



AEROSPACE STANDARD

AS8009™**REV. C**

Issued 1979-05
Revised 2016-05
Reaffirmed 2022-08

Superseding AS8009B

(R) Pressure Altimeter Systems

RATIONALE

This standard was revised to: clarify some design requirements; update the environmental test requirements to include those of RTCA DO-160G; clarify some performance test requirements and to more closely align the equivalent metric test values with metric instrument markings. Special requirements for RVSM applications were not included because general RVSM requirements cannot be independently detailed at the component level. The intent is for this standard to replace AS392.

AS8009C has been reaffirmed to comply with the SAE Five-Year Review policy.

TABLE OF CONTENTS

1.	SCOPE.....	4
2.	REFERENCES.....	4
2.1	SAE Publications.....	4
2.2	Other Documents	4
2.3	Glossary of Terms.....	5
3.	GENERAL REQUIREMENTS	6
3.1	Compatibility.....	6
3.2	Accessibility of Controls	6
3.3	Interchangeability	6
3.4	Altitude Range.....	6
3.5	Barometric Setting System	6
3.6	Multiple Mode Indications.....	6
3.7	Visibility	6
3.8	Instrument Cover Glass Reflectance	7
3.9	Identification	7
3.10	Cold Temperature Corrections.....	7
3.11	Graduations.....	7
3.12	Display Markings.....	7
3.13	Maximum Altitude.....	7
3.14	Case Pressure	7
3.15	Minimum Operating Rate	7
3.16	Nameplate	8
3.17	Flammability	8
3.18	Altimeters with Electronic Displays	8
3.19	Drift and After Effect.....	8
3.20	Fogging (Hermetically Sealed Instruments Only)	8

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2022 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

Full document details: SAE AS8009C

For more information on this standard, visit
<https://www.sae.org/standards/content/AS8009C/>

Documents

Document Sharing Hub

3.21	Monitoring Functions.....	8
3.22	Vibrator.....	9
3.23	Scale and Hysteresis Error	9
4.	TEST CONDITIONS	9
4.1	Atmospheric Conditions	9
4.2	Power Conditions	9
4.3	Attitude	9
4.4	Standard Pressures	9
4.5	Pressure Reference Standard	9
4.6	Barometric Setting Scale.....	10
5.	INDIVIDUAL PERFORMANCE TESTS	10
5.1	Leakage	10
5.2	Scale and Hysteresis Error	10
5.3	Balance Error	11
5.4	Barometric Setting Scale.....	12
5.5	Friction.....	12
5.6	Static Friction	12
5.7	Minimum Sensitivity Threshold	13
5.8	Electrical Insulation	13
5.9	Fogging (Hermetically Sealed Instruments Only)	13
5.10	Monitoring Functions (for Altimeters with External Power or Excitation Inputs)	13
6.	QUALIFICATION TESTS.....	13
6.1	Temperature and Altitude.....	14
6.2	Temperature Variation	14
6.3	Extreme Temperature Exposure	14
6.4	Humidity	14
6.5	Operational Shocks and Crash Safety.....	14
6.6	Vibration	14
6.7	Explosion Proofness	15
6.8	Waterproofness.....	15
6.9	Fluids Susceptibility.....	15
6.10	Sand and Dust	15
6.11	Fungus Resistance	15
6.12	Salt Spray.....	15
6.13	Magnetic Effect	15
6.14	Power Input	15
6.15	Voltage Spike	16
6.16	Audio Frequency Conducted Susceptibility – Power Inputs	16
6.17	Induced Signal Susceptibility	16
6.18	Radio Frequency Susceptibility (Radiated and Conducted)	16
6.19	Emission of Radio Frequency Energy.....	16
6.20	Lightning Induced Transient Susceptibility.....	16
6.21	Lightning Direct Effects	16
6.22	Icing.....	16
6.23	Electrostatic Discharge	16
6.24	Flammability	17
6.25	Drift and After Effect.....	17
6.26	Minimum Operating (Slew) Rate.....	17
6.27	Thermal Shock, Hermetically Sealed Units Only	18
6.28	Case Pressure	18

7.	NOTES.....	18
7.1	Revision Indicator.....	18
TABLE 1A	LEAKAGE STATIC PRESSURE.....	18
TABLE 1B	BLEAKAGE STATIC PRESSURE, SI UNITS.....	18
TABLE 2A	SCALE AND HYSTERESIS AMBIENT ROOM TEMPERATURE	19
TABLE 2B	BSCALE AND HYSTERESIS AMBIENT ROOM TEMPERATURE, SI UNITS	19
TABLE 3A	DIFFERENT INSTRUMENT ORIENTATION.....	20
TABLE 3B	DIFFERENT INSTRUMENT ORIENTATION, SI UNITS	20
TABLE 4A	BAROMETRIC SETTING MECHANISM	20
TABLE 4B	BAROMETRIC SETTING MECHANISM, SI UNITS	20
TABLE 5A	STOP AND JUMP FRICTION ERROR.....	21
TABLE 5B	STOP AND JUMP FRICTION ERROR, SI UNITS	21
TABLE 6A	STATIC FRICTION	21
TABLE 6B	STATIC FRICTION, SI UNITS	22
TABLE 7A	MINIMUM SENSITIVITY THRESHOLD VALUES	22
TABLE 7B	MINIMUM SENSITIVITY THRESHOLD VALUES, SI UNITS.....	22
TABLE 8A	DRIFT AND AFTER EFFECT	22
TABLE 8B	DRIFT AND AFTER EFFECT, SI UNITS.....	23
TABLE 9	COLD TEMPERATURE CORRECTION VALUES	23
TABLE 10	AS8034B REQUIREMENTS FOR ALTIMETERS WITH ELECTRONIC DISPLAYS	23
FIGURE 1	GRAPHICAL REPRESENTATION OF THE DRIFT AND AFTER EFFECT TEST CYCLE	24

