

MIL-R-3080B

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SUPERSEDING

MIL-T-3080A

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MILITARY SPECIFICATION

RESISTORS, CURRENT-REGULATING (BALLAST TUBES)

*datory for use by the Departments of the Army, the Navy, and the Air Force.
This specification has been approved by the Department of Defense and is man-*

1. SCOPE

1.1 Scope. This specification covers current-regulating resistors consisting of a conductor or group of conductors, hermetically sealed in an envelope containing a suitable gas coolant under pressure, whose current or currents remain substantially constant over a given range of voltage.

1.2 Classification.

1.2.1 Type designation. The type designation shall be in the following form and as specified (see 3.1 and 6.2):

| | | | |
|-----------|-----------|-----------|---------------|
| TJ | 128 | A | 01 |
| Component | Current | Voltage | Serial number |
| (1.2.1.1) | (1.2.1.2) | (1.2.1.3) | (1.2.1.4) |

1.2.1.1 Component. Resistors covered by this specification are identified by the two-letter symbol "TJ".

1.2.1.2 Current. The nominal current in milliamperes is designated by a three-digit number; the first two digits are the first two figures of the current and the third digit indicates the number of zeros to follow. When the nominal current is less than 10 milliamperes (ma), the first digit indicating the current is a zero. For example, 128 designates 12,000 ma and 090 designates 9 ma.

1.2.1.3 Voltage. The approximate threshold voltage of the current-regulating resistor is designated by a letter in accordance with table I. Threshold voltage is defined as the minimum voltage drop at which regulation is effective within the current limits specified.

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TABLE I. Voltage

| Letter designation | Voltage | Letter designation | Voltage | Letter designation | Voltage |
|--------------------|---------|--------------------|---------|--------------------|---------|
| A | 0.18 | H | 2.0 | P | 16.0 |
| B | .25 | J | 2.8 | R | 22.0 |
| C | .35 | K | 4.0 | T | 32.0 |
| D | .5 | L | 5.5 | U | 45.0 |
| E | .7 | M | 8.0 | V | 68.0 |
| F | 1.0 | N | 11.0 | W | 90.0 |
| G | 1.4 | | | | |

1.2.1.4 Serial number. The serial order of assignment within the specific group designated by the symbols for current and voltage, is designated by a two-digit number. When the assignment number is less than ten, the first digit shall be a zero.

2. APPLICABLE DOCUMENTS

2.1 The following specifications, standards, and specification sheets, of the issue in effect on date of invitation for bids, form a part of this specification:

SPECIFICATIONS

MILITARY

- MIL-E-1 — Electron Tubes and Crystal Rectifiers.
- MIL-P-75 — Packaging and Packing and Container-Marking of Electron Tubes.

STANDARDS

MILITARY

- MIL-STD-105 — Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-129 — Marking for Shipment and Storage.

SPECIFICATION SHEETS

(For military specification sheets for resistors covered by this specification, see Supplement-1 to this specification.)

(Copies of specifications and standards required by contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Military specification sheets for individual resistor types. Detail requirements or exceptions applicable to individual types are specified on the military specification sheets listed in Supplement 1 to this specification. In the event of any conflict between requirements of this specification and the individual military specification sheets, the latter shall govern. (See 6.2.)

3.1.1 Abbreviations. For simplification and for conformance with Specification MIL-E-1, the following abbreviations and symbols are used wherever practicable on specification sheets for current-regulating resistors.

- A — amperes (may be either ac (rms) or dc).
- Aac — amperes, ac (rms).
- Adc — amperes, dc.
- ac — alternating current.
- °C — degrees centigrade.
- dc — direct current.
- Ef — filament voltage.
- f — filament.
- G — acceleration of gravity.
- ic — internal connections,
- If — filament current (current-regulating element).

mA — ac (rms) or dc milliamperes.
 mAac — ac (rms) milliamperes.
 mAdc — dc milliamperes.
 nc — no connections.
 rms — root mean square.
 T — temperature.
 t — test duration.
 V — volts (may be either ac (rms) or dc).
 Vac — volts, ac (rms).
 Vdc — volts, dc.
 W — watts.

3.2 Preproduction. Resistors furnished under this specification shall be a product which has passed the preproduction inspection specified in 4.4 (See 6.2.)

