

MIL-T-7990B
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MILITARY SPECIFICATION

TRANSMITTER, TEMPERATURE, ELECTRICAL RESISTANCE, -70° TO $+300^{\circ}\text{C}$

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

1. SCOPE

1.1 This specification covers electrical resistance temperature transmitter used in aircraft in conjunction with electrical resistance temperature indicators.

1.2 Classification. Electrical resistance temperature transmitter shall be of the types designated by the following part numbers, as specified (see 6.2):

Part No. MS28034-1 - 1.875 inch stem
 Part No. MS28034-2 - 4.000 inch stem
 Part No. MS28034-3 - 0.325 inch stem

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

QQ-M-151 Metals; General Specification for Inspection of

Military

MIL-E-5272 Environmental Testing, Aeronautical and Associated Equipment, General Specification for

MIL-D-1000 Drawings, Engineering and Associated List

FSC 6685

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STANDARDS

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U. S. Military Property
MIL-STD-143	Specification and Standards, Order of Precedence for a Selection of
MIL-STD-831	Test Reports, Preparation of
MS28034	Transmitter - Temperature, Electrical Resistance (-70° to +300°C)

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Qualification. The transmitter furnished under this specification shall be a product which has been tested and has passed the qualification tests specified herein, and has been listed on or approved for listing on the applicable Qualified Products List.

3.2 Components. The transmitter shall consist of a resistance element, a transmitter housing, an electrical connector, and a gasket.

3.3 Selection of specifications and standards. Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.4 Materials. Metals shall be corrosion resistant, unless protected to resist corrosion during normal service life. The use of dissimilar metals, especially brass, copper, or steel in intimate metal-to-metal contact with aluminum or aluminum alloy shall be avoided where practicable.

3.4.1 Protective treatment. When materials are used in the construction of the transmitter that are subject to deterioration when exposed to climatic and environmental conditions likely to occur during service usage, they shall be protected against such deterioration in a manner that will in no way prevent compliance with the performance requirements of this specification. The use of any protective coating that will crack, chip, or scale with age or extremes of climatic and environmental conditions shall be avoided.

3.4.2 Selection of materials. Specifications and standards for all materials, parts, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with MIL-STD-143, except as provided in the following paragraph.

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3.4.2.1 Standard parts. Standard parts (MS, AN or JAN) shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their part numbers. Commercial utility parts such as screws, bolts, nuts, cotter pins, etc., may be used, provided they possess suitable properties and are replaceable by the standard parts (MS, AN or JAN) without alteration, and provided the corresponding standard part numbers are referenced in the parts list and, if practicable, on the contractor's drawings. In the event there is no suitable corresponding standard part in effect on date of invitation for bids, commercial parts may be used provided they conform to all requirements of this specification.

3.5 Design and construction.

3.5.1 The transmitter shall be designed to function satisfactorily throughout the temperature range of -70° to $+300^{\circ}\text{C}$.

3.5.2 The transmitter shall be so constructed as to withstand the normal strains of jars, vibrations, and such other conditions as are incident to shipping, storage, installation, and service, without failure. The stem of the transmitter shall be so brazed (or otherwise attached, subject to the approval of the procuring activity) to the transmitter head as to prevent any leakage into the transmitter winding or electrical receptacle.

3.5.3 Resistance element. The resistance element of the transmitter shall be hermetically sealed in a metal well, as specified in the applicable tests of Section 4.

3.5.4 The resistance transmitter shall conform to MS28034.

3.5.5 Temperature-resistance characteristics. The temperature-resistance characteristics of the transmitter shall conform to the values given in Table I.

3.5.6 Electrical connection. The transmitter shall be provided with a suitable electrical receptacle as shown on MS28034.

3.5.7 Gasket. Each transmitter shall be provided with a gasket as specified in MS28034.

3.6 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 MIL-D-70327.

3.7 Weight. The weight of the transmitter shall not exceed 0.25 pound.

3.8 Identification of product. Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-130.

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TABLE I

Temperature-Resistance Values

°C	OHMS RESISTANCE	°C	OHMS RESISTANCE
-70	68.27 \pm .50	60	112.28 \pm .50
-60	71.19 \pm .50	70	116.27 \pm .50
-50	74.24 \pm .40	80	120.36 \pm .50
-40	77.39 \pm .40	90	124.55 \pm .50
-30	80.56 \pm .40	100	128.85 \pm .50
-20	83.77 \pm .40	110	133.26 \pm .50
-10	87.04 \pm .40	120	137.78 \pm .60
0	90.38 \pm .40	130	142.40 \pm .60
10	93.80 \pm .40	140	147.11 \pm .60
20	97.31 \pm .40	150	151.91 \pm .60
30	100.91 \pm .40	200	177.95 \pm 1.00
40	104.60 \pm .40	250	208.00 \pm 1.00
50	108.39 \pm .40	300	242.70 \pm 1.50

3.8.1 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, until notice of approval has been received from the activity responsible for qualification, or from the Aeronautical Standards Group.

