The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE STANDARD

SAE AS8005 REV. A

Issued 1977-01
Revised 1996-09

Submitted for recognition as an American National Standard

MINIMUM PERFORMANCE STANDARD TEMPERATURE INSTRUMENTS

FOREWORD

Changes in the revision are format/editorial only.

1. SCOPE:

This SAE Aerospace Standard (AS) applies to all temperature instruments used in aircraft applications and environments. The word “instrument” as used in this Standard encompasses only the display device and does not include the temperature sensors. Examples of the types of instruments covered are as follows:

1.1 Temperature instruments using a Resistance Temperature Detector for temperature sensing.

1.2 Temperature instruments using a thermocouple for temperature sensing.

1.3 Temperature instruments using an averaging thermocouple harness for temperature sensing.

1.4 Temperature instruments receiving an input from a signal conditioning unit.

1.5 Temperature instruments receiving an input from another temperature instrument.

1.6 Temperature instruments receiving an input from other temperature sensing devices.

1.7 Purpose:

This document establishes the essential minimum performance requirements for electrical type temperature instruments primarily for use on aircraft which may subject the instruments to environmental conditions specified herein.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 RTCA Publications:

Available from RTCA Inc., 1140 Connecticut Avenue, NW, Suite 1020, Washington, DC 20036.

RTCA Document No. DO-138, June 27, 1968

2.2 FAA Publications:

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591.

Federal Aviation Regulations, Vol. III, Part 25
Airworthiness Standards: Transport Category Airplanes

3. GENERAL STANDARDS:

3.1 Classification by Instrument Accuracies:

Class I	Class Ia:	±0.1% of indicated range
	Class Ib:	±0.2% of indicated range
	Class Ic:	±0.5% of indicated range
Class II	Class IIa:	±1% of indicated range
Class III	Class IIIa:	±2% of indicated range
	Class IIIb:	±3% of indicated range
	Class IIIc:	±5% of indicated range

3.2 Method of Indication:

3.2.1 If applicable, 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 temperature.

3.2.2 Sufficient numerals and graduations shall be provided to positively and quickly identify temperature indications. The inscription "°C", "°F", or "°K", as appropriate, shall also appear on the instrument face.

3.2.3 Indications beyond the normal range of the instrument shall not be displayed in a manner interpretable as an on-scale reading or as an off-scale reading in the wrong direction.

3.3 Power Malfunction:

Means (e.g. warning flags, off-scale indication) shall be incorporated in the instrument to indicate the loss of essential power for proper operation of the indicator. This does not apply to the loss of signal used to drive the instrument where no other power is used.

3.4 Markings:

Where terminal posts are used for thermocouple connections, they shall be of different sizes and shall be distinctly identified to indicate plus for the larger terminal, and minus for the smaller terminal. The thermocouple material, and when applicable, the required external resistance of the lead and thermocouple, or the thermocouple circuit shall be plainly marked.

3.5 Signal (Sensor) Characteristics:

Instruments shall be calibrated to indicate temperature in accordance with the signal characteristic specified by the manufacturer of the instrument in his installation instructions.

3.6 Adjustments:

When provided, external adjustment provisions shall have sufficient friction so that they will not change in the environment encountered in service.

3.7 Accessibility of Controls:

Controls which are not normally adjusted in flight shall not be readily accessible to flight personnel when the equipment is installed in accordance with the manufacturer's instructions.

3.8 Effects of Tests:

Unless otherwise stated, the application of the specified tests shall produce no subsequently discernible condition which would be detrimental to the continued performance of the equipment.

3.9 Interchangeability:

Instruments and components which are identified in accordance with the requirements applicable to this standard and are identified with a manufacturer's part and/or model number shall be directly and completely interchangeable with all items identified with that part and/or model number.

3.10 Fire Resistance:

Except for small parts (such as knobs, fasteners, seals, grommets, and small electrical parts) that would not contribute significantly to the propagation of a fire, all materials used must be self-extinguishing when tested in accordance with the requirements of Federal Aviation Regulation 25.1359 (d) and Appendix F thereto, with the exception that materials tested may be configured in accordance with paragraph (b) of Appendix F or may be configured as used.