1. SCOPE

This SAE Aerospace Standard (AS) specifies minimum performance requirements for pressure altimeter systems other than air data computers.

This document covers altimeter systems that measure and display altitude as a function of atmospheric pressure. The pressure transducer may be contained within the instrument display case or located remotely. Requirements for air data computers are specified in AS8002. Some requirements for nontransducing servoed altitude indicators are included in AS791.

This document does not address RVSM requirements because general RVSM requirements cannot be independently detailed at the component level.

The instrument system specified herein does not include aircraft pressure lines. Unless otherwise specified, whenever the term "instrument" is used, it is to be understood to be the complete system of pressure transducer components, any auxiliary equipment, and display components.

The test procedures specified herein apply specifically to mechanical type instruments. Solid state instruments or automatic test instrumentation may require other test procedures. Such differing procedures shall be justified prior to use.

2. REFERENCES

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 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AS791	Remote Servoed Air Data Instruments for Subsonic Aircraft
AIR1075	Barometry for Altimeter Calibration
AS8002	Air Data Computer - Minimum Performance Standard
AS8034	Minimum Performance Standard for Airborne Multipurpose Electronic Displays

2.2 Other Documents

2.2.1 Available from: Superintendent of Documents, Government Printing Office, Washington, DC 20402, Web address: www.gpo.gov or from various independent document service companies.

U.S. Standard Atmosphere, 1976 (Altitude Reference)

Tables of Airspeed, Altitude, and Mach Number Based on Latest International Values for Atmospheric Properties and Physical Constants, Livingston and Gracey, NASA Technical Note D-822, August 1961

2.2.2 RTCA Publications

Available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

Environmental Conditions and Test Procedures for Airborne Equipment, RTCA Document DO-160G, December 2010

2.2.3 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

Federal Aviation Regulations, Part 25 Airworthiness Standards; Transport Category Airplanes

2.2.4 NASA Publications

Available from NASA, Documentation, Marshall Space Flight Center, AL 35812, www.nas.nasa.gov.

NACA TR-1135, Equations, Tables, and Charts for Compressible Flow

2.2.5 ICAO Publications

Available from International Civil Aviation Organization, 999 University Street, Montreal, Quebec H3C 5H7, Canada, Tel: +1 514-954-8219, <http://www.icao.int/>

Manual of the ICAO Standard Atmosphere - ICAO Document 7488, 1993

2.3 Glossary of Terms

2.3.1 SHALL

The word “shall” is used in this document to express an essential requirement where compliance is mandatory.

2.3.2 SHOULD

The word “should” is used in this document to express a recommendation. Deviation from the specified recommendation shall require justification.

2.3.3 MUST

The word “must” is used in this document to express an essential (mandatory) requirement that is required by a specific regulation.

2.3.4 MAY

The word “may” is used to denote a permissible or possible action. It does not express a requirement of this specification.

2.3.5 CALIBRATED STANDARD

A calibrated standard is a system, instrument, artifact, device, or material that is used as a defined basis for making quantitative measurements. Calibrated standards have lower uncertainty and better resolution than general purpose items.

2.3.6 DRIFT

Drift is defined as the change in altimeter reading with time when the instrument is subject to constant pressure.

2.3.7 AFTER EFFECT

After Effect is defined as the hysteresis at sea-level pressure, when the instrument has completed a pressure cycle.

2.3.8 PRESSURE ALTITUDE

Pressure altitude is the height above sea level (standard datum plane) on a standard day when the barometric pressure is 29.92 in Hg (1013.25 mb).

2.3.9 RVSM

Reduced Vertical Separation Minima or Minimum (RVSM) is defined as the reduction of the minimum vertical separation between aircraft provided by air traffic control from 2000 to 1000 feet at flight levels from 29000 feet up to and including 41000 feet (RVSM airspace). RVSM airspace is special qualification airspace where the operator and the aircraft used by the operator must be approved by the regulating agency.

3. GENERAL REQUIREMENTS

3.1 Compatibility

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

3.2 Accessibility of Controls

Controls that are not normally adjustable in flight shall not be readily accessible to flight personnel when the instrument is installed in accordance with the manufacturer's instructions.