3.3 Material. The material for each part shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the resistors to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.3.1 Bases. Bases shall be made of material having the insulating qualities defined in Specification MIL-E-1 for the zone number specified. (See 3.1.)

3.2.2 Regulating element. Each regulating element shall consist of a continuous length of conductor without joints, welds, or bonds, except at the end terminals. The regulating element shall possess a substantially uniform cross-sectional area and shall be as free as practicable from impurities, grain growth, and other factors contributing to spot weakness. The cross-sectional area of the regulating element shall be the maximum possible for fulfillment of the operational requirements specified herein.

3.3.3 Ferrous materials. The use of fer-

rous materials as current-carrying parts in other than the regulating element and the lead-in wires, is prohibited.

3.4 Design and construction. Resistors shall be of the design, construction, and physical dimensions specified. (See 3.1.)

3.4.1 Glass envelope (bulb). The glass envelope shall conform to the applicable bulb outline in Specification MIL-E-1. Except where specifically permitted, the glass envelope shall not have an exposed seal-off tip. (See 3.1.)

3.4.2 Base and connections. The base and pin numbers shall be in accordance with the applicable standard type in Specification MIL-E-1 and as specified. Connection to base pins shall be as specified. (See 3.1.)

3.5 Heating time. When resistors are tested as specified in 4.6.2, the heating time and limits of current shall be as specified. (See 3.1.)

3.6 Current (ambient-, low-, and high temperature operation). When resistors are tested as specified in 4.6.3, the current and the current regulation (controlled variation between respective current values) shall be within the specified limits when the specified voltages are applied. (See 3.1.) Resistors shall not have sustained any physical damage as a result of the low- and high-temperature operation tests.

3.7 Cement immersion. When resistors are tested as specified in 4.6.4, there shall be no damage to the tube-base structure and no breaking of the seal between the base and the envelope.

3.8 Vibration. When resistors are tested as specified in 4.6.5, there shall be no mechanical damage, no open- or short-circuiting, and no electrical damage as evidenced by a change in current of 2 percent or more.

3.9 Life (see 4.6.6).

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3.9.1 Intermittent life. At the end of the time specified (considering "on" time only), the average life of the group of resistors under test shall be not less than the minimum percentage specified. (See 3.1.)

3.9.2 Life-test end point. The life of a resistor will have been concluded when, measured under the specified electrical conditions, the current is no longer within the limits specified as the life-test end point. (See 3.1.) The life of a resistor shall be determined as follows: Add to the number of hours at the last test interval at which the resistor passed the test, either 10 percent of the hours specified as the required life (see 3.1) or one-half the difference between the number of hours at the last interval at which the resistor passed and the interval at which the resistor failed, whichever value is smaller.

3.10 Marking. The resistors shall be permanently and legibly marked with the type designation (see 1.2.1), the manufacturer's name or trade-mark, and the acceptance date. There shall be no space between the symbols which comprise the type designation. The acceptance date shall be marked by a code. The first number in the code shall be the last digit of the number of the year. The second number shall consist of two digits indicating the calendar week of the year; when the number of the week is a single digit, it shall be preceded by a zero. When read from left to right or top to bottom, the code number shall designate the year and the week of acceptance, in the order shown. The space between numbers shall not exceed 1/16 inch. All marking shall be placed on the side wall of the base, or on the envelope of resistors without bases.

3.11 Workmanship. Resistors shall be manufactured and processed in a careful and workmanlike manner, in accordance with good design and sound practice, and shall meet all requirements of the specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of inspection. The examination and testing of current-regulating resistors shall be classified as follows:

- (a) Preproduction inspection. (See 4.4.)
- (b) Acceptance inspection. (See 4.5)

4.2 Inspection conditions. Unless otherwise specified herein, all inspection shall be made at room ambient temperature, pressure, and humidity. Inspection shall be conducted in still air. Still air is air with no circulation other than that created by the heat of the resistor being operated.

4.2.1 Holding period. Resistors shall be held without operation for a minimum period of 24 hours prior to beginning of inspection.

4.3 Test equipment and inspection facilities. Test equipment and inspection facilities shall be of sufficient accuracy, quality, and quantity to permit performance of the required acceptance inspection. The manufacturer shall establish adequate calibration of test equipment to the satisfaction of the Government.

