Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE STANDARD

AS 942

Issued 6-15-71
Revised

PRESSURE ALTIMETER SYSTEM MINIMUM SAFE PERFORMANCE STANDARD

SECTION I

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).

2. 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.

3. 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, D.C. 20006.

4. GENERAL REQUIREMENTS

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

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

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

a) Name of Instrument
b) Manufacturer's 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

4.4 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(4.3 g) may be used as a means of identification.

4.5 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.

4.6 Barometric System:

4.6.1 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 in. 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.

4.6.2 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.

4.7 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.

4.8 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.

5. PERFORMANCE

5.1 Individual Requirements:

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

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

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

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

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

5.1.6 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.

5.1.7 Friction: Friction errors shall not exceed those specified for dynamic friction in Table V and static friction in Table VI.

5.1.8 Minimum Operating Rate: The instrument shall be capable of a slew rate of 20,000 feet/minute.

5.1.9 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.

5.1.10 Power Loss: When electrical power is required for the instrument operation, the instrument shall provide for an indication of loss of power.

5.1.11 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.

5.1.12 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.

5.2 Qualification Requirements:

5.2.1 Drift and After Effect: The instrument when subjected to 80% of the operating pressure range for 6 hr shall meet the tolerances specified in Table VII for drift and after effect.

5.2.2 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.

5.2.3 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 RTCA DO-138.

5.2.4 Humidity: The instrument shall withstand relative humidity up to 100% without affecting performance and there shall be no evidence of corrosion following this test.

5.2.5 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 cover glass 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.

5.2.6 Thermal Shock (Hermetically Sealed Instruments): The instruments shall be subjected to four cycles of exposure to water at 85 C ±5 C and 4 ±3 C without evidence of moisture penetration or damage to enclosure.

5.2.7 Power Variation: The instrument shall function with ±15 % variation in D.C. and/or ±10 % variation in A.C. voltage, and ±5 % variation in frequency.

5.2.8 Magnetic Effect: The magnetic effect of the instrument shall not cause the indication of an aircraft compass to change by more than five degrees when held 12 inches from the center of the magnet.

5.2.9 Radio Interference: The instrument shall not be a source of objectionable electrical interference under operating conditions.

SECTION II

6. 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.

7. CROSS REFERENCE INDEX

SECTION I		SECTION II	
REQUIREMENT		TEST	
5.1.1	Electrical Insulation	9.1	Electrical Insulation
5.1.2	Case Pressure	9.2	Case Pressure
5.1.3	Case Leak (Table I)	9.3	Case Leak (Table I)
5.1.4	Scale Error (Table II)	9.4	Scale Error (Table II)
5.1.5	Balance Error (Table III)	9.5	Balance (Table III)
5.1.6	Barometric Setting Scale (Table IV)	9.6	Baro-Set Scale (Table IV)
5.1.7	Friction (Table V, VI)	9.7	Dynamic (Table V)
		9.8	Static (Table VI)
5.1.8	Minimum Operating Rate	9.9	Slew Rate
5.1.9	Threshold	9.10	Threshold
5.1.10	Power Loss	9.11	Power Loss
5.1.11	Servo Performance	9.12	Servo Performance
5.1.12	Scale Error (Low-High Temperature)	9.13	Temperature Test
5.2.1	Drift & After Effect (Table VII)	10.1	Drift & After Effect (Table VII)
5.2.2	Temperature Extreme	10.2	Low Temperature
		10.3	High Temperature
		10.4	Extreme Temperature Exposure
5.2.3	Vibration	10.5	Vibration
5.2.4	Humidity	10.6	Humidity
5.2.5	Fogging	10.7	Fogging
5.2.6	Thermal Shock	10.8	Thermal Shock
5.2.7	Power Variation	10.9	Power Variation
5.2.8	Magnetic Effect	10.10	Magnetic Effect
5.2.9	Radio Interference	10.11	Radio Interference

8. TEST CONDITIONS

8.1 Atmospheric Conditions: Unless otherwise specified herein, all tests required herein shall be made at an atmospheric pressure of approximately 29.92 in. 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.

8.2 Power Conditions: Unless otherwise specified herein, all tests shall be conducted at the power rating recommended by the manufacturer.