3.9 Workmanship.

3.9.1 General. The transmitter, including all parts and accessories, shall be constructed and finished in a thoroughly workmanlike manner. Particular attention shall be given to neatness and thoroughness of soldering, wiring, marking of parts and assemblies, and freedom of parts from burrs and sharp edges.

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3.9.2 Cleaning. The transmitter shall be thoroughly cleaned of loose, spattered, or excess solder, metal chips, and other foreign material after final assembly. Burrs and sharp edges, as well as resin flash that may crumble, shall be removed.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of tests. The inspection and testing of transmitters shall be classified as follows:

a. Qualification tests: Qualification tests are those tests performed on samples submitted for approval as qualified products.

b. Acceptance tests: Acceptance tests are those tests performed on individual lots which have been submitted for acceptance.

4.3 Qualification testing.

4.3.1 Qualification tests shall consist of all the tests specified under 4.6.

4.3.2 Qualification test samples. The qualification test samples shall consist of three transmitters. Samples shall be identified with the manufacturer's part number and any additional information required by the letter of authorization.

4.3.3 Test report. When tests are conducted at a location other than a laboratory of the procuring activity, three copies of a test report in accordance with MIL-STD-831 shall be furnished to that activity.

4.3.4 Failure. Failure of a qualification sample to pass any of the examinations or tests specified herein shall be cause for rejection of all samples submitted for qualification at one time.

4.4 Acceptance tests. The acceptance tests of the transmitters shall consist of individual tests and Sampling Plans A and B as applicable.

4.4.1 Individual tests. Each production transmitter shall be subjected to the following tests as described under 4.6:

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a. Examination of Product.

b. Transmitter adjustment.

4.4.2 Sampling plans and tests.

4.4.2.1 Sampling Plan A. Five transmitters selected at random from each 500 or less lot produced on the contract or order shall be subjected to the following tests as described under 4.6:

a. Examination of Product.

b. Transmitter resistance

c. Vibration endurance.

A lot shall consist of transmitters manufactured under essentially the same conditions and submitted for inspection at substantially the same time.

4.4.2.2 Sampling Plan B, sample selection. Unless otherwise specified, two transmitters shall be selected at random from the first 15 transmitters produced on contract and submitted within 10 days after manufacture. These transmitters shall be forwarded to a laboratory designated by the procuring agency (see section 6). Each sample shall be plainly identified by a securely attached durable tag marked with the following information:

Submitted by (name) (date) for Sample Plan B tests in accordance with (Contract No.) Manufacturer's Part Number _____, and serial no. as applicable.

4.4.2.2 Sampling Plan B tests. Each transmitter selected for sampling plan B tests shall be subjected to the following:

Sampling plan A tests.

Low temperature exposure.

High temperature exposure.

Vibration-high temperature.

Humidity.

Insulation leakage.

Salt spray.

Strength.

Pressure test (as applicable).

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4.4.2.3 Rejection and retest. When tests are specified on a quantity of transmitters that are selected as representative of a certain lot, and one or more of this number fails to meet the specified tests, additional transmitters of the lot represented shall be tested immediately to determine the extent of failure. Individual performance tests shall not be interrupted, unless the defect is of such a nature that it will seriously affect the performance or safe use of the transmitter.

4.5 Test conditions.

4.5.1 Standard atmospheric conditions. Whenever the pressure and temperature existing at the time of the test are not specified definitely, it is understood that the test is to be made at atmospheric pressure (approximately 29.92 inches Hg) and at room temperature (approximately 25°C). When tests are made with atmospheric pressure or room temperature differing materially from the above values, proper allowance shall be made for the difference from the specified condition.

4.5.2 Vibration. A vibration stand shall be used which will vibrate at any desired frequency between 300 and 3,000 cpm and shall subject the transmitter to a linear vibration of the amplitude specified herein.

