

# MIL-R-7790

## 8 OCTOBER 1951

Superseding  
AN-R-13a  
17 September 1945

### MILITARY SPECIFICATION

#### RESISTOR, THERMOCOUPLE LEAD SPOOL

This specification was approved by the Departments of the Army, the Navy, and the Air Force for use of procurement services of the respective Departments.

#### 1. SCOPE

1.1 This specification covers one type of thermocouple lead spool resistor.

#### 2. APPLICABLE SPECIFICATIONS AND DRAWINGS

2.1 The following publications, of the issue in effect on date of invitation for bids, shall form a part of this specification to the extent specified herein:

##### 2.1.1 Specifications.-

###### Military

MIL-D-5028	Drawings and Data Lists; Preparation of (For Engines Accessories, and Other Auxiliary Equipment)
MIL-P-6064	Packaging of Lightweight Aircraft Accessories
MIL-P-6906	Plates, Information and Identification
MIL-S-7742	Screw-Threads, Standard, Aeronautical

###### Air Force-Navy Aeronautical

AN-P-13	Preservation and Packaging; Parts and Equipment (General Specification for)
---------	---

##### 2.1.2 Drawings.-

###### Air Force-Navy Aeronautical Standard Drawing

AN5534	Resistor - Thermocouple Lead Spool
--------	------------------------------------

(Copies of specifications, standards, and drawings 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 Materials.- Materials shall be as specified herein. Materials which are not specifically designated shall be of the best commercial quality and suitable for the purpose intended.

3.1.1 Fungus-Proof Materials.- Materials which are not nutrients for fungi shall be used to the greatest extent practicable. Where materials which are nutrients for fungi must be used, such materials shall be treated with an approved fungicidal agent.

3.2 Design and Construction.- The resistor shall consist of a base and cover, two terminal posts, and two spools of wire as shown on Drawing AN5534. It shall be so constructed as to withstand the normal strains of jars, vibrations, and other conditions incident to shipping, storage, installation, and service, without failure.

MIL-R-7790  
(October 1951)

3.2.1 Base and Cover.- The base shall be of a suitable nonconducting material. The cover shall be anodized aluminum alloy with suitable insulating bushings provided, for the two lead ports. Base and cover shall conform to the dimensions shown on Drawing AN5534. The cover shall be attached by snap slide fasteners of the design shown by Drawing AN5534 and shall not become loose under conditions of vibration.

3.2.2 Terminal Posts.- The terminal posts shall be as shown on Drawing AN5534. They shall be so attached to the base that they will not turn in their mountings. The following shall be furnished as part of the terminal post and shall be attached in the order given: Solder terminal, lock washer, hex nut, plain washer, lock washer, and hex nut. The hardware shall be of commercial design suitably plated.

3.2.3 Spools.- The spools shall be of suitable material and of sufficient size to hold the required wire. They shall be securely attached to the base.

3.2.3.1 Wire.- The wire used shall be constantan No. 24 Enamel Insulation and shall be neatly wound on the spool. The free ends of each spool of wire shall be secured so that the wire will not unravel.

3.2.4 Peg.- A peg of nonconducting material shall be furnished as shown on Drawing AN5534 to secure the loose end of wire prior to soldering at installation and prevent the spool from becoming unwound.

3.2.5 Screw-Threads.- Screw-threads shall be in accordance with Specification MIL-S-7742.

3.3 Interchangeability.- All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance. Changes in manufacturer's part numbers shall be governed by the drawing number requirements of Specification MIL-D-5028.

3.4 Finish.- All metal parts, including hardware, shall be suitably finished to resist corrosion.

3.5 Performance.- The resistor shall perform satisfactorily when subjected to all the tests specified in Section 4.

3.6 Identification of Product.-

3.6.1 Nameplate.- The following information shall be permanently and legibly marked on the resistor or on a nameplate conforming to Specification MIL-P-6906.

RESISTOR, THERMOCOUPLE LEAD SPOOL  
AN5534 - (proper dash No.)  
Stock No. (USAF or Navy, as applicable)  
Manufacturer's Part No.  
Contract or Order No.  
Manufacturer's Name or Trade-Mark  
U S Property

3.6.2 Use of AN or MIL Designations.- AN or MIL designations shall not be applied to a product, except for qualification test samples, nor referred to in correspondence or sales matter, until notification has been received from the Aeronautical Standards Group that the product has been approved for aeronautical use, by both the Air Force and the Bureau of Aeronautics.