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

8.4 Standard Pressures:

8.4.1 Altitude pressures values shall be in accordance with U. S. Standard Atmosphere, 1962 (reference ICAO Standard Atmosphere Doc. 7488/2).

8.4.2 Differential pressure values shall be in accordance with NASA Technical Note D-822, "Tables of Airspeed, Altitude and Mach Number based on latest International Values for Atmospheric Properties".

8.4.3 Pressure Reference Standard: The reference standard for atmospheric pressure shall be a mercury barometer or equivalent. The reference barometer shall be maintained in such a manner as to assure that the reference barometer, utilizing its calibration data, will have an accuracy of ±.005 in. of mercury when checked against the plant standard. The user shall maintain records to show that above conditions have been complied with at intervals of three months or less, dependent on usage.

The plant standard shall be a mercury barometer whose calibration is traceable, to the Reference Prime Standard as maintained by the National Bureau of Standards. Using calibration data, it shall have an accuracy of ±.003 in. of mercury. The user shall maintain records to show that above conditions for the plant standard have been complied with, at intervals of one year.

If used, a differential pressure manometer or equivalent, shall exhibit the same accuracy characteristics as those specified for the atmospheric pressure standard and shall be maintained accordingly.

8.5 Vibration During Performance Tests:

8.5.1 Instruments intended for installation in reciprocating powered aircraft and turbine powered helicopters, shall have external vibration applied while accomplishing the performance tests.

8.5.2 Instruments intended for installation in turbine powered aircraft, except helicopters, shall not have external vibration applied while accomplishing the performance tests unless otherwise specified herein. Where integral vibrators are provided for, they shall be activated throughout the performance tests unless otherwise specified.

8.6 Barometric Setting Scale: When adjusting the barometric pressure scale to 29.92 in. of mercury (1013.2 millibars) prior to starting a performance test, the 29.92 (1013.2) setting shall always be approached from the low value end of the baro-scale.

9. INDIVIDUAL TESTS

All instruments shall be tested in accordance with the following recommended test procedures to show specific compliance with this standard and any additional test recommended by the manufacturer.

9.1 Electrical Insulation: Each instrument shall be tested by the method of inspection listed herein:

9.1.1 Insulation Resistance: The insulation resistance measured at 200 volts DC for 5 seconds between all ungrounded electrical connector terminals connected together and the metallic case shall not be less than 20 megohms. Insulation resistance measurements shall not be made to circuits where the potential will appear across elements such as windings, resistors, capacitors, semiconductors, etc., since this measurement is intended only to determine adequacy of insulation.

9.1.2 Overpotential: The instrument shall not be damaged by the application of a test potential between isolated electrical circuits and between isolated electrical circuits and the metallic case. The test potential shall be a sinusoidal voltage of a commercial frequency with an R.M.S. value of five times the maximum circuit voltage not to exceed 500 volts, or per paragraphs 9.1.2.1 or 9.1.2.2, whichever applies. The potential shall start from zero and be increased at a uniform rate not to exceed 100 volts per second to its test value. It shall be maintained at this value for 5 seconds, and then reduced at a uniform rate not to exceed 100 volts per second to zero. Since these tests are intended to insure proper electrical isolation of the circuit components in question, these tests shall not be applied to circuits where the potential will appear across elements such as windings, resistors, capacitors, semiconductors, etc.

9.1.2.1 Hermetically sealed instruments shall be tested at five times the maximum circuit voltage up to a maximum of 200 volts R.M.S.

9.1.2.2 Circuits that contain solid state units are not to be subjected to overpotential tests.

9.2 Case Pressure: The instrument shall be placed in a pressure chamber with the pressure port(s) connected to outside ambient pressure during this test. The chamber pressure shall be increased to 26 in. of mercury differential (gage) and maintained at approximately 25 C for a period of one hour. At the conclusion of the test period, the instrument shall be examined and any evidence of deformation, damage or unsatisfactory operation shall be cause for rejection.

9.3 Case Leak:

9.3.1 Static Pressure: The static pressure connection and the pitot or total pressure connection (if applicable) shall be connected to the master test equipment and to a source of vacuum. The total volume including the instrument under test shall be 100 ±10 cu inches. An absolute pressure shall be applied to the pressure connections in accordance with Table I. After the instrument indication has stabilized the source shall then be sealed off for a period of one minute during which time the readings of the master test equipment shall not exceed the tolerance specified in Table I.

