10 to 1 M	±50, ±100, ±300	.998 x .098 x .197 S

TABLE IV. Variable wirewound resistor selection guidance table.

Specification	Styles	Power rating (Watts)	Resistance range (ohms)	Maximum body size (inches) (Configuration see figure 3)
MIL-PRF-19 Resistor, Variable, Wirewound (Low Operating Temperature)	RA20 RA30	2, 1 4, 2.2	3Ω to 15kΩ 3Ω to 25kΩ	1.310 x .700 1.710 x .810 D
MIL-PRF-22 Resistor, Variable (wirewound Power Type)	RP05 RP06 RP07 RP10 RP11 RP15 RP16 RP20 RP25 RP30 RP35 RP40 RP45 RP50 RP55	5 12.5 6.25 25 12.5 50 25 75 100 150 225 300 500 750 1,000	10 to 5k 1 to 3.5k 1 to 3.5k 1 to 5k 2 to 5k 1 to 10k 1 to 10k 2 to 10k 2 to 10k 2 to 10k 2 to 2.5k 2 to 2.5k 2 to 2.5k 2 to 2.5k 2 to 2.5k	.525 x .687 .906 x .751 1.094 x 1.126 1.680 x 1.410 1.880 x 1.750 2.410 x 1.440 2.750 x 1.750 2.810 x 1.780 3.190 x 1.780 4.060 x 2.030 5.090 x 2.160 6.090 x 2.410 8.090 x 2.250 10.090 x 3.030 12.310 x 3.250 D
MIL-PRF-12934 Resistor, Variable Wirewound Precision	RR0900 RR1000 RR1100 RR1300 RR1400 RR2000 RR2100 RR3000 RR3100 RR3200 RR3300 RR3400 RR3500 RR3600 RR3700 RR3800 RR3900 RR4000 RR4100 RR2002 RR1004 2RR2104 RR3601	1.25 2.0 1.5 2.0 3.0 4.0 5.0 6.0 1.25 1.50 2.0 4.0 6.0 1.5 1.5 1.5 1.5 2.0 5.0 4.0 2.0 5.0 1.5	100 TO 10K 100 TO 50K 100 TO 20K 100 TO 40K 200 TO 200K 100 TO 60K 200 TO 250K 200 TO 100K 100 TO 10K 100 TO 20K 100 TO 40K 100 TO 60K 200 TO 100K 100 TO 50K 100 TO 50K 100 TO 100K 100 TO 100K 100 TO 50K 200 TO 250K 20K 100K 20K / 20K 10K	.880 x .812 .880 x 1.625 1.067 x .812 1.468 x 1.062 1.468 x 2.250 2.031 x 1.312 2.031 x 2.250 3.031 x 1.312 .906 x .750 1.093 x .750 1.468 x 1.062 2.031 x 1.156 3.031 x 1.156 .906 x 1.076 .906 x 1.076 .906 x 1.219 .906 x 1.219 .890 x 1.500 1.844 x 2.094 2.005 x 1.781 .880 x 1.580 2.005 x 4.311 .922 x .875 g
MIL-PRF-39002 Resistor, Variable, Wirewound, Semi-Precision	RK09 RK11	1.21.5	10 to 100k 5k	.515 x .650 .615 x .315 F

3.1.5 Variable Nonwirewound Resistors. See table V.

3.1.5.1 MIL-PRF-94, RV, Resistor, Variable Composition. These variable resistors have a composition resistance element shaped in an arc, and a contact bearing uniformly thereon, so that a change in resistance is produced between the terminal of the contact and the terminal of either end of the resistance element when the operating shaft is turned. These resistors are capable of full load operation (where maximum resistance is engaged) at a maximum ambient temperature of +70°C, and suitable for continuous operation when properly derated, at a maximum temperature of +120°C. Use where initial setting stability is not critical and long-term stability needs to be no better than ±20 percent.

3.1.5.2 MIL-PRF-22097, RJ, Resistor, Variable, Nonwirewound (Adjustment Type). These multiturn lead screw actuated and single-turn nonwirewound variable resistors with a contact bearing uniformly over the entire surface of the entire resistive element, when positioned by the actuator. These resistors are capable of full load operation (where maximum resistance is engaged) at a maximum ambient temperature of +70°C and +85°C, and are suitable for continuous operation when properly derated, at a maximum temperature of +120°C and +150°C, respectively. Use for matching, balancing, and adjusting circuit variables in computers, telemetering equipment, and other critical applications.