3.7 Workmanship.- Workmanship shall be in accordance with high-grade commercial practice covering this class of work.

#### 4. SAMPLING, INSPECTION, AND TEST PROCEDURES

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

- (a) Qualification tests: Qualification tests are those tests accomplished on samples submitted for qualification as a satisfactory product.
- (b) Inspection tests: Inspection tests are those tests accomplished on the resistors manufactured and submitted for acceptance under contract.

#### 4.2 Qualification Tests.-

4.2.1 Sampling Instructions.- Qualification test samples shall consist of three resistors of each manufacturer's part number upon which qualification is desired. Samples shall be identified as required and forwarded to the agency designated in the Letter of Authorization from the qualifying agency. (See paragraph 6.3.)

4.2.2 Tests.- The Qualification tests of resistors shall consist of all the tests of this specification. The Qualification tests may at the option of the qualifying agency, be supplemented with tests under actual service conditions.

4.3 Inspection Tests.- The contractor shall furnish all samples and shall be responsible for accomplishing the required tests. When inspection is conducted at the contractor's plant, all inspection and testing shall be under the supervision of the Government Inspector. Contractors not having laboratory testing facilities satisfactory to the Government shall engage the services of a commercial testing laboratory acceptable to the procuring agency. The contractor shall furnish test reports, in duplicate, showing quantitative results for all tests required by this specification, and signed by an authorized representative of the contractor or laboratory, as applicable. Acceptance or approval of material during course of manufacture shall in no case be construed as a guaranty of the acceptance of the finished product.

4.3.1 Individual Tests.- Each resistor submitted for acceptance under contract shall be subjected to the following tests:

- (a) Examination of Product
- (b) Total Resistance
- (c) High Temperature Resistance

In addition, each resistor shall be subject to any other test specified herein which the Inspector considers necessary to determine conformance with the requirements of this specification.

4.3.2 Sampling Tests.- Three sample resistors from the manufacturer's first contract or order shall be selected by the Inspector and subjected to the following tests:

- (a) High Temperature Exposure
- (b) Cold Resistance
- (c) Humidity
- (d) Vibration
- (e) Fungus Resistance

4.3.2.1 Additional resistors shall be selected on subsequent contracts for submission to the Sampling tests as considered necessary by the Inspector to determine conformance with the requirements of this specification.

4.3.3 Rejection and Retest.- When any representative sample fails to meet the requirements of the Sampling tests, the lot represented shall be rejected and returned at the contractor's expense. Any resistor failing to meet the requirements of the Individual tests shall be rejected and returned at the contractor's expense. Resistors which have been rejected may be replaced or repaired to correct the defects and resubmitted for all the specified

tests. Before resubmitting, full particulars concerning previous rejections and the action taken to correct the original defects will be furnished the Inspector. Units rejected after retest shall not be resubmitted without the specific approval of the Inspector.

#### 4.4 Test Conditions.-

4.4.1 Room Temperature.- Whenever the temperature existing at the time of tests is not specified, it is to be understood that the test should be made at room temperature, 25°C (77°F). When tests are made with room temperature substantially different from the above value, proper allowance shall be made for the difference from the specified temperature.

4.4.2 Resistance Reading.- The resistance may be measured by any convenient method satisfactory to the Inspector which will give the desired accuracy.

#### 4.5 Test Methods.-

4.5.1 Examination of Product.- Each resistor shall be carefully examined to determine conformance with this specification with respect to material, workmanship, and marking.

4.5.2 Total Resistance.- The resistance of each spool of wire shall be measured. It shall be 8 ohms  $\pm 10$  percent. The value of the resistance of each spool shall be noted for use in the High Temperature tests of paragraphs 4.5.3.1 and 4.5.3.2.

4.5.3 Environmental Tests.- The resistor shall be subjected to the following Environmental tests:

4.5.3.1 High Temperature Resistance.- The resistor shall be placed within a test chamber and the initial temperature of the chamber raised to 71°C with an internal relative humidity of not more than 5 percent. The source of heat for the chamber shall be arranged in such a manner that radiant heat shall not fall on the test specimen. The total volume occupied by the resistor being tested shall not exceed 50 percent of the internal volume of the test chamber. The resistor shall be maintained at 71°C for a period of 1 hour. At the end of this period and while still at the high temperature, the resistance of the resistor shall be measured. The resistance shall be within 0.05 ohms of the value recorded in the total resistance test.