NOTE: Thermal equilibrium shall be maintained while performing this test.

9.3.2 Total Pressure (If Applicable): The pitot pressure connection shall be connected to the master test equipment and to a source of pressure. The total volume including the instrument under test shall be 100 ±10 cu inch. A pressure of 300 knots (approximately 4.5 in. of mercury) shall be applied to the total pressure connection. After the instrument indication has stabilized the source shall be then sealed off for a period of one minute during which time the master test equipment shall not change by more than the tolerance specified in Table I.

9.3.3 Hermetically Sealed Components (If Applicable): Hermetically sealed components shall be tested for leaks by a mass spectrometer leak detector of the helium type or equivalent. The leak rate shall not exceed 0.0434 micron cu ft per hr per cu in. of filling gas, at a pressure differential of one atmosphere.

NOTE: A micron cubic foot/hour leak rate is defined as that gas leakage which would change the pressure of a one cubic foot volume by the amount of one micron (one millionth of a meter of mercury) in one hour. At a pressure differential of one atmosphere at 25 C.

9.4 Scale Error:

9.4.1 Scale Error at Room Temperature Operation (25 C): For Altimeters Without Automatic Static Pressure Error Correction Mechanism: For a period of not less than 6 hours prior to this test, the instrument shall not have been subjected to other than ambient pressure and no adjustments made. The barometric pressure scale shall be set at 29.92 in. of mercury. The instrument shall be subjected successively to decreasing and increasing pressures specified in Table II (within the maximum pressure altitude range).

9.4.1 Continued:

Change in pressure shall be made at a rate not in excess of 20,000 ft per min until within approximately 500 ft of the test point, then the test point shall be approached at a rate compatible with the test equipment, being careful not to overshoot the test point. The scale error in feet of altitude at any test pressure within the altitude range of the instrument shall not exceed the tolerance specified in Table II. The movement of the indicating means shall be free from erratic motion when the pressure is changed uniformly.

9.4.2 Scale Error at Room Temperature Operation (25 C): For Altimeters with Automatic Static Pressure Error Correction Mechanism: For a period of not less than 6 hours prior to this test the instrument shall not have been subjected to other than ambient pressure. The barometric pressure scale shall be set at 29.92 in. of mercury. The instrument shall be subjected successively to decreasing and increasing pressures specified in Table II or these pressures plus the equivalent of the static pressure error (within the maximum pressure altitude range) while the static pressure error correction functions are varied over the ranges specified for the applicable aircraft. Change in pressures shall be made at a rate not in excess of 20,000 ft per min until within approximately 500 ft of the test point, then the test point shall be approached at a rate compatible with the test equipment. The test reading (altimeter indication) represents the algebraic sum of the applied test pressure and static pressure error. The scale error in feet of altitude at any test pressure, within the pressure altitude range of the instrument, shall not exceed the tolerance specified in Table II, with an additional tolerance for static pressure source error. The additional tolerance for static pressure source in feet of altitude shall be a value equal to the slope of the actual aircraft's static pressure source error curve at the test point multiplied by 0.007. The movement of the indicating means shall be free from erratic motion when the pressure is changed uniformly.

9.5 Balance Error: The instrument shall be subjected to the test pressures (within the maximum pressures altitude range) specified in Table III and readings taken while the instrument is in each of the following attitudes.

(1) Normal operating position
(2) Instrument rotated clockwise around its X (longitudinal) axis, 90° from its normal position
(3) Instrument rotated clockwise around its X (longitudinal) axis, 180° from its normal position
(4) Instrument rotated counterclockwise around its X (longitudinal) axis, 90° from its normal position
(5) Instrument rotated about its Y (lateral) axis, 90° from its normal operating position so that its dial is up
(6) Instrument rotated about its Y (lateral) axis, 90° from its normal operating position so that its dial is down

A change in indication from that obtained when tested in the normal position (item 1 above) shall be considered "balance error" and shall not exceed the tolerance specified in Table III.