3.11 Instrument Cover Glass Reflectance:

The total reflectance of the instrument cover glass including the integral lighting wedge, if applicable, shall not exceed 10% of the incident light. This reflectance applies over the visible light spectrum from 450 milli-microns to 600 milli-microns, and over an incident solid angle of 60° perpendicular to the viewing plane.

4. MINIMUM PERFORMANCE STANDARDS UNDER STANDARD CONDITIONS:

4.1 Standard Atmospheric Conditions:

Unless otherwise specified herein, all tests required shall be made at atmospheric conditions specified in paragraph 3.4 of DO-138.

4.2 Attitude:

Unless otherwise specified herein, all tests shall be conducted with the instrument in its normal operating attitude.

4.3 Vibration to Minimize Friction:

Unless otherwise specified herein, all tests for performance may be conducted in accordance with instructions found in paragraph 3.5 of DO-138.

4.4 Power Input Voltage:

4.4.1 Direct Current: Unless otherwise specified, when the equipment is designed for operation from a current power source, all measurements shall be conducted with the power input voltage adjusted to 13.75 volts ± 2% for 10 - 14 volt equipment or 27.5 volts ± 2% for 24 - 28 volt equipment. The power input voltage shall be measured at the power input terminals.

4.4.2 Alternating Current: Unless otherwise specified, when the equipment is designed for operation from an alternating current power source all tests shall be conducted with the power input voltage adjusted to design voltage ±2 percent. In the case of equipment designed for operation from a power source of essentially constant frequency (e.g. 400 Hz), the input frequency shall be adjusted to design frequency ±1 percent. In the case of equipment designed for operation from a power source of variable frequency (e.g. 350 - 1,000 Hz), tests shall be conducted with the input frequency adjusted to within 5% of the high frequency limit, the low frequency limit, and the mid frequency (test at three frequencies).

4.5 Scale Error:

4.5.1 With the appropriate signal applied, the scale error shall be determined at not less than 5 test points, each taken in a different 1/5 of the scale range, and shall not exceed the scale error tolerances of the specific class of instrument involved as shown in 3.1.

4.5.2 In the event that a non-uniform tolerance is required, compliance with 4.5.1 is demonstrated if the error at any calibration point does not exceed the value appropriate for that point.

4.6 Position Error:

4.6.1 If the instrument is potentially subject to position (balance) error, the instrument shall be electrically energized and a reading shall be taken while in each of the following positions:

1. Normal operating attitude.
2. Instrument rotated clockwise around its X (longitudinal) axis, 180 degrees from its normal position.
3. Instrument rotated clockwise around its X (longitudinal) axis, 90 degrees from its normal position.
4. Instrument rotated counter-clockwise around its X (longitudinal) axis, 90 degrees from its normal position.

4.6.2 The maximum change in reading from the normal shall not exceed the tolerance of the specific class of instrument involved.

4.7 Lead Resistance Effect:

For instruments using a resistance temperature detector, where the ground lead is connected at the detector, there shall not be a change in indication at any point on the scale due to changing the balanced lead resistance, more than that allowable for the class of instrument involved, provided the instrument is installed in accordance with the manufacturer's installation instructions.

4.8 Friction Error:

The friction test may be conducted in conjunction with the scale error test. The signal shall be slowly increased up to the test point. The instrument reading shall be noted before and after the instrument is lightly tapped or vibrated. The change in reading must not exceed the tolerance allowed for the particular class of instrument involved. The above procedure shall be repeated for decreasing signal values.

4.9 Magnetic Effect:

The magnetic effect of the instrument shall be determined in terms of the deflection of a free magnet, approximately 1-1/2 inches (3.81 cm) long, in a magnetic field with a horizontal intensity of 0.18 ± 0.01 gauss when the instrument is held in various positions on an east-west line with the nearest part 12 inches (30.48 cm) from the center of the magnet. With the instrument operating, the maximum deflection of the free magnet shall not exceed 5 degrees from an indicating or reference position.