4.4 Preproduction inspection. Preproduction inspection will be performed at a laboratory specified by the bureau or service concerned (see 6.2), to determine compliance of the preproduction sample with this specification, prior to production.

4.4.1 The preproduction sample shall be representative of the manufacturer's normal production. The manufacture of resistors for a Government contract, prior to approval of the preproduction sample, shall be at the manufacturer's risk. A sample consisting of 10 specimens of each type of resistor specified (see 6.2) shall be submitted.

4.4.2 Inspection routine. The specimens will be subjected to the preproduction inspection specified in table II, in the order shown. All specimens will be subjected to

the inspection of group I. The specimens will then be equally divided into two groups in accordance with table II and subjected to the inspection for their particular group.

4.4.3 *Defectives*. Defectives in excess of those allowed in table II will be cause for refusal to grant approval of the type represented.

TABLE II. *Preproduction inspection*

| Examination or test | Requirement paragraph | Method paragraph | Number of defectives allowed |
|---|--|------------------|------------------------------|
| <i>Group I</i> | | | |
| Visual and mechanical examination. ¹ | 3.1, 3.3 to 3.4.2, incl, 3.10 and 3.11 | 4.6.1 | 20 |
| Heating time | 3.5 | 4.6.2 | |
| Ambient-temperature operation. | 3.6 | 4.6.3.1 | |
| Low-temperature operation. ² | 3.6 | 4.6.3.2 | |
| High-temperature operation. ³ | 3.6 | 4.6.3.3 | |
| <i>Group II</i> | | | |
| Cement immersion | 3.7 | 4.6.4 | |
| <i>Group III</i> | | | |
| Vibration | 3.8 | 4.6.5 | |
| Life ³ | 3.9 | 4.6.6 | |

¹ Marking will be considered a defect only if it is illegible after completion of any of the required inspection.

² Only two specimens will be subjected to these tests. After completion of these tests, one of the two specimens will be included in the specimens to be subjected to group II tests, and the other will be included in the specimens to be subjected to group III tests.

³ In the intermittent life test (see 3.9.1), failure shall have occurred when the average life of the group tested fails to meet the minimum percentage of average life specified. (See 3.1.)

4.5 *Acceptance inspection*. Acceptance inspection shall consist of groups A, B, and C.

4.5.1 *Inspection lot*. An inspection lot shall be as specified in Standard MIL-STD-105 and shall consist of resistors of the same type offered for delivery at one time.

4.5.2 *Resubmitted lots*. If an inspection lot is rejected, the manufacturer may rework the lot or screen out defectives and resubmit it for acceptance inspection. Resubmitted lots shall be kept separate from new lots. The resubmitted lot shall be inspected, using tightened inspection.

4.5.3 *Group A inspection*. Group A inspection shall consist of the examinations and tests specified in table III, in the order shown. Statistical sampling and inspection shall be in accordance with Standard MIL-STD-105. The acceptable quality levels

(AQL) shall be as shown in table III. Major and minor defects shall be as defined in Standard MIL-STD-105.

4.5.4 *Group B inspection*. Group B inspection shall consist of the tests specified in table IV, in the order shown. Separate samples shall be selected for each subgroup.

4.5.4.1 *Sampling procedure*. The sampling procedure shall be in accordance with the appendix to Standard MIL-STD-105. Unless otherwise specified herein, normal inspection shall be used at the start of the contract. The reduced inspection procedure shall be R-1. The AQL (percent defective) and the inspection levels for normal and reduced inspection shall be as specified in table IV.

4.5.4.2 *Disposition of sample units*. Sample units which have been subjected to group B

TABLE III. Group A inspection

| Examination or test | Requirement paragraph | Method paragraph | AQL (percent defective) | |
|------------------------------------|--|------------------|-------------------------|-------|
| | | | Major | Minor |
| Visual and mechanical examination. | 3.1, 3.3 to 3.4.2 incl, 3.10, and 3.11 | 4.6.1 | 1.0 | 2.5 |
| Ambient-temperature operation. | 3.6 | 4.6.3.1 | 1.0 | ... |

TABLE IV. Group B inspection

| Test | Requirement paragraph | Method paragraph | AQL (percent defective) | Inspection level | |
|---|-----------------------|------------------|-------------------------|-----------------------|------------------------|
| | | | | For normal inspection | For reduced inspection |
| <i>Subgroup 1</i> Cement immersion | 3.7 | 4.6.4 | 4.0 | L8 | L6 |
| <i>Subgroup 2</i> Heating time | 3.5 | 4.6.2 | 6.5 | L7 | L5 |
| Low-temperature operation. | 3.6 | 4.6.3.2 | | | |
| High-temperature operation. | 3.6 | 4.6.3.3 | | | |
| Vibration | 3.8 | 4.6.5 | | | |

inspection shall not be delivered on the contract or order.

