

Altimeter, Pressure, Compensated
(Turbine Powered Subsonic Aircraft)

1. PURPOSE:

This Aerospace Standard establishes the essential minimum safe performance standards for Pressure Actuated Compensated Altimeters, primarily for use with turbine powered subsonic transport aircraft, the operation of which may subject the instruments to the environmental conditions specified in paragraph 3.3.

2. SCOPE:

This Aerospace Standard covers two types of compensated altimeters which indicate, by visual means, the pressure altitude compensated for the static pressure system errors of the aircraft.

Type I - Range: -1,000 to 30,000 feet. Barometric pressure--scale range: at least 28.1-30.99 in. Hg (952-1049 millibars). May include markers working in conjunction with the Barometric Pressure Scale to indicate pressure altitude.

Type II - Range: -1,000 to 60,000 feet. Barometric pressure--scale range: at least 28.1- 30.99 in. Hg (952-1049 millibars). May include markers working in conjunction with the Barometric Pressure Scale to indicate pressure.

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.

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3.2 Identification:

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

- 3.2.1
- a) Name of instrument.
 - b) SAE AS 415
 - c) Manufacturer's part number.
 - d) Manufacturer's serial number.
 - e) Manufacturer's name and/or trademark.
 - f) Range.
 - g) Rating (electrical if applicable).
 - h) Explosion category (if applicable).
 - i) Aircraft type.

- 3.2.2 Compatibility of Components: If the scale error compensated altimeter comprises separate components and they are individually acceptable, but require matching for scale error correction, they shall be properly identified.

3.3 Environmental Conditions:

The following conditions have been established as design requirements. Tests shall be conducted as specified in Sections 5, 6 and 7.

- 3.3.1 Temperature: When installed in accordance with the instrument manufacturer's instructions, the instrument shall function over the range of ambient temperatures listed in Column "A" below and shall not be affected adversely by exposure to the temperatures shown in Column "B" except as limited by paragraph 3.3.2:

<u>Instrument Location</u>	<u>A</u>	<u>B</u>
Pressurized Areas	-30 to 70C	-65 to 70C
Non-pressurized or External Areas	-55 to 70C	-65 to 70C

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- 3.3.2 Altitude: When installed in accordance with the instrument manufacturer's instructions, the instruments shall function from sea level up to the altitudes and temperatures listed below. Altitude pressures are per NACA Report 1235.

Pressure sensing instruments which are connected to the static system shall withstand an external case pressure of 50 in. Hg abs when installed properly and vented to an atmospheric pressure of approximately 29.92 in. Hg abs. All other instruments shall not be adversely affected following exposure to extremes in ambient pressure of 50 and 3 in. Hb abs.

<u>Instrument Location</u>	<u>Altitude (Ft)</u>	<u>Temperature (C)</u>
Pressurized Areas	15,000	50
Non-pressurized or External Areas	60,000	40

- 3.3.3 Vibration: When installed in accordance with the instrument manufacturer's instructions, the instruments shall function and shall not be adversely affected when subjected to vibrations having the following characteristics:

<u>Instrument Location in Airframe</u>	<u>Cycles Per Sec.</u>	<u>Max. Double Amp. (In.)</u>	<u>Maximum Acceleration (g)</u>
Flight Deck Area	5 - 30	0.020	---
	30 - 1000	---	0.25
Vibration Isolated Rack	5 - 1000	0.030	1.00
Wings, Empennage and Wheel Wells	5 - 1000	0.036	10
Fuselage			
Forward of Spar Area	5 - 500	0.036	2
Center of Spar Area	5 - 1000	0.036	4
Aft of Spar Area	5 - 500	0.036	7
	500 - 1000	---	5

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- 3.3.4 Humidity: The unit shall function and shall not be adversely affected when exposed to any relative humidity within the range of 0 to 95% at a temperature of approximately 70 C.
- 3.3.5 Magnetic Effect: The magnetic effect of the instrument shall not adversely affect the operation of other instruments installed in the same aircraft.
- 3.3.6 Radio Interference: The instruments shall not be the source of objectionable interference under operating conditions at any frequencies used on aircraft, either by radiation or feedback, in electronic equipment installed in the same aircraft as the instrument.
- 3.3.7 Explosion Category: The instrument component, when intended for installation either in uninhabited areas of non-pressurized aircraft or in non-pressurized areas of pressurized aircraft, shall not cause an explosion when operated in an explosive atmosphere. The component shall meet the requirements applicable to the explosion category below. Specifically, any instrument component which can be an ignition source and is intended for installation in an area in which combustible fluid or vapor may result from abnormal conditions, e.g., fuel line leakage, shall meet the requirements of Category I. If the intended location is an area where combustible fluid or vapor can occur during normal operation, e.g., fuel tank, the instrument component shall meet the requirements of Category II, listed below:

