

INCH-POUND

MIL-DTL-7990D
 15 August 2012
 SUPERSEDING
 MIL-DTL-7990C
 20 September 2007

DETAIL SPECIFICATION

TRANSMITTER, TEMPERATURE, ELECTRICAL RESISTANCE, -70° TO +300°C

Reactivated after 20 September 2007 and may be used for new and existing designs and acquisitions.

This specification is approved for use by all departments and agencies of the Department of Defense.

1. SCOPE

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

1.2 Classification. The electrical resistance temperature transmitters are of the sizes specified in table I ([see 6.2](#)).

TABLE I. Size - stem length and overall length.

Size	PIN	Stem length (inches)	Overall length (inches)
1	MS28034-1	1.875	3.500
2	MS28034-2	4.000	5.625
3	MS28034-3	0.325	2.125
4	MS28034-4	1.875	2.506

1.3 Part or identifying number (PIN). The PIN to be used for electrical resistance temperature bulbs acquired to this specification is created in accordance with MS28034.

Comments, suggestions, or questions on this document should be addressed to DLA Aviation VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616 or e-mailed to STDZNMGT@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST database at <https://assist.dla.mil>.

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2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of the documents cited in sections 3 and 4 of this specification, whether or not they are listed.

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 issues of these documents are those cited in the solicitation or contract ([see 6.2](#)).

DEPARTMENT OF DEFENSE SPECIFICATIONS

MS28034	- Bulbs, Temperature, Electrical Resistance (-70 °C to +300 °C).
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DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130	- Identification Marking of U.S. Military Property.
MIL-STD-810	- Environmental Engineering Considerations and Laboratory Tests.
MIL-STD-1916	- DoD Preferred Methods for Acceptance of Product.
MIL-STD-31000	- Technical Data Packages.

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-831	- Preparation of Test Reports.
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(Copies of these documents are available at <https://assist.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other government documents, drawings, and publications. The following other government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract ([see 6.2](#)).

STANDARDIZATION DOCUMENTS

SD-6	- Provisions Governing Qualification.
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(Copies of these documents are available at <https://assist.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract ([see 6.2](#)).

ASTM INTERNATIONAL

ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

(Copies of these documents are available at <http://www.astm.org/> or from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with MS28034. In the event of any conflict between the requirements of this specification and the specification sheet, the later shall govern.

3.2 Qualification. Transmitters furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award ([see 4.3](#) and [6.3](#)).

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

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 alloy, shall be avoided where practicable.

3.4.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

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3.4.2 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 climate and environmental conditions shall be avoided.

3.5 Design and construction.

3.5.1 Temperature range. The transmitter shall be designed to function satisfactorily throughout the temperature range of -70 °C to 300 °C.

3.5.2 Construction. The transmitter shall conform to MS28034. The transmitter shall be constructed to withstand the normal strains of jars, vibrations, and other conditions incident to shipping, storage, installation, and service without failure. The stem of the transmitter shall be brazed (or otherwise attached, subject to the approval of the procuring activity) to the transmitter head 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 or stem.

3.5.4 Temperature resistance characteristics. The temperature resistance characteristics of the transmitter shall conform to the values in table II.

TABLE II. Temperature resistance values.

°C	Ohms resistance	°C	Ohms resistance
-70	68.27 ± 0.50	60	112.28 ± 0.50
-60	71.19 ± 0.50	70	116.27 ± 0.50
-50	74.24 ± 0.40	80	120.36 ± 0.50
-40	77.39 ± 0.40	90	124.55 ± 0.50
-30	80.56 ± 0.40	100	128.85 ± 0.50
-20	83.77 ± 0.40	110	133.26 ± 0.50
-10	87.04 ± 0.40	120	137.78 ± 0.60
0	90.38 ± 0.40	130	142.40 ± 0.60
10	93.80 ± 0.40	140	147.11 ± 0.60
20	97.31 ± 0.40	150	151.91 ± 0.60
30	100.91 ± 0.40	200	177.95 ± 1.00
40	104.60 ± 0.40	250	208.00 ± 1.00
50	108.39 ± 0.40	300	242.70 ± 1.50

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

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3.5.6 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-STD-31000.