3.1.5.3 MIL-PRF-23285, RVC, Resistor, Variable, Nonwirewound. These nonwirewound variable resistors having a film resistive element shaped in an arc, and a contact bearing uniformly thereon, so that a change in resistance is produced between the terminal of the contact and the terminal of either end of the resistance element when the operating shaft is turned. These resistors are capable of full load operation (where maximum resistance is engaged) at a maximum ambient temperature of +125°C, and suitable for continuous operation when properly derated, at a maximum temperature of +175°C. Use where initial setting stability is not critical and long-term stability needs to be no better than +5 percent. RVC resistors have low noise and long life characteristics.

3.1.5.4 MIL-PRF-39023, RQ, Resistor, Variable, Nonwirewound Precision. These precision, nonwirewound, variable resistors whose electrical output (in terms of percent of applied voltage) are linear or nonlinear with respect to the angular position of the operating shaft. These resistors have a resistance tolerance of ±10 percent. These resistors are capable of full-load operation at maximum ambient temperatures of +70°C and are suitable for continuous operation, when properly derated, to maximum temperatures of +125°C. Use in servo mounting application requiring precise electrical and mechanical output and performance. Used in computer, antenna, flight control, and bomb navigation systems.

3.1.5.5 MIL-PRF-39035, RJR, Resistors, Variable, Nonwirewound (Adjustment Type), Nonestablished Reliability and Established Reliability. These nonestablished and established reliability multiturn lead screw actuated, and single-turn nonwirewound variable resistors with a contact bearing uniformly over the surface of the entire resistive element, when position by an actuator. These resistors are capable of full load operation (when the maximum resistance is engaged), at maximum ambient temperature of +85°C and are suitable for continuous operation, when properly derated, at a maximum ambient temperature of +150°C. Use for matching, balancing, and adjusting circuit variables in computers, telemetering equipment, and other critical applications. The resistors have product levels ranging from Non-ER, and a life failure rate (FR) 1.0 percent to 0.001 percent per 1,000 hours. The FR levels are established at a 60 percent confidence level on basis of life tests.

3.1.6 Special Resistors. See table VI.

3.1.6.1 MIL-PRF-23648, RTH, Resistor, Thermal (Thermistor) Insulated. These resistors exhibit a rapid change in resistance for a relative small temperature change. These resistors are used to measure temperature or to compensate for changes in temperature.

3.1.6.2 MIL-PRF-83530, RVS, Resistors, Voltage Sensitive Resistor, (Varistor, Metal-Oxide). These devices function as a nonlinear variable impedance dependent on voltage. They are designed to protect a circuit from a surge in voltage.

TABLE V. Variable nonwirewound resistor selection guidance table.

Specification	Styles available	Power and max voltage ratings	Resistance tolerance (± percent)	Resistance range	Maximum body size (inches) and Configuration (see figure 3)
MIL-PRF-94 Resistor, Variable, Composition	RV2 RV4 RV5 RV6 2RV7 RV8	1.0/0.5* 2.0/1.0* 0.5/0.25* 0.5/0.25* various 0.5/0.25* *A taper/C and F taper	±10/±20 ±10/±20 ±10/±20 ±10/±20 ±10/±20 ±10/±20	100 to 2.5M 50 to 2.5M 250 to 2.5M 100 to 5M 50 to 5M 100 to 5M	.453 x .906 .609 x 1.094 .375 x .750 .453 x .500 1.266 x 1.094 .581 x .500 F
MIL-PRF-22097 Resistor, Variable, Nonwirewound (Adjustment type)	RJ11 RJ12 RJ22 RJ24 RJ26 RJ50	0.25 0.75 0.50 0.50 0.25 0.25	±10 ±10 ±10 ±10 ±10 ±10	100 to 1M 10 to 1M 10 to 1M 10 to 1M 10 to 1M 10 to 1M	1.250 x .275 x .312 (I) 1.250 x .190 x .315 (I) .500 x .187 x .500 (H) .375 x .150 x .375 (H) .250 x .165 x .250 (H) .250** x .250 (J) ** diameter
MIL-PRF-23285 Resistor, Variable, Nonwirewound	RVC6	0.5/0.25*** ***A taper/ C taper	±10	100 to 2.5M	.688 x .500 F
MIL-PRF-39023 Resistor, Variable, Nonwirewound, Precision	RQ051 RQ090 RQ091 RQ100 RQ110 RQ150 RQ160 RQ200 RQ210 RQ300	.50 1.00 1.00 2.50 1.25 1.50 3.50 2.00 4.50 3.00	±10	5000 100 to 1M 100 to 1M 1000 to 1M 100 to 1M 100 to 1M 1000 to 3M 100 to 1M 1000 to 3M 100 to 1M	.9644 x .550 .906 x .810 .906 x .750 . 906 x 1.880 1.125 x .810 1.500 x 1.060 1.468 x 2.500 2.031 x 1.310 2.031 x 2.900 3.031 x 1.310 H
MIL-PRF-39035 Resistor, Variable, Nonwirewound (Adjustment Type)	RJR24 RJR26 RJR50	.50 .25 .25		10 to 1M	.375 x .150 x .375 (H) .270 x .165 x .250 (H) .25** x .25 (J) **diameter

TABLE VI. Special resistors.