9.6 Barometric Setting Scale: The instrument shall be subjected to a constant pressure between -1000 and 5000 ft altitude when performing this test. Starting below the lowest value on the barometric scale, it shall be set successively to each value of barometric setting number shown in Table IV, first with increasing and then with decreasing barometric settings. The instrument indication shall be recorded at each setting. The difference between each increasing reading and the reading at the 29.92 setting (A Column 3) and the difference between each decreasing reading and the reading at the 29.92 setting (B Column 6) shall be obtained. The difference in feet between the A and B readings (representing the system "backlash" at 29.92 in. of mercury, or 1013 millibars) shall be divided by 2 and this quotient subtracted from 20 feet. This resultant value is the tolerance which applies to each difference (function error) obtained above (Column 5 and 8). If both inches of mercury and millibar barometric setting indications are provided, the test shall be conducted for each indication independently.

9.6 Continued:

If the specific design of barometric setting system is such that additional barometric setting errors are possible and are undetected by the procedure above, the manufacturer shall submit a method of measuring this error, and the tolerance for the test in Table IV shall be reduced by this amount so as to retain the total tolerance of ±20 feet.

The barometric setting knob shall be tested through its full range in either direction. The torque required to turn the knob shall be between two and seven inch ounces.

NOTE: Attachment "A" illustrates above.

9.7 Dynamic Friction (Pressure Operated Instruments):

9.7.1 Counter-Pointer Display: With the integral vibrator in operation, the altimeter shall be subjected to a constant rate of decreasing and increasing pressure equivalent to the rate indicated at the test points specified in Table V. The change in reading of the pointer at the test points, due to its stopping and jumping shall be recorded as dynamic friction and shall not exceed the tolerances specified in Table V, Column "A". This test shall be repeated with the integral vibrator inoperative. The dynamic friction shall not exceed the tolerances specified in Table V, Column "B".

9.7.2 Other Displays: With the integral vibrator in operation, the altimeter shall be subjected to a constant rate of decreasing and increasing pressure equivalent to the rate indicated at the test points specified in Table V. The change in reading of the indication at the test points, due to its hesitation shall be recorded as dynamic friction and shall not exceed the tolerance specified in Table V, Column "A". This test shall be repeated with the integral vibrator inoperative. The dynamic friction shall not exceed the tolerances specified in Table V, Column "C".

9.8 Static Friction (Pressure Operated Instruments):

9.8.1 Instrument Without Integral Vibrator: While connected in accordance with Scale Error Test the instrument shall be tested for friction at each of the test pressures specified in Table VI. Pressure shall be decreased at a rate compatible with the test equipment, but not to exceed 5,000 ft per min, until within approximately 500 ft of a test point when the rate shall be reduced to 500 ft per min until the test is approximated. The pressure shall then be held constant while two readings are taken. The first with no external vibration applied to the instrument and the second with external vibration applied to the instrument. Sufficient external vibration shall be applied to assure removal of all friction. The difference between the two readings shall be considered "friction" and shall not exceed the tolerances specified in Table VI, Column "A".

9.8.2 Instruments With Integral Vibrator: While connected in accordance with Scale Error Test the instrument shall be tested for friction at each of the test pressures specified in Table VI. Pressure shall be decreased at a rate compatible with the test equipment, but not to exceed 5,000 ft per min, until within approximately 500 ft of a test point when the rate shall be reduced to 500 ft per min until the test point is approximated. The pressure shall then be held constant while three readings are taken. The first with no internal vibration applied (integral vibrator inoperative) nor external vibration applied to the instrument. The second with only internal vibration applied (integral vibrator operating) and the third with both internal and external vibration applied to the instrument. The difference between the first and third reading shall not exceed the tolerance specified in Table VI, Column "A" and the difference between the second and third reading shall not exceed the tolerance specified in Table VI, Column "B".

9.9 Minimum Response (Electrical Instruments) (Slew Rate): Power shall be applied and the instrument subjected to a pressure equivalent to a value above 25,000 ft altitude. With power off the pressure shall be changed to zero feet altitude. Power shall then be applied and the time required for the instrument indication to change from 20,000 ft to 10,000 shall be 30 seconds or less.