3.3 Interchangeability

Instruments that are identified with the same manufacturer's part or model number shall be completely interchangeable.

3.4 Altitude Range

The minimum calibrated altitude at a 29.92 in Hg (1013.25 mb) barometric setting shall be -1000 feet (-300 m). The maximum shall be as specified by the manufacturer and marked on the nameplate and dial.

3.5 Barometric Setting System

The barometric setting system shall permit the altimeter to be set to any ambient barometric pressure throughout a minimum range of 27.50 to 31.50 in Hg (931.3 to 1066.7 mb). A safety feature shall be provided that will prevent either incorrect indication or damage to the mechanism should attempts be made to operate the barometric setting adjustment beyond the design range specified for the instrument. The barometric setting number shall increase with a clockwise motion of the knob.

3.6 Multiple Mode Indications

An instrument intended for operation in more than one mode shall meet the requirements of this document in each mode. The "normal" mode shall be as specified by the manufacturer. Means shall be provided to indicate when in other than the "normal" mode. If the instrument is provided with an automatic static source correction function, positive indication shall be given when it is not in use.

3.7 Visibility

3.7.1 Mechanical Display Altimeters

Pointers and dial markings shall be visible from any point within the frustum of a cone; the side of which makes an angle of 45 degrees with the 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.

3.7.2 Electronic Display Altimeters

Electronic displays must meet the minimum performance requirements in Section 4 of AS8034B.

3.8 Instrument Cover Glass Reflectance

3.8.1 Mechanical Display Altimeters

The total reflectance of the instrument cover glass including the integral lighting wedge, if applicable, shall not exceed 3% of the incident light. This reflectance applies over the visible light spectrum from 450 to 600 nm (4500 to 6000 Å) and over an incident solid angle of 30 degrees perpendicular to the viewing plane.

3.8.2 Electronic Display Altimeters

Electronic displays must meet the minimum performance requirements in Section 4 of AS8034B.

3.9 Identification

When an instrument employs a correction mechanism that is unique to a particular aircraft, a unique part number or model number shall be clearly and permanently marked on the instrument.

3.10 Cold Temperature Corrections

Instruments covered by this standard are not required to incorporate automatic cold temperature corrections. The correction values shown in Table 9 are those that existed at the time of publication and are shown only for reference. Any instrument covered by this standard that does employ automatic cold temperature corrections shall provide a clear indication to the pilot when cold temperature corrections are being automatically applied or when the instrument cannot compute the correction.

3.11 Graduations

Markings on displays that can provide indications in between intervals shall provide intervals not exceeding 20 feet of altitude with major increment markings at 100 foot intervals. Metric scale intervals on the same type of display shall not exceed 10 m with major increment markings at 100 m intervals.

Displays that do not provide indications in between intervals shall provide intervals not exceeding 10 feet (3 m) of altitude and shall have a non-ambiguous means of displaying altitudes below 0 feet (0 m).

3.12 Display Markings

Altitude shall be indicated in feet or meters as required, by means of one or more pointers, dials, tapes, drums, digital readouts, 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. In the case of counters, drums, or tapes, the higher number shall be above the lower. The word ALTITUDE or ALT shall be marked on the dial in capital letters and may be in the same finish as the numerals. The altitude range shall be shown on the dial. The maker's name or trademark shall not appear unless in black-on-black.

3.13 Maximum Altitude

Tests at altitudes beyond the range marked on the nameplate and dial are not required.

3.14 Case Pressure

The instrument case shall withstand a positive external differential pressure of 26 in Hg (660 mm Hg or 88 kPa).

3.15 Minimum Operating Rate

The instrument shall be capable of a minimum operating rate of 20000 ft/min (6100 m/min).

3.16 Nameplate

The instrument shall carry a nameplate that shall be permanently marked with the following:

- a. Name of instrument
- b. Altitude range
- c. Barometric range
- d. Manufacturer
- e. Part number or model number
- f. Serial number

3.17 Flammability

The instrument shall comply with the fire, flammability requirements of RTCA DO-160G, Section 26, Category C.

3.18 Altimeters with Electronic Displays

Altimeters having electronic displays must also meet the requirements of the AS8034B sections listed in Table 10.

3.19 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 8A or 8B for drift and after effect.

3.20 Fogging (Hermetically Sealed Instruments Only)

The instrument cover glass shall exhibit no fogging due to vapors or other materials when the instrument is subjected to extreme changes in temperature.

3.21 Monitoring Functions

A means shall be incorporated in the instrument to indicate when it is not receiving an adequate level of power (voltage and/or current). An indicator or display of the repeating or remote indicating type shall be provided with means to monitor and indicate the presence of the other failures such as:

- a. Primary power loss to the indicator or display
- b. Loss of synchro excitation
- c. Servoamplifier failure or power loss
- d. Electrical failure in the servomotor drive phases
- e. Loss of a "valid" signal provided by a remote sensor or computer

All failure indicating means shall display the failure or malfunction in a positive and conspicuous manner.