Specification	Styles available	Power rating (Watts)	Thermal time constant (Seconds)	Dissipation constant mW/°C	Resistance tolerance (percent)	Resistance ratio (ohms)	Max body size (inches) (Configuration see figure 3)
MIL-PRF-23648 Resistor, Thermal (Thermistor) Insulated	RTH06	0.05	80	5	5	68Ω min 75kΩ max	.30 D. M
	RTH08	1.0	250	10	5	27Ω min 22kΩ max	.50 D. M
	RTH10	1.5	450	15	5	10Ω min 6.8kΩ max	.92 D. M
	RTH22	0.5	60	15	5	10Ω min 39kΩ max	.43 L. x .16 D. M
	RTH42	0.25	60	2.5	5	10Ω min 10kΩ max	.30 L. x .11 D. M
	RTH44	0.2	25	2.0	5	300Ω min 500kΩ max	.25 L. x .13 D. x .135 T.

Specification	PIN M83530/1	Nominal varistor voltage (V)	Voltage rating (V) rms	 dc	Energy rating (joules)	Clamping voltage at 100 A (V)	Capacitance at 1 MHz (pF)	Clamping voltage at peak current rating (V)	Max body size (inches) A x D x E (Configuration see figure 3)
MIL-PRF-83530 Resistors, Voltage Sensitive Resistor, (Varistor, Metal-Oxide)	-2000B	200	130	175	50	325	3800	570	.110 x .95 x .32 (W)
	-2200D	220	150	200	55	360	3200	650	.110 x .95 x .32 (W)
	-4300E	430	275	369	100	680	1800	1200	.110 x .95 x .32 (W)
	-5100E	510	320	420	120	810	1500	1450	.110 x .95 x .32 (W)

3.2 Mounting guide.

3.2.1 Stress mounting. Improper heat dissipation is the predominant contributing cause of failure for any resistor type; consequently, the lowest possible resistor surface temperature should be maintained. Figure 4 illustrates the manner in which heat is dissipated from fixed resistors in free air. The intensity of radiated heat varies inversely with the square of the distance from the resistor. Maintaining maximum distance between heat generating components serves to reduces cross radiation heating effects and promotes better convection by increasing air flow. For optimum cooling without a heat sink, small resistors should have large diameter leads of minimum length terminating in tiepoints of sufficient mass to act as heat sinks. All resistors have a maximum surface temperature which should never be exceed. Any temperature beyond maximum can cause the resistor to malfunction. Resistors should be mounted so that there are no abnormal hot spots on the resistor surface. When mounted, resistor should not come in contact with heat insulating surfaces.

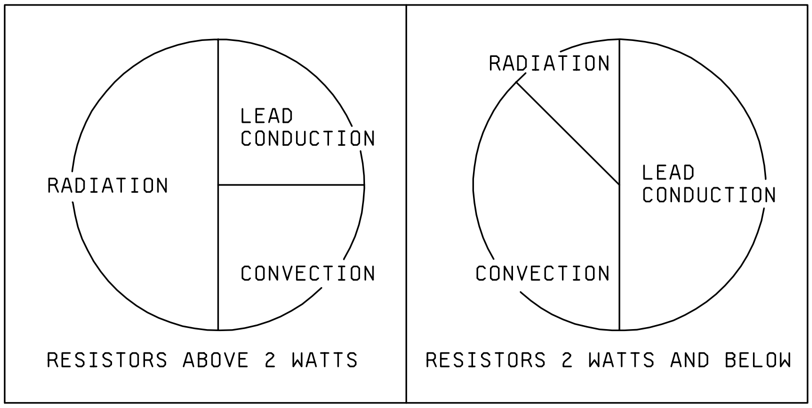

FIGURE 4. Heat dissipation of resistors under room conditions.

3.2.2 Resistor mounting for vibration. Resistors should be mounted so resonance does not occur within the frequency spectrum of the vibration environment to which the resistors may be subjected. Some of the most common resistor packaging methods result in large resistor noise. Resistor mounting for vibration should provide (1) the least tension or compression between the lead and body, (2) the least excitation of the resistor in relation with any other surface, and (3) no bending or distortion of the resistor body.