4.5.3 Resistance values. Where practicable, the resistance values given for test results shall be the averages of direct and reversed readings to eliminate thermoelectric potential errors.

4.5.4 Test voltage. Unless otherwise specified, a voltage of $1.5 \pm 0.2V$ dc shall be applied across the transmitter for making resistance measurements.

4.6 Test methods.

4.6.1 Examination of product. Each transmitter shall be inspected to determine compliance with the requirements specified herein with respect to materials, workmanship, and marking.

4.6.2 Transmitter adjustment. The resistance of the transmitter shall be measured at room temperature. The transmitter shall be placed in an agitated liquid bath, or other suitable nongradient apparatus, to the top of the attaching threads for conducting this test. The measured resistance of the transmitter shall conform to the value given in Table I.

4.6.3 Transmitter resistance. The resistance of each transmitter shall be measured at temperatures of $-50^{\circ} \pm 5^{\circ}C$, $0^{\circ} \pm 5^{\circ}C$, $+100^{\circ} \pm 5^{\circ}C$, $+200^{\circ} \pm 5^{\circ}C$ and $+300 \pm 5^{\circ}C$ in an agitated liquid bath. If desired by the inspector, resistance measurements at any other points in Table I may also be made. The measured resistance shall be within the tolerance specified in Table I for the exact temperature of the master. To determine the true resistance equivalent to the temperature of the master, interpolation of the values given in Table I may be required. The transmitter shall be immersed in the agitated liquid baths to the top of the attaching threads for all resistance measurements.

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4.6.4 Vibration endurance.

4.6.4.1 For the MS28034-1 and -2 configuration the transmitter shall be mounted by the attaching threads on a suitably designed vibration stand as specified herein. For one-half of the test, the linear vibration shall be applied perpendicular to the longitudinal axis of the transmitter, and for the other half of the test the linear vibration shall be applied parallel to the longitudinal axis of the transmitter. The vibration test shall be conducted for 4 hours with a total amplitude of vibration between 0.030 and 0.032 inch. The frequency shall be varied uniformly from 300 to 3,000 cpm and return once each hour during this test. No failure of any kind shall occur during the vibration period. Following the 4-hour vibration period, the transmitter shall meet the requirements specified for the transmitter adjustment test.

4.6.4.2 For the MS28034-3 configuration the transmitter shall be mounted by the attaching threads on a suitable designed vibration stand as specified herein. The transmitter shall be tested in accordance with Procedure XII, Curve A, of MIL-E-5272C(1).

4.6.5 Response time. The sensitive element of the transmitter shall be quenched from an agitated liquid bath at $100^{\circ} \pm 2^{\circ}\text{C}$ to an agitated ice bath at $0^{\circ} \pm 2^{\circ}\text{C}$. The time required for the transmitter temperature to fall from $+100^{\circ} \pm 2^{\circ}\text{C}$ to $+10^{\circ} \pm 2^{\circ}\text{C}$ shall be noted. In conducting this test, a calibrated indicator may be connected to the transmitter, or a Wheatstone bridge may be used. The time required shall not exceed 8 seconds.

4.6.6 Thermal conductivity. The head of the transmitter shall be packed in ice providing a head temperature of substantially 0°C . The stem of the transmitter shall then be immersed for its entire length in an agitated liquid bath at $+100^{\circ} \pm 5^{\circ}\text{C}$. The resistance of the transmitter shall then be measured. The resistance of the transmitter shall not differ by more than 1.3 ohms from the resistance at the same temperature when measured without cooling the transmitter head.

4.6.7 Thermoelectric potential. The potentials produced in the transmitter winding measured with a potentiometer, when the sensitive element of the transmitter is subjected to an air temperature of $+150^{\circ} \pm 5^{\circ}\text{C}$, shall not exceed 1 mv.

4.6.8 Self-heating. The transmitter shall be immersed to the top of the attaching threads in an agitated bath of water at a temperature of $+25^{\circ} \pm 2^{\circ}\text{C}$. A current of 150 ma shall be applied to the transmitter for a minimum period of 2 minutes and the maximum rise in resistance measured during this period. The rise shall not exceed 7 ohms.

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4.6.9 Low temperature exposure. The transmitter shall be subjected to a temperature of $-65^{\circ} \pm 2^{\circ}\text{C}$ for a period of 48 hours. With the transmitter at $-65^{\circ} \pm 2^{\circ}\text{C}$, it shall be checked for continuity. After the transmitter has returned to room temperature, it shall meet the requirements specified in the transmitter adjustment test. There shall be no damage which would adversely affect subsequent operation.