9.10 Threshold and Resolution: The pressure altitude system shall be set at the specific test points indicated below. The static pressure shall be slowly increased and decreased around the test point (sinusoidal rates are desired) until a change in indication or output is noticed. The total change in increasing and decreasing pressure shall not exceed the equivalent values in feet below:

4,000 ft (25.842 in. Hg abs.) 10 ft.
40,000 ft (5.538 in. Hg abs.) 20 ft.

If differential pressure is used in the system, it shall remain constant during this test.

9.11 Power Loss: Means shall be incorporated in the instrument to indicate when adequate electric power is not available for proper operation. Such means shall indicate this loss in a positive manner according to the importance of the loss, i.e. If performance is degraded but usable a flag shall be adequate. If the instrument is unusable, readability shall be noticably obscured by the warning device.

9.12 Servo Performance (Electrical Instruments): The servo performance shall have a minimum frequency response of 1.25 Hertz and a damping ratio of 0.80 + 0.1, - 0.2 of critical damping. The damping ratio specified is indicative of adequate response and stable operation of linear servos. Where performance requirements dictate use of non-linear servos, the damping ratio may vary from that specified, provided comparable response and stability is maintained.

9.13 Scale Error High or Low Temperature: As determined by the environmental condition, the instrument shall be subjected to an ambient temperature of either 0 C or 50 C for a period of 3 hr without operating. Then while at the selected temperature the instrument shall be subjected to the Scale Error test specified in paragraph 9.4, except the test shall be performed with decreasing pressure (increasing altitude) only. The scale error in the altimeter system shall not 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.

10. QUALIFICATION TESTS

As many instruments or components as deemed necessary by the manufacturer, shall be tested to demonstrate that all instruments will comply with the requirements of this section.

10.1 Drift and After Effect: If the instrument is equipped with an automatic correction device the electrical power shall be applied. The reading at the zero foot test point shall be recorded. The pressure shall then be reduced, at a rate corresponding to an increase in altitude of approximately 10,000 ft per min, to a pressure equal to 80% of the maximum pressure altitude range and a reading taken within two minutes after reaching altitude. The instrument shall be held at 80% of the full altitude range for a period of 6 hr, the pressure shall be maintained within ±2000 feet. At the completion of the 6 hr exposure period the pressures shall be readjusted to the previous pressure and a reading taken. The pressure shall then be increased at a rate corresponding to a decrease in altitude of approximately 10,000 ft per min until within approximately 500 ft of the zero foot test point then the test pressure shall be approached and reached at a rate compatible with the test equipment. Within three minutes after passing through the 500 ft approach point a reading shall be taken at the zero foot test point. The allowable change in indication between the first and second reading (drift) taken at the 80% test point shall not exceed the tolerance specified in Table VII for the applicable altimeter range. The allowable change in indication between the first and second reading (after effect) taken at zero foot test point shall not exceed the tolerance specified in Table VII for the applicable altimeter range.

10.2 Low Temperature Operations: The instrument shall be subjected to the low temperature for the environmental condition specified in the applicable category of RTCA DO-138 for a period of 3 hr without operating. Then while at that temperature, the instrument shall be subjected to the scale error test specified in paragraph 9.4, except that the test shall be performed with decreasing pressure (increasing altitude) only. The scale error in feet of altitude shall not exceed the sum of the room temperatures tolerance (Table II) and 1% from 25 C to 0 C and 2% from 0 C to the extreme low operating temperature of those tolerances per degree of temperature change from room temperature (25 C).

10.3 High Temperature Operation: The instrument shall be subjected to the high temperature for the environmental condition specified in the applicable category of RTCA DO-138 for a period of 3 hr without operating. (Electrical equipment shall be energized.) Then while still at the applicable high ambient temperature, the instrument shall be subjected to the scale error test specified in paragraph 9.4, except that the test shall be performed with decreasing pressure (increasing altitude) only. The scale error in feet of altitude shall not exceed the sum of the room temperature tolerances (Table II) and 1% from 25 C to 50 C and 2% from 50 C to the extreme high operating temperature of those tolerances per degree of temperature change from room temperature (25 C).