3.2.3 Circuit packaging. Resistors that are crowed together and come into contact with each other can provide leakage paths (even well insulated parts) for external current passage. This can change the resultant resistance in the circuit. Moisture traps and dirt traps are easily formed by crowding. Moisture and dirt eventually form corrosive materials which can deteriorate the resistors and other electronic parts. Moisture can accumulate around dirt even in an atmosphere of normal humidity. Planning should be done to eliminate crowding of parts. Proper space utilization of electronic parts can reduce the package size and still provide adequate spacing of parts.

3.2.4 Summary. The following is a guide for resistor mounting:

a. Maintain lead length to a minimum. The mass of the point acts as a heat sink. (NOTE: Where low temperatures are present, leads should be offset (bent slightly) to allow for thermal contraction).

b. Close tolerance and low value resistors require special precautions (such as short leads and good soldering techniques) since the resistance of the leads and the wiring may be as much as several percent of the resistance of the resistor.

c. Maintain maximum spacing between resistors.

d. For resistors mounted in series, consider the heat being conducted through the leads to the next resistor.

e. Large power units should be mounted to the chassis.

f. Do not mount high power units directly on terminal boards or printed circuits.

g. To provide for the most efficient operation and even heat distribution, power resistors should be mounted in a horizontal position.

h. Select mounting materials that will not char and can withstand due to expansion.

i. Consider proximity to other heat sources as well as self-heat.

j. Consider levels of shock and vibration to be encountered. Where large body mass is present, the body should be restrained from movement.

3.3 Effects of circuit usage. Resistors must be selected to be compatible with the conditions to which they are exposed. Numerous matters must be considered in this selection process. The most important are noted in the following.

3.3.1 Resistance value. This is initially determined by the circuit requirements, and may seem a trivial thing to mention. However, most resistor calculations that are made without reference to available resistors come out to a resistance value that are not standard. The design engineer should be aware of the standard resistance values that are available from manufacturers who adhere to this handbook and various Department of Defense specifications for resistors. These differ somewhat with the various types of resistors. It is a usually a fairly simple thing to bring the exact calculated value in line with a standard value. In the case where this cannot be done, a parallel or series combination of resistors can usually be used. The design engineer should also remember that the resistance value of the resistor that gets into the physical circuit will differ from the value that is stated on the circuit schematic, and that this difference will change as time goes by. The purchase tolerance of the resistor to be used will allow it to differ from the nominal stated value, depending on the type of resistor specified. Furthermore, the temperature at which the resistor works, the voltage across it, and the environment in which it lives will affects the actual value at particular times. For example, the designer should allow for a possible variation of ±15 percent from the nominal value of a purchased ±5 percent composition resistor, for the circuit to continue to operate satisfactorily over a very long time under moderate ambient conditions. Such a figure is a rule of thumb, based on many tests, and many resistors will remain much nearer their starting value; but if many are used, chance will ensure that some will go near this limit. A similar figure can be deduced from each variety of resistor used.

3.3.1.1 Summary.

a. Select a resistor for each circuit application from the lists of standard types and values.

b. Be sure that the circuit being designed will work with any resistor whose resistance value is within the limits set by tolerance plus voltage coefficient plus temperature coefficient plus drift with time. Failure to take these precautions can possibly mean that in equipment produced in quantity for the armed services, there may be some circuits that will not work under extreme conditions.

c. Various initial tolerances are available depending on the type of resistor. It should be remembered that initial accuracies become meaningless if the inherent stability of the resistor does not support the initial accuracy.

d. During shelf life, as well as during operational life, any characteristic (such as resistance, power rating, dielectric strength, or size) of any part may change value due to stresses caused by environmental changes of temperature , humidity, pressure or vibration. Changes of characteristic caused by environmental stresses may be linear or nonlinear, reversible or nonreversible (permanent), or combinations thereof. Where a characteristic of the part undergoes a linear change during environmental stress, and the change reverses itself linearly when the environmental stress is removed so that characteristic returns to its normal value, this rate of change in characteristic value (per unit change in stress value) is designated (x) coefficient, and is usually expressed in percent or ppm/°C.

3.3.2 Power rating. The minimum required power rating of a resistor is another factor that is initially set by the circuit usage, but is markedly affected by other conditions of use. As mentioned previously, the power rating is based on the hot spot temperature the resistor will withstand, while still meeting its other requirements of resistance variation, accuracy, and life. For derating information see 3.3.2.2.

3.3.2.1 Self-generated heat. Self generated-heat in a resistor is, of course, calculated as $P = I^2R$. This figure, in any circuit, must be less than the actual power rating of the resistor used. It is the usual practice to calculate this value and to use the next larger power rating available in the handbook. This calculation should, however, be considered only as a first approximation of the actual rating to be used.