4.5.3.2 High Temperature Exposure.- The resistor shall be placed within a test chamber and the initial temperature of the chamber raised to 71°C with an internal relative humidity of not more than 5 percent. The source of heat for the chamber shall be arranged in such a manner that radiant heat shall not fall on the test specimen. The total volume occupied by the resistor being tested shall not exceed 50 percent of the internal volume of the test chamber. The resistor shall be maintained at 71°C for a period of 15 hours. Following the test period, the resistor shall be examined, and there shall be no damage as a result of this test.

4.5.3.3 Humidity.- The resistor shall be placed in a test chamber which is capable of being sealed, and the temperature and relative humidity raised to 71°C and 95 percent, respectively, during a 2-hour period. The source of heat for the chamber shall be so arranged that radiant heat shall not fall upon the resistor. The temperature of 71°C and relative humidity of 95 percent shall be maintained for a period of 6 hours. At the conclusion of the 6-hour period the heat shall be shut off. During the following 16-hour period the temperature must drop at a uniform rate with condensation to 38°C or less. The cycle shall be repeated a sufficient number of times to extend the total time of the test to 360 hours (15 cycles). At the conclusion of the 360-hour period the resistor shall be examined for damage. There shall be no warpage, corrosion, or deterioration as a result of this test. Distilled or demineralized water having a pH value of between 6.8 and 7.2 at 25°C shall be used to obtain the desired humidity.

4.5.3.4 Vibration.- The resistor shall be mounted on the apparatus in a position dynamically similar to the most severe mounting likely to be used in service. The amplitude or acceleration for the frequency cycling test shall be within  $\pm 10$  percent of the

specified values. Vibration tests shall be conducted under resonant conditions. Resonant frequencies of the test specimen shall be determined by varying the frequency and double amplitude of the applied vibration slowly through the following ranges:

0.050-inch double amplitude from 5 to 10 cps.  
0.036-inch double amplitude from 10 to 75 cps.  
±10g vibratory acceleration from 75 to 500 cps.

This procedure shall be followed successively for vibration applied along three mutually perpendicular axes of the test specimen. Whenever practicable, functioning of the test specimen shall be checked concurrently with the operation of scanning the frequency range for resonant frequencies. The resistor shall be vibrated at the indicated resonant conditions for the following periods and with the applied double amplitude or vibratory acceleration listed above:

At room temperature	60 minutes
At 71°C	15 minutes
At -55°C	15 minutes

These periods of vibration shall be accomplished in sequence for each of three mutually perpendicular axes of vibration. When more than one resonant frequency is encountered with vibration applied along any one axis, the test period may be accomplished at the most severe resonance or the period may be divided among the resonant frequencies, whichever is considered most likely to produce failure. When resonant frequencies are not apparent within the specified frequency range, the resistor shall be vibrated for periods twice as long as those shown above for resonance, at a frequency of 55 cps and an applied double amplitude of 0.060 inch. There shall be no damage, and no parts shall become loosened as a result of these tests. The resistance before and after the test shall be the same within ±0.01 ohm.

#### 4.5.3.5 Fungus Resistance.-

4.5.3.5.1 Method.- At least five fungi shall be used in each test. Five groups of fungi are listed below, and one type of fungus from each group shall be used. In preparing the spore suspension, distilled water (having a pH value between 6.8 and 7.2 at 25°C) shall be prepared by sterilization in convenient containers (approximately 100 ml each). Approximately 10 ml of the solution shall then be introduced directly into a stock culture of one fungus and shaken vigorously so that a well sporulated suspension will result without disturbing the agar. This process shall be repeated for each type fungus. The separate spore suspensions from the five types of fungi shall then be mixed together in an atomizer to provide a composite suspension. The equipment, including applicable external connections shall be placed in a mold chamber maintaining an internal temperature of 30°C and a relative humidity of 95 percent, and sprayed with the suspension of mixed spores similar to those encountered in tropical climates. The test period shall be 28 days. At the conclusion of the test, the equipment shall be visually inspected to determine that no growth of fungus has occurred.

