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**Temperature Instruments  
(Reciprocating Engine Powered Aircraft)**

**FOREWORD**

This document has been declared "NONCURRENT". It is recommended, therefore, that this document not be specified for new designs. "NONCURRENT" refers to those documents which have previously been widely referenced and may continue to be required on some existing designs. "NONCURRENT" documents are available from SAE upon request.

**1. PURPOSE:**

This Aerospace Standard establishes the minimum safe performance standards for electrical type temperature instruments primarily for use with reciprocating engine powered transport aircraft, the operation of which may subject the instruments to the environmental conditions specified in Section 3.4.

**2. SCOPE:**

This Aerospace Standard covers two basic types of temperature instruments as follows:

**TYPE I:** Ratiometer type, actuated by changes in electrical resistance of a temperature sensing electrical resistance element; the resistance changes being obtained by temperature changes of the temperature sensing resistance element.

**TYPE II:** Millivoltmeter type, operated and actuated by varying E.M.F. output of a thermocouple; the varying E.M.F. input to the instrument being obtained by temperature changes of the temperature sensing thermocouple.

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### 3. GENERAL REQUIREMENTS:

#### 3.1 Materials and Workmanship:

- 3.1.1 Materials: Materials shall be of a quality which experience and/or tests have demonstrated to be suitable and dependable for use in aircraft instruments.
- 3.1.2 Workmanship: Workmanship shall be consistent with high grade aircraft instrument manufacturing practice.

#### 3.2 Identification:

The following information shall be legibly and permanently marked on the instrument or nameplate attached thereto:

- a. Name of Instrument (Temperature Instrument)
- b. SAE AS 413B
- c. Manufacturer's Part Number
- d. Manufacturer's serial number or date of manufacture
- e. Manufacturer's name and/or trademark
- f. Range
- g. Rating (Electrical)
- h. FAA TSO C-43

#### 3.3 Compatibility of Components:

If components are individually acceptable but require matching for proper operation, they shall be specified accordingly.

#### 3.4 Environmental Conditions:

The following conditions have been established as minimum design requirements. Tests shall be conducted as specified in Sections 6, 7, and 8.

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- 3.4.1 Temperature: When installed in accordance with the instrument manufacturer's instruction, the instrument shall function over the range of ambient temperatures shown in Column A below and shall not be adversely affected by exposure to the range of temperature shown in Column B below:

| <u>Instrument Location</u>               | <u>A</u> | <u>B</u>   |
|------------------------------------------|----------|------------|
| Heated Areas<br>(Temperature Controlled) | 0 to 50C | -65 to 70C |

NOTE: Should cooling be required to reduce the maximum operating temperature below the values specified above for proper operation of the equipment, it shall be the responsibility of the equipment manufacturer to either provide such cooling or to notify the user that such cooling is required.

- 3.4.2 Altitude: When installed in accordance with the instrument manufacturer's instructions, the instrument shall function and shall not be adversely affected following exposure to a pressure and temperature range equivalent to -1000 to 40,000 ft standard altitude per NACA Report 1235, except as limited by the application of paragraph 3.4.1. The instrument shall not be adversely affected when subjected to an ambient pressure of 50 and 3 in. Hg absolute.
- 3.4.3 Vibration: When installed in accordance with the instrument manufacturer's instructions, the instrument shall function and shall not be adversely affected when subjected to vibration of the following characteristics:

| <u>Instrument Location</u>                                  | <u>Cycles Per Sec.</u> | <u>Max. Double Amplitude (in.)</u> | <u>Maximum Acceleration</u> |
|-------------------------------------------------------------|------------------------|------------------------------------|-----------------------------|
| <u>In Airframe</u><br>Panel or Rack<br>(Vibration isolated) | 5-50                   | 0.020                              | 1.5 G.                      |

- 3.4.4 Humidity: The instrument shall function and shall not be adversely affected following exposure to any relative humidity in the range of 0 to 95% at a temperature of approximately 70C.

### 3.5 Fire Hazard:

The Instrument shall be so designed as to safeguard against hazards to the aircraft in the event of malfunction or failure, and the maximum operating temperature of surfaces of any instrument component contacted by combustible fuel or vapor shall not exceed 200C due to self heating.