5. MINIMUM PERFORMANCE STANDARDS UNDER ENVIRONMENTAL CONDITIONS:

Unless otherwise specified, the measurement procedures applicable to a determination of the performance of temperature instruments under environmental conditions are set forth in RTCA Document Number DO-138 entitled “Environmental Conditions and Test Proc. for Airborne Electronic/Electrical Equipment and Instruments”, dated 27 June 1968. Performance tests which cannot be made after subjection to test environments may be conducted after exposure to several environmental conditions. The order of tests shall be in accordance with paragraph 3.2, page 5, DO-138.

5.1 Temperature Altitude:

5.1.1 Low Temperature: When subjected to the tests of DO-138, paragraph 4.1, the instrument shall operate electrically and mechanically and the requirements of 4.5 of this standard must be met except that a tolerance of two times that of the class involved shall apply. After subjection to this test, the requirements of 4.5 and 4.8 of this standard shall be met under standard conditions.

5.1.2 High Temperature: When subjected to the tests of DO-138, paragraph 4.2.1, the instrument shall operate electrically and mechanically and there shall be no evidence of materials such as grease, potting, or sealing compounds exuding or dripping from the instrument. When subjected to the tests of DO-138, paragraph 4.2.2, the instrument shall operate electrically and mechanically and the requirements of 4.5 of this standard shall be met except that a tolerance of two times that of the class involved shall apply. After subjection to this test, the requirements of 4.5 and 4.8 of this standard shall be met under standard conditions.

5.1.3 Altitude: When subjected to the tests of DO-138, paragraph 4.3.1, the instrument shall operate electrically and mechanically and the requirements of 4.5 of this standard shall be met. After the tests of paragraph 4.3.2, DO-138, the requirements of 4.5 and 4.8 of this standard shall be met at standard conditions, and after the tests of 4.3.3, DO-138, the requirements of 4.5 and 4.8 of this standard shall be met at standard conditions.

5.2 Power Input:

5.2.1 Electrical Input Variation Test:

5.2.1.1 When the instrument is subjected to the test in DO-138, paragraph 9.1B, it shall operate electrically and mechanically and meet the requirements of 4.5 of this standard except that the indications at the increased voltage shall not differ from the indications at nominal test voltage by more than that allowed by the class of instrument being tested.

5.2.1.2 When the instrument is subjected to the tests in paragraph 9.1D, it shall operate electrically and mechanically and meet the requirements of 4.5 of this standard except that the indications at the reduced voltage shall not differ from the indications at nominal test voltage by more than that allowed by the class of instrument being tested.

5.2.2 Low Voltage Test:

5.2.2.1 When the instrument is subjected to the tests of DO-138, paragraph 9.2.1, it shall operate electrically and then meet the requirements of 4.5 of this standard except that the indications at decreased voltage shall not differ from the indications at nominal test voltage by more than that allowed by the class of instrument being tested.

5.2.2.2 When the instrument is subjected to the tests in DO-138, paragraph 9.2.2A, it shall operate electrically and mechanically and meet the requirements of 4.5 of this standard.

5.2.2.3 When the instrument is subjected to the tests in DO-138, paragraph 9.2.2B, there shall be no evidence of the presence of fire or smoke. Following the tests, the instrument shall meet the requirements of 4.5 of this standard at standard conditions.

5.3 Conducted Voltage Transients:

5.3.1 Intermittent Transients: Following the tests of DO-138, paragraph 10.1.1, the instrument shall meet the requirements of 4.5 of this standard at standard conditions.

5.3.2 Repetitive Transients: When the instrument is subjected to the tests of DO-138, paragraph 10.1.2, it shall meet the requirements of 4.5 of this standard.

5.3.3 Interconnecting Wiring Induced Transients: When the instrument is subjected to the tests of DO-138, paragraph 10.1.3, it shall meet the requirements of 4.5 of this standard.

5.3.4 Equipment Operated from AC Power: When the instrument is subjected to the tests of DO-138, paragraph 10.2, it shall meet the requirements of 4.5 of this standard.

5.4 Conducted Audio Frequency Susceptibility Test:

When the instrument is subjected to the tests of DO-138, Section 11.0, it shall meet the requirements of 4.5 of this standard.