3.3.2.2 Rating versus ambient conditions. The power rating of a resistor is based on a certain temperature rise from an ambient temperature of a certain value. If the ambient temperature is greater than this value, the amount of heat that the resistor can dissipate is correspondingly reduced, and therefore it must be derated because of temperature. The applicable section of this handbook and all of the Department of Defense specifications contain derating curves to be applied to the resistors covered.

3.3.2.3 Rating versus accuracy. Because of temperature coefficient of resistance that all resistors possess, a resistor which is expected to remain near its measured value under conditions of operation must remain cool. For this reason, all resistors designated as “accurate” are very much larger physically for a certain power rating than are ordinary “nonaccurate” resistors. In general, any resistor, “accurate” or not, must be derated to remain very near its original measured value when it is being operated.

3.3.2.4 Rating versus life. If especially long life is required of a resistor, particularly when “life” means remaining within a certain limit of resistance drift, it is usually necessary to derate the resistor, even if ambient conditions are moderate and if accuracy by itself is not important. A good rule to follow when choosing a resistor size for equipment that must operate for many thousands of hours is to derate it to one half of its nominal power rating. Thus, if the self-generated heat in the resistor is one third watt, do not use a one half watt resistor, but rather 1 watt size. This will automatically keep the resistor cooler, will reduce the long term drift, and will reduce the effect of the temperature coefficient. In equipment that need not live so long and must be small in size, this rule may be impractical, and the engineer should adjust the dependence on the rules to the circumstances at hand. A “cool” resistor will generally last longer than a “hot” one, and can absorb transient overloads that might permanently damage a “hot” resistor.

3.3.2.5 Rating under pulsed conditions and under intermittent loads. When a resistor is used in circuits where power is drawn intermittently or in pulses, the actual power dissipated with safety during the pulses can sometimes be much more than the maximum rating of the resistor. For short pulses, the actual heating is determined by the duty factor and the peak power dissipated. Before approving such a resistor application, however, the engineer should be sure (1) that the maximum voltage applied to the resistor during the pulses is never greater than the permissible maximum voltage for the resistor be used, (2) that the circuit cannot fail in such a way that continuous excessive power can be through the resistor and cause it to fail also, (3) that the average power being drawn is well within the agreed on rating of the resistor, and (4) that continuous steep wavefronts applied to the resistor do not cause any unexpected troubles.

3.3.3 High frequency. For most resistors, the lower the resistance value, the less total impedance it exhibits at high frequency. Resistors are not generally tested for total impedance at frequencies above 120 Hz. Therefore, this characteristic is not controlled. The dominating conditions for good high frequency resistor performance are geometric considerations and minimum dielectric losses. For the best high frequency performance, the ratio of resistor length to the cross sectional area should be a maximum. Dielectric losses are kept low by proper choice of the resistor base material, and when dielectric binders are used, their total mass is kept to a minimum. The following is a discussion of the high frequency merits of these major resistor types:

a. Film type. Film type resistors have the best high frequency performance. The effective dc resistance for most resistance values remains fairly constant up to 100 MHz and decreases at higher frequencies. In general, the higher the resistance value the greater the effect of frequency.

b. Wirewound. Wirewound resistors have inductive and capacitive effects and are unsuited for use above 50kHz, even when specially wound to reduce the inductance and capacitance. Wirewound resistors usually exhibit an increase in resistance with high frequencies because of “skin” effect.

3.4 Effects of mechanical design and ambient conditions. Since the operation of a circuit cannot be divorced from the physical configuration it assumes when assembled, some of the points that apply herein have already been discussed. It is well, however, to check this aspect of equipment design several times, so redundancies in the following paragraphs are deliberate for the sake of emphasis.

3.4.1 Mechanical design of resistors. Much trouble during the life of the equipment can be eliminated if the design engineer can be sure that the resistors he is specifying for his circuits are soundly constructed and proper equipment assembly techniques are utilized. The resistor types listed in this handbook provide a great measure of this assurance and, in general, assure a uniform quality of workmanship. The areas defined in 3.4.1.1 through 3.4.1.6 are included as indicators of sound product construction.

3.4.1.1 End caps or terminations. The connection between the resistor element itself and the pigtails or leads that connect it into the circuit must be so good that no possible combination of conditions met in the proposed service can cause an intermittent connection. The Department of Defense specifications cover this point, and provide tests to check for it. When resistors are handled in automatic assembly machines, this precaution is particular important.

3.4.1.2 Effect of soldering. There are assembly techniques that affect resistor reliability. Resistors should never be overheated by excessive soldering iron applications, and the resistor leads should not be abraded by assembly tools. No normal soldering practice, either manual or dip soldering, should damage the resistor physically or change its resistance value appreciably.