4.5.5 *Group C inspection.* Group C inspection shall consist of the test specified in table V. The number of sample units to be tested shall be as specified in table VI.

TABLE V. Group C inspection

| Test | Requirement paragraph | Method paragraph | Number of defectives allowed |
|-------------------------|-----------------------|------------------|------------------------------|
| Life ¹ | 3.9 | 4.6.6 | 10 |

¹ In the intermittent life test (see 3.9.1), failure shall have occurred when the average life of the group tested fails to meet the minimum percentage of average life specified. (See 3.1.)

TABLE VI. Sampling procedure for group C inspection

| Lot size | Sample size |
|----------------------------|-------------|
| Less than 66 | 2 |
| 66 to 1,300, incl. | 7 |
| 1,301 to 3,000, incl. | 15 |
| 3,001 and over | 25 |

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

4.5.5.2 *Release of resistors before completion of life test.* The Government may release lots of resistors for shipment before completion of the life test specified in 4.6.6, if, at the time, the completed average life of the group of resistors under test equals or exceeds the percent of specified life shown in table VII, and if the number of failures in the immediately preceding life tests on the specified number of groups of resistors of the same type have not exceeded those shown in table VII, Provisions of this paragraph shall not be in effect until a minimum of ten lots has been life-tested.

4.5.5.3 *Noncompliance.* If a sample fails to pass group C inspection, the manufacturer shall take corrective action on the process and on all units of product which can be cor-

TABLE VII. Release of resistors before completion of life test

| Average life of test group (percent of required life) | Maximum number of failures permitted in immediately preceding life tests on other groups of same resistor type | |
|--|--|------------------|
| | Number of failures | Number of groups |
| 0 | 0 | 10 |
| 10 | 0 | 7 |
| 10 | 1 | 17 |
| 30 | 0 | 5 |
| 80 | 1 | 14 |
| 60 | 0 | 8 |
| 60 | 1 | 10 |

rected and which were manufactured with the same conditions, materials, processes, etc., and are considered subject to the same test failure. Acceptance inspection shall be discontinued until corrective action has been taken. After the corrective action, sample units shall be subjected to the necessary group C inspection (all inspections, or the failed inspections at the option of the Government). Groups A and B inspection may be reinstated; however, final acceptance shall be withheld until the group C inspection has shown that the corrective action was successful.

4.6 Methods of examination and test.

4.6.1 Visual and mechanical examination.

Resistors shall be examined externally to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements. (See 3.1, 3.3 to 3.4.2, incl, 3.10, and 3.11.)

4.6.2 Heating time. The specified voltage shall be applied. (See 3.1.) The voltage source shall be a step-down transformer controlled by a variable voltage transformer, and the regulation of this system shall be 0.5 percent from no load to five times the specified current. The time required for the current to decrease to the specified value shall be measured. (See 3.1.) The resistor shall not

have been energized during the hour preceding initiation of each heating-time test. (See 3.5.)

4.6.3 Current.

4.6.3.1 Ambient-temperature operation.

For each voltage specified (see 3.1), the current through the element shall be measured after at least 5 minutes of operation at that voltage. The current regulation, ie, the algebraic difference between the current at higher voltage and the current at lower voltage, shall be computed from the measurements recorded during the test. (See 3.6.)

4.6.3.2 Low-temperature operation.

The resistor shall be placed in a cold chamber and maintained for a period of 1 hour at the low temperature specified. (See 3.1.) Upon written authorization by the contracting officer, this time may be shortened if the contractor establishes that the resistor can reach a stable temperature in less time. While still exposed to the low-temperature conditions, the resistor shall be operated for at least 10 minutes at each specified voltage, in the order listed; at the end of each operating period, the current shall be within the specified limits. (See 3.1.) After the resistor has been stabilized at room temperature, it shall be subjected to the tests specified in 4.6.3.1 to ascertain whether the tube has sustained any electrical damage. Visual examination shall be made for any physical damage as a result of the low-temperature-operation test. (See 3.6.)