4.6.10 High temperature exposure. The sensitive element of the transmitter shall be subjected to a temperature of $+300^{\circ} \pm 5^{\circ}\text{C}$ for a period of 50 hours. After the transmitter temperature has returned to room temperature, it shall be subjected to the transmitter resistance test. The resistance of the transmitter shall not differ by more than ± 0.3 ohm from the original resistance values determined. The entire transmitter assembly shall be subjected to a temperature of $+200^{\circ} \pm 5^{\circ}\text{C}$ for a period of 8 hours. Following this test, the head of the transmitter shall be examined, and there shall be no damage which would adversely affect subsequent operation.

4.6.11 Vibration - high temperature. The transmitter shall be subjected to the vibration endurance test specified in 4.6.4, except that during the 4 hour vibration period, the sensitive element of the transmitter shall be subjected to a temperature of $+200^{\circ} \pm 5^{\circ}\text{C}$. Following the 4 hour vibration period, the transmitter shall meet the requirements specified in the transmitter resistance test.

4.6.12 Humidity. The transmitter shall be placed in a test chamber which is capable of being sealed, and the temperature and relative humidity raised to 65°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 specimen. The temperature of 65°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). 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. There shall be no evidence of corrosion or rusting of the transmitter or any other damage as a result of this test.

4.6.13 Insulation leakage. Immediately following the humidity test, a potential of 100V shall be applied between either electrical receptacle pin and the transmitter housing. Air drying of the transmitter receptacle, connecting leads, and outer housing prior to conducting this test is permissible. The insulation resistance of the transmitter shall be not less than 20 megohms.

4.6.14 Salt spray. The transmitter shall be subjected to salt spray tests outlined in QQ-M-151 for a period of 50 hours. No damage to the transmitter shall result from this test.

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4.6.15 Strength. The transmitter shall be screwed into a suitably tapped rigid plate, in order that the temperature-sensitive part of the transmitter is held rigidly in a horizontal plane without additional support. The temperature-sensitive part shall then be subjected to a temperature of $+300^{\circ} \pm 5^{\circ}\text{C}$ for a period of 2 hours. While at this temperature, a weight of 10 pounds shall be suspended from the temperature-sensitive part of the transmitter at a distance of $1\frac{1}{2}$ inches from the gasket seat for a period of 5 minutes. No damage to any part of the transmitter shall occur. At the completion of this test, the transmitter shall be resubjected to the transmitter adjustment test.

4.6.16 Pressure test. The MS28034-3 transmitters shall be exposed to an external hydraulic pressure proof test of 400 psig for one minute at room temperature, and a burst test of 600 psig for one minute at room temperature. This test applies to MS28034-3 only.

4.7 All parts, specimens, or assemblies destroyed in making tests required by this specification and drawings, to determine compliance with the specification and drawings, shall be in addition to the quantity specified in the contract or purchase order and shall be furnished without increasing the cost of the contract or order.

5. PREPARATION FOR DELIVERY

5.1 Application. The requirements of Section 5 apply only to direct purchases by or direct shipments to the Government.

5.2 Preservation and packing. Transmitters shall be prepared for delivery in accordance with MIL-P-7936, level A, B, or C as specified (see 6.2).

5.3 Marking of shipments. Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129. The nomenclature shall be as follows: Transmitter, Temperature, Electrical Resistance, -70° to $+300^{\circ}\text{C}$, MS28034- (applicable dash number), MIL-T-7990B, Manufacturer's Part No., Federal Stock No. (if no FSN available, leave space therefore).

6. NOTES

6.1 Intended use. The transmitter covered by this specification is intended for use in aircraft in conjunction with electrical resistance temperature indicators to indicate liquid or gas temperatures in the range of -70° to $+300^{\circ}\text{C}$.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number and date of this specification.
- b. Part number of transmitter required (see 1.2).
- c. Levels of preservation and packaging and packing required (see 5.2).

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6.3 Qualification. With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is Commander, Middletown Air Materiel Area, Attn: MANE, Olmsted Air Force Base, Pennsylvania 17057, and information pertaining to qualification of products may be obtained from that activity.

Custodians:

Army - MO
Navy - WP
Air Force - 67

Preparing Activity:

Air Force - 67
Project Number 6685-0138

Reviewer Activities:

Army - MO
Navy - WP
Air Force - 67

User Activities:

Army - GL

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