3.4.1.3 Moisture resistance. Moisture is the greatest enemy of components and electronic equipment. Usually a resistor will keep itself dry because of its own self-generated heat; this is, of course, only true when the equipment is turned on. If the equipment must stand for long periods under humid conditions without power applied, the engineer should determine whether his circuits will operate with resistance values which have changed from the “hot” condition, and whether the retrace of the resistance value during the warm up period will allow the equipment to work satisfactorily during this period. If it will not, the resistor must be adequately protected against moisture absorption. The resistor cannot be blamed for performing improperly if it is not designed for the use to which it is put. It is therefore up to the design engineer to analyze what is needed and to provide the resistor to meet these conditions. This handbook and the applicable Department of Defense specifications constitute a guide as to what various kinds of resistors will do under humid conditions.

3.4.1.4 Method of mounting. Large resistors that are not provided with adequate means of mounting should not be considered, under conditions of vibration or shock. Lead failure can occur, and the larger the mass supported by the leads the more probable a failure will be. Even when vibration or shock will not be a serious problem, ease of assembly and replaceability suggest that large components be mounted individually.

3.4.1.5 Resistor body. The body of the resistor must be sufficiently strong to withstand any handling it is likely to get. The specifications call out, through workmanship and packaging requirements, that it be shown by the manufacturer that the product will not crack, chip, or break in transit, on the shelf, or in the normal assembly process.

3.4.1.6 Insulation or coating. All resistors intended for use in reliable electronic equipment must be protected by an insulating coating. Sometimes this is a molded phenolic case, epoxy coating, or ceramic or glass sleeves. Wirewound power resistors use various cement and vitreous enamel coatings to protect the windings, and to insulate and provide moisture barriers. Not all of the coatings and insulations applied to commercial resistors are satisfactory for extreme variations in ambient conditions; the various Department of Defense specifications include test used to qualify the various manufacturer's products thus providing a greater confidence in the coating used.

3.4.2 Effects of ambient conditions. In the establishment of rating for resistors, the design engineer has implicitly considered the mechanical design of the equipment. This may not have been realized, but it is so because the ambient conditions in which the resistor must operate determine to a large degree the power rating and mechanical construction of the resistor if long life, or any life, under extreme conditions is desired.

3.4.2.1 Resistor heating. A very important question in the application of resistors is how hot will they get in service. In a piece of equipment the heat in a resistor comes from several sources; namely, (1) self-generated heat, and is the thing that can be easily calculated, and (2) the heat that the resistor receives from other resistors or other heat producing components in the same immediate neighborhood by radiation, and is not so easily calculated. The important thing to remember is under these conditions each resistor will be heated more than I^2R would suggest; when much heat is produced, as in stacked wirewound resistors, the design engineer would do well not to freeze his design until he has measured a typical assembly with power on to see just how hot the resistor gets. The same thing is true of the extra heating given the resistors by convection. This is another way of saying that high ambient temperature will reduce the actual power rating of the resistor by reducing permissible temperature rise, a point that has been made several times before. The equipment designer must realize also that the heat being produced by "hot" resistors can injure other components. This is a very important point to remember; capacitors, diodes, and other resistors usually do not fail immediately when overheated. The effect of too much heat is a deteriorating one, weakening the component until at a later date it will unexpectedly fail. It is very easy to put a "heat bomb" in a piece of equipment that will not go off in normal production testing but will do its duty. It is also very easy to eliminate such troubles by strict and thoughtful attention to the problem of heating. A few rules have been given for use as guides to protect against these factors (see 3.2).

3.4.2.2 High altitude. With the exception of the dielectric withstanding voltage test at reduced barometric pressure, all tests in Department of Defense specifications referenced herein are performed at ambient atmospheric pressure. This fact should be considered when the use of these resistors for high altitude conditions is contemplated.

3.4.2.3 Flammability. It should be noted that Department of Defense specifications referenced herein contain no requirements concerning the flammability of the materials used in the construction of these resistors. Users should take this into consideration when a particular application involves this requirement.

APPENDIX

SECTION 4: SUPPLEMENTAL INFORMATION

4.1 Reliability. The established reliability specification provides for the establishment of a failure rate figure through the single parameter of load life only. Although, in most instances, the established reliability specification provides for more frequent moisture resistance, burn in, and other types of screening tests on a 100 percent basis, the failure rate (in percent per 1,000 hours) is based only on load life test results.

4.2 Metric equivalent. The metric equivalents (to the nearest 0.01 mm) which are provided in the individual sections are for general information only and are based upon 1 inch = 25.4 mm.