4.6.3.3 High-temperature operation.

The resistor shall be placed in a hot chamber and maintained for a period of 1 hour at the high temperature specified. (See 3.1.) While still exposed to the high-temperature conditions, the resistor shall be operated at the specified maximum voltage for at least 1 hour and immediately thereafter, at the specified minimum voltage for at least 10 minutes. At the end of each operating period, the current shall be within the specified limits. (See 3.1.) After the resistor has been

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stabilized at room temperature, it shall be subjected to the tests specified in 4.6.3.1 to ascertain whether the tube has sustained any electrical damage. Visual examination shall be made for any physical damage as a result of the high-temperature-operation test. (See 3.6.)

4.6.4 Cement immersion. Assembled glass resistors shall be immersed in water at a temperature $50^{\circ} \pm 2^{\circ}$ C. for 42 hours, then removed and cooled for 1 hour at room temperature. The bases shall then be subjected to a gradually applied torque, as follows:

- (a) Bases having a maximum overall diameter of $1\frac{1}{2}$ inches or smaller — 20 pound-inches.
- (b) Bases having a maximum overall diameter larger than $1\frac{1}{2}$ inches — 40 pound-inches.

After completion of the test, resistors shall be examined for damage to the resistor-base structure and breakage of the seal between base and envelope. (See 3.7.)

4.6.5 Vibration. Resistors shall be tested in accordance with method 201 of Standard MIL-STD-202. The following details shall apply:

- (a) Initial measurement — Current measured as specified in 4.6.3.1.
- (b) Mounting — Rigidly mounted on the vibration platform.
- (c) Duration of vibration — 15 minutes (5 minutes in each direction).
- (d) Frequency range — 10 to 50 cycles per second and return with an amplitude of 0.04 inch (0.08 inch maximum total excursion) to be traversed in approximately 5 minutes.
- (e) Direction of motion — In each of three mutually perpendicular directions one of which shall be the long axis of the resistor.

(f) Load — Voltage applied as specified in 3.1.

(g) Final measurements — Current measured as specified in 4.6.3.1. Resistors shall then be examined for mechanical damage, open- or short-circuiting, and electrical damage. (See 3.8.)

4.6.6 Life. The resistor shall be operated intermittently, using a cycle of 45 minutes "on" and 15 minutes "off". The tube filament shall be connected directly to the voltage source. The applied voltage shall be as specified. (See 3.1.) The test shall be interrupted at approximately 5, 30, and 60 percent of the hours specified as the required life and at other intervals if desired by the manufacturer, for the measurement of current to determine the life-test end point. (See 3.9.)

5. PREPARATION FOR DELIVERY

5.1 Packaging and packing. All current-regulating resistors (ballast tubes) shall be packaged and packed for shipment in accordance with Specification MIL-P-75, for the specified package group and packing. (See 3.1 and 6.2.)

5.2 Marking. In addition to any special marking required by the contract or order, unit packages, intermediate packages, and exterior shipping containers shall be marked in accordance with Standard MIL-STD-129. (See 6.2.)

6. NOTES

6.1 Intended use. Current-regulating resistors (ballast tubes) covered by this specification are intended for use in compatible electrical circuits where a relatively constant level of current passed by the resistor can be effectively applied. These resistors have been employed to provide controlled current to filaments of electron tubes and to compatible telephone-circuit elements.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Complete type designation, and the title, number, and date of the applicable military specification sheet. (See 1.2.1 and 3.1.)
- (c) Where preproduction inspection is to be performed.
- (d) Levels of preservation and packaging and packing, and applicable marking. (See sect 5.)

6.2.1 Indirect shipments. The packaging, packing, and marking specified in section 5 apply only to direct purchases by or direct shipments to the Government and are not intended to apply to contracts or orders between the manufacturer and prime contractor.

6.3 Design and application of current-regulating resistors. Matters relating to the de-

sign and application of current-regulating resistors covered by this specification should be referred to the bureau or service whose equipment is involved.

Notice. When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Custodians:

Army—Signal Corps
Air Force

Other interest:

Army COT

Preparing activity:

Army—Signal Corps