

**PRESSURE ALTIMETER SYSTEM
MINIMUM SAFE PERFORMANCE STANDARD**

FOREWORD

Changes in the revision are format/editorial only.

SECTION I

1. SCOPE:

The instrument system specified shall accept an input of static pressure and in some equipment other inputs that contribute altitude information to provide a visual indication of pressure altitude. If equipped with an automatic correction mechanism, it shall indicate by a positive means when the automatic correction mechanism is not in use. If the static source pressure error compensating mechanism is operational it shall be functional throughout the required operating envelope of the particular aircraft. Each aircraft type has its own static source error data which shall be obtained from the airframe manufacturer's certified data. When a Central Air Data Computer is used in the altimeter system, the CADC shall be certified to its own governing document and the altimeter system (CADC and display) shall comply with the requirements of this document.

NOTE: The instrument system specified herein does not include the aircraft pressure lines and pressure sources.

1.1 Purpose:

The purpose of Section I of this document is to specify the requirements for minimum safe performance of an altimeter system in its normal mode of operation on subsonic aircraft. Compliance with this section is a means of assuring that the altimeter system will satisfactorily perform its intended function when exposed to conditions encountered in routine aeronautical operations (normal operation).

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SAE AS942 Revision A

2. APPLICABLE DOCUMENTS:

Altitude Reference - U.S. Standard Atmosphere, 1962.

Airspeed Reference - NASA TN-D822 Tables.

Both of the above references are available from the Superintendent of Documents, U.S. Government Printing Office.

Environmental Conditions and Test Procedures - RTCA Document No. DO-138, June 27, 1968, by Radio Technical Commission for Aeronautics, 2000 K Street, N.W., Washington, DC 20006.

3. GENERAL REQUIREMENTS:

3.1 Materials:

Materials shall be of a quality which experience and/or tests have demonstrated to be suitable and dependable for use in aircraft instruments.

3.2 Workmanship:

Workmanship shall be consistent with high grade aircraft instrument manufacturing practice.

3.3 Identification:

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

- a. Name of Instrument
- b. Manufacturers Part Number
- c. Manufacturer's Serial Number or date of manufacture and/or modification
- d. Manufacturer's Name and address
- e. Range
- f. Normal operating environment. See code in RTCA DO-138, Appendix B.
- g. Aircraft identification (if applicable)
- h. TSO or other means of certification

3.4 Aircraft Installation:

When instruments have a correction mechanism that is unique to a particular aircraft, means shall be provided to prevent installation in the incorrect aircraft type.

NOTE: Paragraph (3.3 g) may be used as a means of identification.

3.5 Compatibility:

If components are individually acceptable, but require matching for proper operation, they shall be identified in a manner that will assure performance to the requirements of this standard.

SAE AS942 Revision A

3.6 Barometric System:

3.6.1 Barometric Setting System: The barometric setting system shall permit the altimeter to be set to any ambient barometric pressure throughout a minimum range of 28.1 to 31.0 inches of mercury (951.5 to 1050.0 millibars). A safety feature shall be provided which will prevent an incorrect indication of the barometric pressure scale when the setting mechanism exceeds its intended barometric pressure limits.

3.6.2 Interaction: Means shall be incorporated to prevent the barometric setting system adjustment from causing the additional requirement for adjustment of other coupled systems or outputs.

3.7 Multiple Mode Indications:

Where an instrument has more than one mode of operation, means shall be provided to indicate other than normal mode of operation.

NOTE: When an instrument has more than one mode of operation the "normal mode" is the usual operating condition.

3.8 Environmental Conditions:

The instrument shall be capable of its intended function throughout the environmental conditions set forth, and the conditions selected shall be declared as operating limitations.

4. PERFORMANCE:

4.1 Individual Requirements:

4.1.1 Electrical Insulation: The instrument shall withstand voltage applications that are consistent with good engineering practice.

4.1.2 Case Pressure (Pressure Operated Instruments): The instrument case shall withstand a positive external differential pressure of 26 inch Hg.

4.1.3 Case Leakage (Pressure Operated Instruments): The static and total (if applicable) pressure systems shall not exceed the allowable leak, in 1 minute, as specified in Table 2.

4.1.4 Scale Error: The instrument shall meet the tolerance specified in Table 3 which includes the following conditions: decreasing and increasing pressure for the test pressure ranges specified in Table 3, or these pressures plus the static defect correction pressures (if specified) for the applicable aircraft as supplied by the airframe manufacturer.

4.1.5 Balance Error: Balance errors shall not exceed those specified in Table 4 for a change in indication from the normal operating position.