4.3 International standardization agreements. Certain provisions of the specifications referenced in this handbook are subjected on international standardization agreements. When amendment, revision, or cancellation of any of these specification is proposed which will affect or violate the international agreement concerned, the preparing activity will take appropriate reconciliation action through international standardization channels including departmental standardization offices, if required.

4.4 Cross reference. A cross reference of section number, Department of Defense specification numbers, associated specification numbers, and style numbers are included for reference (see table VII).

TABLE VII. Detailed specification number by style number.

Performance specification	Style	Performance specification	Style
MIL-PRF-19/2	RA20	MIL-PRF-12934/29	RR3800
MIL-PRF-19/3	RA30	MIL-PRF-12934/30	RR3900
		MIL-PRF-12934/31	RR4000
MIL-PRF-22/1	RP06	MIL-PRF-12934/32	RR4100
MIL-PRF-22/2	RP07	MIL-PRF-12934/33	RR2002
MIL-PRF-22/3	RP10	MIL-PRF-12934/34	RR1004
MIL-PRF-22/4	RP11	MIL-PRF-12934/35	2RR2104
MIL-PRF-22/5	RP15	MIL-PRF-12934/36	RR3601
MIL-PRF-22/6	RP16		
MIL-PRF-22/7	RP20	MIL-PRF-18546/2	RE77
MIL-PRF-22/8	RP25	MIL-PRF-18546/2	RE80
MIL-PRF-22/9	RP30		
MIL-PRF-22/10	RP35	MIL-PRF-22097/2	RJ12
MIL-PRF-22/11	RP40	MIL-PRF-22097/4	RJ24
MIL-PRF-22/12	RP45		
MIL-PRF-22/13	RP50	MIL-PRF-22684/8	RL42...TX
MIL-PRF-22/14	RP55		
MIL-PRF-22/15	RP05	MIL-PRF-23285/3	RVC6
MIL-PRF-26/3	RW29	MIL-PRF-23648/1	RTH06
MIL-PRF-26/3	RW31	MIL-PRF-23648/2	RTH08
MIL-PRF-26/3	RW33	MIL-PRF-23648/3	RTH10
MIL-PRF-26/3	RW35	MIL-PRF-23648/9	RTH22
MIL-PRF-26/3	RW37	MIL-PRF-23648/19	RTH42
MIL-PRF-26/3	RW38	MIL-PRF-23648/20	RTH44
MIL-PRF-26/3	RW47		
MIL-PRF-26/4	RW56	MIL-PRF-27208/2	RT10
		MIL-PRF-27208/8	RT12
MIL-PRF-94/2	RV5	MIL-PRF-27208/9	RT24
MIL-PRF-94/3	RV6	MIL-PRF-27208/10	RT26
MIL-PRF-94/4	RV2		
MIL-PRF-94/5	RV4	MIL-PRF-39002/1	RK09
MIL-PRF-94/6	2RV7	MIL-PRF-39002/3	RK11
MIL-PRF-94/7	RV8		
		MIL-PRF-39005/1	RBR52
MIL-PRF-914/3	RNS030	MIL-PRF-39005/2	RBR53
MIL-PRF-914/4	RNS040	MIL-PRF-39005/3	RBR54
MIL-PRF-914/5	RNS050	MIL-PRF-39005/4	RBR55
		MIL-PRF-39005/5	RBR56
MIL-PRF-12934/1	RR0900	MIL-PRF-39005/6	RBR71
MIL-PRF-12934/2	RR1100	MIL-PRF-39005/7	RBR57
MIL-PRF-12934/4	RR2000	MIL-PRF-39005/8	RBR74
MIL-PRF-12934/5	RR3000	MIL-PRF-39005/9	RBR75
MIL-PRF-12934/6	RR1000	MIL-PRF-39005/10	RBR76
MIL-PRF-12934/9	RR2100	MIL-PRF-39005/11	RBR80
MIL-PRF-12934/10	RR3100	MIL-PRF-39005/11	RBR81
MIL-PRF-12934/15	RR3200		
MIL-PRF-12934/16	RR3300	MIL-PRF-39007/7	RWR78
MIL-PRF-12934/17	RR3400	MIL-PRF-39007/8	RWR80
MIL-PRF-12934/18	RR3500	MIL-PRF-39007/9	RWR81
MIL-PRF-12934/19	RR1300	MIL-PRF-39007/10	RWR84
MIL-PRF-12934/20	RR1400	MIL-PRF-39007/11	RWR89
MIL-PRF-12934/27	RR3600	MIL-PRF-39007/12	RWR82
MIL-PRF-12934/28	RR3700		

TABLE VII. Detailed specification number by style number - Continued.