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

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

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.

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. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see [4.3](#)).
- b. Conformance inspection (see [4.4](#)).

4.2 Test conditions.

4.2.1 Standard atmospheric conditions. Whenever the pressure and temperature existing at the time of the test are not specified, 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.

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

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

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4.2.4 Test voltage. Unless otherwise specified herein, a voltage of 1.5 volts DC (VDC) \pm 0.2 VDC shall be applied across the transmitter for making resistance measurements.

4.3 Qualification inspection. The sample for qualification inspection shall be subjected to the examination and tests specified in 4.5.

4.3.1 Inspection samples. The qualification inspection samples shall consist of three transmitters. Samples shall be identified with the manufacturer's part number and any additional information required by the contracting official.

4.3.2 Inspection report. When inspections are conducted at a location other than a laboratory of the procuring activity, three copies of the inspection report shall be submitted to that activity. MIL-HDBK-831 may be used as guidance when preparing the inspection report.

4.4 Conformance inspection. The conformance inspection of the transmitters shall consist of individual tests and sampling plan A or B inspections, as specified (see [6.2](#)).

4.4.1 Conformance inspection lot. An inspection lot shall consist of all transmitters manufactured under essentially the same conditions and offered for inspection at one time.

4.4.2 Individual tests. Each production transmitter shall be subjected to the following tests:

- a. Examination of product (see [4.5.1](#)).
- b. Transmitter adjustment (see [4.5.2](#)).

4.4.3 Sampling plan A inspection. Sampling and inspection shall be in accordance with MIL-STD-1916 for verification level I. Sampling plan A inspection shall consist of the following tests:

- a. Individual tests (see [4.4.2](#)).
- b. Transmitter resistance (see [4.5.3](#)).
- c. Vibration endurance (see [4.5.4](#)).
- d. Response time (see [4.5.5](#)).
- e. Thermal conductivity (see [4.5.6](#)).
- f. Thermoelectric potential (see [4.5.7](#)).
- g. Self-heating (see [4.5.8](#)).

4.4.4 Sampling plan B inspection. Unless otherwise specified (see [6.2](#)), two transmitters shall be selected at random from the first 15 transmitters produced on the contract or acquisition order. Each transmitter selected for sampling plan B inspection shall be subjected to the following tests:

- a. Sampling plan A tests (see [4.4.3](#)).
- b. Low temperature exposure (see [4.5.9](#)).

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- c. High temperature exposure (see [4.5.10](#)).
- d. Vibration - high temperature (see [4.5.11](#)).
- e. Humidity (see [4.5.12](#)).
- f. Insulation leakage (see [4.5.13](#)).
- g. Salt spray (see [4.5.14](#)).
- h. Strength for MS28034-1, MS28034-2, and MS28034-4 transmitters only (see [4.5.16](#)).
- i. Pressure test for MS28034-3 transmitters only (see [4.5.16](#)).

4.5 Test methods.

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

4.5.2 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 II.

4.5.3 Transmitter resistance. The resistance of each transmitter shall be measured at temperatures of $-50\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$, $0\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$, $100\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$, $200\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$, and $300\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ in an agitated liquid bath. If desired by the inspector, resistance measurements at any other points in table II may also be made. The measured resistance shall be within the tolerance specified in table II 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 II may be required. The transmitter shall be immersed in the agitated liquid baths to the top of the attaching threads for all resistance measurements.

4.5.4 Vibration endurance.

4.5.4.1 MS28034-1, MS28034-2, and MS28034-4. For the MS28034-1, MS28034-2, and MS28034-4 configurations, the transmitter shall be mounted by the attaching threads on a suitably designed vibration stand. 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 inch and 0.032 inch. The frequency shall be varied uniformly from 300 cpm to 3,000 cpm and return once each hour during 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 of 4.5.2.