#### 4.5.3.5.2 Organisms.-

- Group I Chaetomium globosum USDA 1042.2 or Myrothecium verrucaria USDA 1334.2
- Group II Rhizopus nigricans S.N. 32 or Aspergillus niger USDA TC215-4247
- Group III Aspergillus flavus AMC No. 26 or Aspergillus terreus PQMD 82J
- Group IV Penicillium luteum USDA 1336.1, Penicillium sp. USDA 1336.2 or Penicillium citrinum ATCC 9849
- Group V Memnoniella echinata AMC. No. 37 or Fusarium moniliforme USDA 1004.1

4.5.3.5.3 Stock Culture Designation and Source.-

<u>Symbols</u>	<u>Source</u>
USDA	U. S. Department of Agriculture, Beltsville, Maryland
ATCC	American Type Culture Collection, Georgetown University, Washington, D. C.
PQMD	Philadelphia Q.M. Depot, 2800 South 20th Street, Philadelphia, Pennsylvania
AMC	Wright Air Development Center, Materials Laboratory, Wright-Patterson Air Force Base, Dayton, Ohio
S.N.	Dr. W. B. Weston, Biological Laboratories, Harvard University, Cambridge, Massachusetts

4.5.4 Cold Resistance.- The resistor shall be subjected to a temperature of  $-65^{\circ}\text{C}$  ( $-85^{\circ}\text{F}$ ) for a period of 48 hours. There shall be no damage.

5. PREPARATION FOR DELIVERY

5.1 Application.- The packaging, packing, and marking requirements specified herein apply only to direct purchases by or direct shipments to the Government.

5.2 Preservation and Packaging.- The resistor shall be prepared for shipment in accordance with Group I of Specification MIL-P-6064, in a type I, class I container. Preservation shall be in accordance with Specification AN-P-13, method IA, without preservative.

5.3 Packing.- Resistors shall be packed for shipment in accordance with Specification MIL-P-6064

5.4 Marking and Labeling.- Interior packages and shipping containers shall be marked in accordance with MIL-P-6064 in addition to the markings specified herein.

5.4.1 Packages.- Each interior package shall be durably and legibly marked with the following information in such a manner that the markings will not become damaged when the packages are opened.

RESISTOR, THERMOCOUPLE LEAD SPOOL  
AN5534 - (proper dash No.)  
Stock No. (USAF or Navy, as applicable)  
Manufacturer's Part No.  
Quantity  
Contract or Order No.  
Name of Manufacturer  
Name of Contractor (if different from manufacturer)  
Date of Manufacture

6. NOTES

6.1 Intended Use.- The resistors covered by this specification are intended for use in aircraft thermocouple leads installed in accordance with Drawings AND10406 and AND10408.

6.2 Ordering Data.- Requisitions, contracts, and orders should state the AN part number of the resistor desired, quantity, and whether overseas packing is desired. (See Section 5 and Specification MIL-P-6064.)

6.3 Provisions for Qualification Tests.- The right is reserved to reject any bids on items which have not been subjected to the required tests and found satisfactory. The attention of the manufacturers is called to this provision, and they are urged to request authorization for tests of the items which they propose to offer to the Air Force or Navy under this specification. Requests for authorization of tests together with certified test reports showing conformance with all the requirements of this specification and the manufacturer's assembly and detail drawings, and for information as to the marking and forwarding of samples should be addressed to the Commanding General, Wright Air Development Center, Wright-Patterson Air Force Base, Dayton, Ohio; or to the Bureau of Aeronautics, Navy Department, Washington 25, D. C., the qualifying agencies, with a copy to the other Service.

6.3.1 It is to be understood that upon receipt of the Letter of Authorization, samples shall be furnished at no cost to the Government, and that the manufacturers shall pay the transportation charges to and from the designated point where tests are to be made. In the case of failure of the sample or samples submitted, consideration will be given to the request of the manufacturer for additional tests only after it has been clearly shown that changes have been made in the product which the Government considers sufficient to warrant additional tests.

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:

Navy - Bureau of Aeronautics  
Air Force

Other interest:

Army - T  
Navy - Sh

**SPECIFICATION ANALYSIS SHEET**

Form Approved  
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).

SPECIFICATION

ORGANIZATION (of submitter)

CITY AND STATE

CONTRACT NO.

QUANTITY OF ITEM PROCURED

DOLLAR AMOUNT

\$

MATERIAL PROCURED UNDER: A

DIRECT GOVERNMENT CONTRACT

SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?  
A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

YES  NO IF "YES", IN WHAT WAY?

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED BY (Printed or typed name and activity)

DATE

FOLD

---

DEPARTMENT OF THE NAVY

POSTAGE AND FEES PAID  
NAVY DEPARTMENT

                      
OFFICIAL BUSINESS

COMMANDER  
INTERCHANGEABILITY & CONTROL DIV.  
(AFLC, SGEBA)  
WRIGHT-PATTERSON AFB, OHIO 45433

---

FOLD

PLATE NO. 15419 (BAC)