SAE AS942 Revision A

- 4.1.6 Barometric Setting Scale: The barometric setting scale shall not introduce an error in the altimeter system greater than ± 20 ft at any altitude between -1000 and 18,000 feet.
- 4.1.7 Friction: Friction errors shall not exceed those specified for dynamic friction in Table 6 and static friction in Table 7.
- 4.1.8 Minimum Operating Rate: The instrument shall be capable of a slew rate of 20,000 feet/minute.
- 4.1.9 Threshold and Resolution: The instrument shall be capable of discerning a change equivalent to 10 ft of pressure altitude from -1000 to 18,000 ft and 20 ft above 18,000 feet.
- 4.1.10 Power Loss: When electrical power is required for the instrument operation, the instrument shall provide for an indication of loss of power.
- 4.1.11 Servo Performance (Electrical Instruments): The damping ratio specified shall be indicative of adequate response and stable operation of linear servos. Where performance requirements dictate use of nonlinear servos, the damping ratio may vary from that specified, provided comparable response and stability is maintained.
- 4.1.12 Scale Error - High or Low Temperature: A change in ambient test temperature of 25 °C shall not cause the scale error in the altimeter system to exceed the sum of the room (25 °C) temperature tolerance and 1% of the room tolerance per degree C temperature change from the room temperature. The high or low temperature that is to be applied shall be determined by the manufacturer and be consistent with the environmental condition specified in the applicable category of RTCA DO-138.
- 4.2 Qualification Requirements:
 - 4.2.1 Drift and After Effect: The instrument when subjected to 80% of the operating pressure range for 6 hours shall meet the tolerances specified in Table 8 for drift and after effect.
 - 4.2.2 Temperature Extremes: The instrument tolerance, when tested within the specified temperature limits for the environmental condition specified shall not exceed the sum of the room temperature tolerance plus 2% of the room temperature tolerance per degree C of temperature change from the room temperature.
 - 4.2.3 Vibration: The instrument shall be subjected to the applicable vibration characteristics in accordance with the aircraft types and locations as specified in the Standard Vibration Environment of RTC DO-138.
 - 4.2.4 Humidity: The instrument shall withstand relative humidity up to 100% without affecting performance and there shall be no evidence of corrosion following this test.

SAE AS942 Revision A

- 4.2.5 Fogging (Hermetically Sealed Instruments): The instrument, while operating, shall be exposed to a 70 °C ambient temperature for a minimum of 30 minutes. While at this temperature, the external face of the coverages shall be reduced to a temperature of 20 °C or less. No moisture or other material shall be deposited on the internal face of the cover glass as a result of this test.
- 4.2.6 Thermal Shock (Hermetically Sealed Instruments): The instruments shall be subjected to four cycles of exposure to water at 85 °C $\pm$ 5 °C and 4 $\pm$ 3 °C without evidence of moisture penetration or damage to enclosure.
- 4.2.7 Power Variation: The instrument shall function with $\pm$ 15% variation in DC and/or $\pm$ 10% variation in AC voltage, and $\pm$ 5% variation in frequency.
- 4.2.8 Magnetic Effect: The magnetic effect of the instrument shall not cause the indication of an aircraft compass to change by more than 5 degrees when held 12 inches from the center of the magnet.
- 4.2.9 Radio Interference: The instrument shall not be a source of objectionable electrical interference under operating conditions.

SECTION II

5. PURPOSE:

The purpose of Section II of this document is to specify test procedures, for an altimeter system, in order to determine compliance with the minimum safe performance requirements specified in Section I.

NOTE: The test procedures specified herein apply specifically to analog type instruments. Digital instruments or automatic test instrumentation may require other test procedures. Such differing procedures shall be justified prior to use.

SAE AS942 Revision A

6. CROSS REFERENCE INDEX

TABLE 1

Section I Requirement		Section II Test	
4.1.1	Electrical Insulation	8.1	Electrical Insulation
4.1.2	Case Pressure	8.2	Case Pressure
4.1.3	Case Leak (Table 2)	8.3	Case Leak (Table 2)
4.1.4	Scale Error (Table 3)	8.4	Scale Error (Table 3)
4.1.5	Balance Error (Table 4)	8.5	Balance (Table 4)
4.1.6	Barometric Setting Scale (Table 5)	8.6	Bar-Set Scale (Table 5)
4.1.7	Friction (Table 6, 7)	8.7	Dynamic (Table 6)
		8.8	Static (Table 7)
4.1.8	Minimum Operating Rate	8.9	Slew Rate
4.1.9	Threshold	8.10	Threshold
4.1.10	Power Loss	8.11	Power Loss
4.1.11	Servo Performance	8.12	Servo Performance
4.1.12	Scale Error (Low-High Temperature)	8.13	Temperature Test
4.2.1	Drift and After Effect (Table 8)	9.1	Drift and After Effect (Table 8)
4.2.2	Temperature Extreme	9.2	Low Temperature
		9.3	High Temperature
		9.4	Extreme Temperature Exposure
4.2.3	Vibration	9.5	Vibration
4.2.4	Humidity	9.6	Humidity
4.2.5	Fogging	9.7	Fogging
4.2.6	Thermal Shock	9.8	Thermal Shock
4.2.7	Power Variation	9.9	Power Variation
4.2.8	Magnetic Effect	9.10	Magnetic Effect
4.2.9	Radio Interference	9.11	Radio Interference

7. TEST CONDITIONS:

7.1 Atmospheric Conditions:

Unless otherwise specified herein, all tests required herein shall be made at an atmospheric pressure of approximately 29.92 inches of mercury absolute, an ambient temperature of approximately 25 °C and a relative humidity of not greater than 85%. When tests are conducted with atmospheric pressure or temperature substantially different from these values, allowance shall be made for the variation from the specified conditions.