4.5.4.2 MS28034-3. For the MS28034-3 configuration, the transmitter shall be mounted by the attaching threads on a suitably designed vibration stand. The transmitter shall be tested in accordance with MIL-STD-810, Method 514, "Vibration", general vibration for jet aircraft.

4.5.5 Response time. The sensitive element of the transmitter shall be quenched from an agitated liquid bath at $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ to an agitated ice bath at $0\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. The time required for the transmitter temperature to fall from $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ to $10\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ shall be noted. In

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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.

4.5.6 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 °C ± 5 °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.

4.5.7 Thermoelectric potential. The potentials produced in the transmitter winding measured with a potentiometer shall not exceed 1 millivolt when the sensitive element of the transmitter is subjected to an air temperature of 150 °C ± 5 °C.

4.5.8 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 °C ± 2 °C. A current of 150 milliamps 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.

4.5.9 Low temperature exposure. The transmitter shall be subjected to a temperature of -65 °C ± 2 °C for a period of 48 hours. With the transmitter at -65 °C ± 2 °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 of 4.5.2. There shall be no damage that would adversely affect subsequent operation.

4.5.10 High temperature exposure. The sensitive element of the transmitter shall be subjected to a temperature of 300 °C ± 5 °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 of 4.5.3. 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 °C ± 5 °C for a period of 8 hours. Following this test, the head of the transmitter shall be examined and there shall be no damage that would adversely affect subsequent operation.

4.5.11 Vibration - high temperature. The transmitter shall be subjected to the vibration endurance test specified in 4.5.4, except that during the 4-hour vibration period the sensitive element of the transmitter shall be subjected to a temperature of 200 °C ± 5 °C. Following the 4-hour vibration period, the transmitter shall meet the requirements specified in the transmitter resistance test of 4.5.3.

4.5.12 Humidity. The transmitter shall be placed in a test chamber that is capable of being sealed and the temperature and relative humidity raised to 65 °C and 95 percent respectively over a 2-hour period. The source of heat for the chamber shall be arranged so 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

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of times to extend 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.

4.5.13 Insulation leakage. Immediately following the humidity test, a potential of 100 volts 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.

4.5.14 Salt spray. The transmitter shall be subjected to salt spray tests outlined in ASTM B 117 for a period of 50 hours. No damage to the transmitter shall result from this test.

4.5.15 Strength. This test is for MS28034-1, MS28034-2, and MS28034-4 transmitters only. The transmitter shall be screwed into a suitably tapped rigid plate so 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 °C ± 5 °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 1.5 inches from the gasket seat for a period of 5 minutes. No damage shall occur to any part of the transmitter. At the completion of this test, the transmitter shall be re-subjected to the transmitter adjustment test of 4.5.2.

4.5.16 Pressure test. The MS28034-3 transmitters shall be exposed to an external hydraulic pressure proof test of 400 pounds per square inch (psig) for one minute at room temperature, and a burst test of 600 psig for one minute at room temperature. This test only applies to the MS28034-3 type transmitters.

4.6 Maintenance of qualification. At specified intervals determined by the qualifying activity, the manufacturer must be able to demonstrate that the company still has the capabilities and facilities necessary to produce the QPL items in accordance with this specification and in accordance with the provisions governing qualification in SD-6.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see [6.2](#)). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the inventory control point's packaging activities within the military service or defense agency, or within the military service's system command. Packaging data retrieval is available from the managing military department's or defense agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

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6. NOTES

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

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 °C to 300 °C.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type and part number of transmitter desired (see [1.2](#)).
- c. The specific issue of individual documents referenced (see [2.2.1](#) and [2.3](#)).
- d. Sampling plan A or B, as required (see [4.4](#)).
- e. Sample size for sampling plan B, if different (see [4.4.4](#)).
- f. Packaging requirements (see [5.1](#)).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products that are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL-7990 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, 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. Information pertaining to qualification of products may be obtained from Defense Supply Center Richmond, Attn: DSCR-VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297 or STDZNMGT@dla.mil.

6.4 Subject term (key word) listing.

aircraft
indicators

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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Custodians:

Army - AV
Navy - AS
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