<u>Category</u>	<u>Definition</u>	<u>Requirement</u>
I	Explosion proofed: case not designed to preclude flame or explosion propagation.	Paragraph 7.4.1
II	Explosion proofed: case designed to preclude flame or explosion propagation.	Paragraph 7.4.2
III	Hermetically Sealed	Paragraph 6.4.2
IV	Instrument not capable of causing an explosion.	Shall not be capable of producing a capacitive or inductive spark of more than 0.2 millijoules of energy or a contract spark of more than 4.0 millijoules of energy.

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- 3.3.8 Decompression: When installed in accordance with the instrument manufacturer's instruction, the instrument shall function and not be adversely affected following exposure to a pressure decrease of from 22 to 2 in. Hg abs in 2 seconds, while the static port is connected to a pressure of 2 in. Hg abs.

4. DETAIL REQUIREMENTS:

4.1 Display Markings:

Altitude shall be indicated in feet by means of one or more pointers, dials, tapes, drums, or any combination thereof. 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 altitude.

- 4.1.1 Graduations: Markings shall be provided at intervals not exceeding 20 feet of altitude, with major increment markings at 100-foot intervals.
- 4.1.2 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.
- 4.1.3 Zero Setting System: A zero setting system shall be provided which will permit the altimeter to be set throughout the range of at least 28.1 to 31.0 inches (952 to 1049 millibars). A safety feature shall be provided which will prevent incorrect reading of the pressure scale when the zero setting mechanism exceeds its barometric pressure limits.
- 4.1.4 Finish: Unless otherwise specified by the user, matte white material shall be applied to all graduations, numerals and indication means. Non-functional surfaces and markings shall be durable dull black.
- 4.1.5 Instrument Title: The instrument title, when used, shall be of a size no larger than the numerals. The title may be of the same finish as the numerals. The unit of measure shall appear on the dial in lettering noticeably smaller than either the numerals or title.
- 4.1.6 Visibility: The indicating means and all markings shall be visible from any point within the frustum of a cone the side of which makes an angle of at least 30° with the 0 perpendicular to the dial, and the small diameter of which is the aperture of the instrument case. The distance between the dial and the cover glass shall be a practical minimum.

4.2 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 $\pm 5\%$ variation in frequency.

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4.3 Power Malfunction Indication:

Means shall be incorporated in the instrument to indicate when adequate power (voltage and/or current) is not being made available to all phases required for the proper operation of the instrument. The indicating means shall indicate a failure or a malfunction in a positive manner.

4.4 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.

4.5 Synchro Requirements:

The synchro requirements when applicable should be in accordance with conditions specified in ARP 461B.

4.6 Performance Requirements:

To permit the altimeter to provide accurate altitude data, the compensating system shall operate within a basic envelope derived from the following characteristics of the aircraft: stalling calibrated airspeed, maximum calibrated airspeed, maximum allowable Mach number, maximum total impact pressure, and altitude limitations. Since each aircraft type has its own static system pressure error, data showing the static pressure error, i.e., the effect of varying parameters of Mach number function and/or angle of attack on altitude, shall be supplied to the instrument manufacturer by the airframe manufacturers. The altimeter accuracy is predicated upon scale error accuracy and upon static system defect correction.

5. TEST CONDITIONS:

5.1 Atmospheric Conditions:

Unless otherwise specified herein, all tests required by this Aerospace Standard shall be made at an atmospheric pressure of approximately 29.92 in. Hg, an ambient temperature of approximately 25 C and a relative humidity of not more than 85%. When tests are conducted with the atmospheric pressure or temperature substantially different from these values, allowances shall be made for the variation from the specified conditions.

5.2 Vibration to Minimize Friction:

Unless otherwise specified herein, all tests for performance may be conducted with the instrument subject to maximum vibration of 0.001 inch double amplitude at a frequency of 60 cps.