Performance specification	Style		Performance Specification	Style
MIL-PRF-39009/1	RER60		MIL-PRF-55182/1	RNC/N/R55
MIL-PRF-39009/1	RER65		MIL-PRF-55182/3	RNC/N/R60
MIL-PRF-39009/1	RER70		MIL-PRF-55182/5	RNC/N/R65
MIL-PRF-39009/1	RER75		MIL-PRF-55182/6	RNC/N/R70
MIL-PRF-39009/2	RER40		MIL-PRF-55182/7	RNC/N/R50
MIL-PRF-39009/2	RER45		MIL-PRF-55182/9	RNC/N90
MIL-PRF-39009/2	RER50		MIL-PRF-55182/10	RNC/N/R75
MIL-PRF-39009/2	RER55		MIL-PRF-55182/13	RNC/N/R77
MIL-PRF-39015/1	RTR12		MIL-PRF-55342/1	RM0502
MIL-PRF-39015/2	RTR22		MIL-PRF-55342/2	RM0505
MIL-PRF-39015/3	RTR24		MIL-PRF-55342/3	RM1005
			MIL-PRF-55342/4	RM1505
MIL-PRF-39017/1	RLR07		MIL-PRF-55342/5	RM2208
MIL-PRF-39017/2	RLR20		MIL-PRF-55342/6	RM0705
MIL-PRF-39017/3	RLR32		MIL-PRF-55342/7	RM1206
MIL-PRF-39017/5	RLR05		MIL-PRF-55342/8	RM2010
MIL-PRF-39017/6	RLR62		MIL-PRF-55342/9	RM2512
			MIL-PRF-55342/10	RM1010
MIL-PRF-39023/1	RQ090			
MIL-PRF-39023/2	RQ110		MIL-PRF-83401/1	RZ010
MIL-PRF-39023/3	RQ150		MIL-PRF-83401/2	RZ020
MIL-PRF-39023/4	RQ200		MIL-PRF-83401/3	RZ030
MIL-PRF-39023/5	RQ300		MIL-PRF-83401/4	RZ040
MIL-PRF-39023/6	RQ100		MIL-PRF-83401/5	RZ050
MIL-PRF-39023/7	RQ160		MIL-PRF-83401/6	RZ060
MIL-PRF-39023/8	RQ210		MIL-PRF-83401/7	RZ070
MIL-PRF-39023/9	RQ091		MIL-PRF-83401/8	RZ080
MIL-PRF-39023/10	RQ051		MIL-PRF-83401/9	RZ090
			MIL-PRF-83401/10	RZ100
MIL-PRF-39035/1	RJR12		MIL-PRF-83401/13	RZ130
MIL-PRF-39035/2	RJR24		MIL-PRF-83401/14	RZ140
MIL-PRF-39035/3	RJR26		MIL-PRF-83401/15	RZ150
MIL-PRF-39035/4	RJR50		MIL-PRF-83401/16	RZ160
			MIL-PRF-83401/17	RZ170
MIL-PRF-49462/3	RHV30		MIL-PRF-83401/18	RZ180
MIL-PRF-49462/3	RHV31		MIL-PRF-83401/19	RZ190
MIL-PRF-49462/3	RHV32		MIL-PRF-83401/20	RZ200
MIL-PRF-49462/3	RHV33		MIL-PRF-83401/21	RZ210
MIL-PRF-49462/3	RHV34		MIL-PRF-83401/22	RZ220
MIL-PRF-49462/3	RHV35		MIL-PRF-83401/23	RZ230
			MIL-PRF-83401/24	RZ240
MIL-PRF-49465/1	RLV10			
MIL-PRF-49465/6	RLV30		MIL-PRF-83530/1	RVS10
MIL-PRF-49465/7	RLV31			

APPENDIX

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

Preparing activity:
DLA - CC

Review activities:
Army - AR, AT, AV, CR4, MI
Navy - AS, CG, MC, OS, SH
Air force - 17, 19, 80

(Project 5905-1553)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

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

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-HDBK-199	**2. DOCUMENT DATE (YYMMDD)**

3. DOCUMENT TITLE
Department of Defense Handbook, Resistor, Selection and Use of.

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

5. REASON FOR RECOMMENDATION

6. SUBMITTER

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

8. PREPARING ACTIVITY

a. NAME Defense Supply Center, Columbus DSCC-VAM	b. TELEPHONE (Include Area Code) (1) Commercial (614) 692-0552 (2) AUTOVON 850-0552
c. ADDRESS (Include Zip Code) 3990 East Broad Street Columbus, OH 43213-1199	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5803 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340