All materials shall be non-combustible and shall not liberate gases or fumes which will result in such corrosion as to cause malfunction of equipment or discoloration of dials or indicia, nor shall toxic gases or fumes that are detrimental to performance of the aircraft or health of personnel be liberated under the operating conditions specified herein.

3.6 Radio Interference:

The instruments shall not be the source of objectionable interference under operating conditions at any frequencies used on the aircraft, either by radiation or feed back, in electronic equipment installed in the same aircraft as the instrument, in accordance with Specification MIL-I-6181, latest revision.

3.7 Magnetic Effect:

The magnetic effect of the instruments shall not adversely affect the performance of other instruments installed in the same aircraft.

3.8 Decompression:

When installed in accordance with the instrument manufacturer's instructions, the instrument shall function and not be adversely affected following exposure to a pressure decrease from 22 to 2 in. of mercury in 2 sec.

3.9 Interchangeability:

Instruments and components which are identified in accordance with paragraph 3.2 shall be directly and completely interchangeable.

3.10 Definitions:

Definitions shall be in accordance with AS 425A - Flight Control Compartment Nomenclature and Abbreviations, and as noted in the glossary of terms defined in paragraph 9.

4. DETAIL REQUIREMENTS:

4.1 Instrument Markings:

- 4.1.1 Finish: Unless otherwise specified by the user, matte white material shall be applied to all graduations, numerals and indications means.

Non-functional surfaces and markings shall be durable dull black.

- 4.1.2 Graduations: The graduations shall be arranged to provide the maximum degree of readability consistent with the accuracy of the instrument.

- 4.1.3 Numerals: The display shall include sufficient numerals to permit quick and positive identification of each graduation.

Numerals shall distinctly indicate the graduation to which each applies.

- 4.1.4 Instrument Title: The instrument title, when used, shall be of the same approximate size but no larger than the numerals. The title may be of the same finish as the numerals. The units of measure (deg C or deg F x 100, as applicable) shall appear on the dial in lettering noticeably smaller than either the numerals or the title. All letters and numerals shall conform to Military Standard Drawing MS33558.
- 4.1.5 Visibility: The indicting means (indicia, pointers, counters etc.) shall be completely visible from all points within a space defined by a surface generated by lines making angles of at least 30 deg with a perpendicular to the display surface and diverging from the perimeter of the instrument window aperture. The distance between the dial and the cover glass shall be a practical minimum.
- 4.2 Function, Indicating Means:
- The function shall be indicated by means of one or more pointers, dials, tapes, drums or other types of moving elements. Relative motion of the index with respect to the scale (either the index or the scale may be the moving element) shall be clockwise, up or to the right for increasing function.
- 4.3 Internal Lighting:
- Red internal lighting shall be in accordance with ARP 582A - Lighting, Integral, for Aircraft Instruments; Criteria for Design. White internal lighting shall be in accordance with ARP 798, Design Criteria for White Incandescent Lighted Aerospace Instruments.
- 4.4 Power Variation:
- The instrument shall properly function with  $\pm 15\%$  variation in D.C. voltage and/or  $\pm 10\%$  variation in A.C. voltage and 5% variation in frequency. This applies to type I instruments only.
- 4.5 Hermetic Sealing:
- When hermetically sealed, the case shall be filled with an inert gas, free of dust particles, and sufficiently dry so that fogging of the indicator glass does not occur during the low temperature and fogging tests of this Aerospace Standard. Helium gas shall not be used for integrally lighted units.
- 4.6 Case Markings:
- Type II instrument terminal posts shall be different sizes and shall be distinctly marked to indicate plus for either iron wire, copper wire, or chromel wire connections, and minus for either the constantan or alumel wire connections. External resistance of the lead and thermocouple shall be plainly marked. The thermocouple type shall also be identified.
- 4.7 Resistance versus Temperature Equivalents:
- Unless otherwise specified, Type I instruments shall be calibrated to indicate temperature in accordance with the temperature versus resistance values listed in Table I.