5.5 Audio Frequency Magnetic Field Susceptibility:

When the instrument is subjected to the tests of DO-138, Section 12.0, it shall meet the requirements of 4.5 of this standard.

5.6 Radio Frequency Susceptibility:

When the instrument is subjected to the tests of DO-138, Section 13.0, it shall meet the requirements of 4.5 of this standard.

5.7 Emission of Radio Frequency Energy:

The instrument shall be tested in accordance with the radio frequency paragraphs of DO-138, Appendix A, for the category to which the instrument is designed.

5.8 Vibration:

With the instrument operating, the vibration frequency shall be varied over the appropriate range and amplitude of Table 2, DO-138, at a rate not to exceed 1.0 octave per minute. While the instrument is being vibrated, the pointer oscillation shall not exceed that allowable for the particular class of instrument being vibrated as defined in 3.1. The pointer variation shall not exceed that allowable for the particular class of instrument being vibrated as defined in 3.1.

The change in indications between this test and the initial scale error test without resetting the zero adjustor shall not exceed that allowable for the particular class of instrument being vibrated as defined in 3.1. The friction after vibration shall not exceed that allowable for the particular class of instrument being vibrated.

5.9 Humidity:

The instrument, unless hermetically sealed, shall be subjected to the appropriate tests of DO-138, Section 5.0. It shall meet the requirements of 4.5 except that the change in reading between this scale error test and the original scale error test shall not exceed that allowable for the particular class of instrument involved, and the requirements of 4.8 of this standard at standard conditions shall be met.

5.10 Salt Spray:

An instrument which is to be marked salt spray category “S” shall be tested in accordance with DO-138, Section 19.0. Following this test, the instrument shall meet the requirements of 4.5 and 4.8 of this standard under standard conditions.

5.11 Waterproofness:

An instrument which is to be marked waterproofness category “W” shall be tested in accordance with DO-138, Section 15.0. Following this test, the instrument shall meet the requirements of 4.5 and 4.8 of this standard under standard conditions.

5.12 Hydraulic Fluid:

An instrument which is to be marked hydraulic fluid category “H” shall be tested in accordance with DO-138, Section 16.0. Following this test, the equipment shall meet the requirements of 4.5 and 4.8 of this standard under standard conditions.

5.13 Sand and Dust:

An instrument which is to be marked sand and dust category “D” shall be tested in accordance with DO-138, Section 17.0. Following this test, the instrument shall meet the requirements of 4.5 and 4.8 of this standard under standard conditions.

5.14 Fungus Resistance:

An instrument which is to be marked Fungus Resistance category “F” shall be tested in accordance with DO-138, Section 18.0. Following this test, the instrument shall meet the requirements of 4.5 and 4.8 of this standard under standard conditions.

5.15 Shock:

5.15.1 After the instrument is subjected to the tests of DO-138, paragraph 6.1, it shall meet the requirements of 4.5 except that the change in indications between this test and the original scale error test shall not exceed that allowable for the particular class of instrument involved, and the requirements of 4.8 of this standard at standard conditions shall be met.

5.15.2 Following the tests of DO-138, paragraph 6.2, the instrument must have remained in its mounting and no parts of the instrument or its mounting become detached or free of the shock test equipment. Paragraph 3.8 of this standard does not apply following this test.

5.16 Explosion:

An instrument which is to be marked explosion category “E” shall be tested in accordance with DO-138, Section 14.0. The requirement of 3.8 of this standard does not apply following this test.

6. TEST PROCEDURES:

6.1 Fire Resistance:

With the exception of small parts (such as knobs, fasteners, seals, grommets and small electrical parts) all combustible materials used in the construction of the instrument shall be tested for fire resistance as specified in paragraphs (e) and (g) of Appendix “F” of Part 25 of the Federal Air Regulations.

6.1.1 “Burn Length” is the distance from the original edge to the farthest evidence of damage to the test specimen due to flame impingement, including areas of partial or complete consumption, charring, or embrittlement, but not including areas sooted, stained, warped, or discolored, nor areas where material has shrunk or melted away from the heat source.

PREPARED BY SAE COMMITTEE A-4, AIRCRAFT INSTRUMENTS

APPENDIX

The Appendix has moved to Section 2.