10.4 Extreme Temperature Exposure: The instrument shall be exposed to low and high temperature for the environmental conditions specified in the applicable category of RTCA DO-138 for a period of 24 hr at each extreme temperature, without operating. After the instrument has attained the normal operating temperature for 3 hr, the instrument shall meet the applicable individual performance tests specified in paragraph 9.4 through 9.8. There shall be no evidence of damage as a result of exposure to the extreme temperatures specified.

10.5 Vibration: The instrument shall be subjected to the applicable vibration characteristics in accordance with the aircraft type and location as specified in the Standard Vibration Environment of RTCA DO-138. The test shall be performed in accordance with the following procedure. After the completion of the tests, no damage should be evident, the barometric scale shall not have shifted more than .01 in. of mercury of 1/3 millibar and the instrument shall meet the individual performance tests specified in paragraph 9.4 through 9.8.

10.5.1 Resonance: The instrument while operating (varying the pressure throughout the normal operating range), shall be subjected to a resonant frequency survey of the appropriate range specified in the applicable paragraph of RTCA DO-138 in order to determine if there exist any resonant frequencies of the parts. The amplitude used may be any convenient value that does not exceed the maximum double amplitude and the maximum acceleration specified in the applicable paragraph of RTCA DO-138. The instrument shall then be subjected to vibration at the appropriate maximum double amplitude or maximum acceleration specified in the applicable paragraph of RTCA DO-138 at the resonant frequency for a period of one hour along each axis. If more than one resonant frequency is encountered with vibration applied along any one axis, a test period may be accomplished at the most severe resonance, or the period may be divided among the resonant frequencies whichever shall be considered most likely to produce failure. The test periods shall not be less than one-half hour at any resonant mode. If the resonant frequencies are not apparent within the specified frequency range, the instrument shall be vibrated for 2 hr along each axis in accordance with the vibration requirements scheduled at the maximum double amplitude and the frequency to provide the maximum acceleration.

10.5.2 Cycling: The instrument while operating shall be tested with the frequency cycled between limits specified in the applicable paragraph of RTCA DO-138 in 15 minute cycles for a period of one hour along each axis at an applied double amplitude specified in the applicable paragraph of RTCA DO-138 or an acceleration specified in the applicable paragraph of RTCA DO-138 whichever is the limiting value.

10.6 Humidity: The instrument, unless hermetically sealed, shall be mounted in its normal operating attitude (with simulated installation conditions by connecting 10 ft of coiled copper tubing to the pressure port(s) in such a manner that moisture can drain out the open end), and subjected to the Standard Humidity Test of RTCA DO-138.

Following this test, there shall be no evidence of damage or corrosion, which affects performance and the instrument shall meet the requirements of Section II, paragraph 9.4 thru 9.8.

10.7 Fogging (Hermetically Sealed Instruments Only): 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 cover glass 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.

10.8 Thermal Shock (Hermetically Sealed Instruments Only): The instrument shall be subjected to four cycles of exposure to water at 85 C ±5 C and 4 C ±3 C without evidence of moisture penetration or damage to enclosure. Each cycle of the test shall consist of immersing the instrument in water at 85 C ±5 C for a period of 30 min and then within five seconds of removal from the bath, immersing the instrument for a period of 30 min in the other bath maintained at 4 C ±3 C. This cycle shall be repeated continuously, one cycle following the other until the four cycles have been completed.

Following this test, the instrument shall be subjected to the sealing test specified in paragraph 9.3.3.

10.9 Power Variation: The instrument shall be subjected to the applicable tests specified in Radio Technical Commission of Aeronautics Document DO-138, Environmental Conditions and Test Procedures Airborne Electronic Equipment and Instruments, to demonstrate that the instrument will properly function with ±15% variation in D.C. voltage and/or ±10 % variation in A. C. voltage and ±5 % variation in frequency.

10.10 Magnetic Effect: The instrument shall be subjected to the applicable tests specified in Radio Technical Commission of Aeronautics Document DO-138, Environmental Conditions and Test Procedures Airborne Electronic Equipment and Instruments, to demonstrate that the instrument is not a source of objectionable magnetic interference.

10.11 Radio Interference: The instrument shall be subjected to the applicable tests specified in Radio Technical Commission of Aeronautics Document DO-138, Environmental Conditions and Test Procedures Airborne Electronic Equipment and Instruments, to demonstrate that the instrument is not a source of objectionable interference at any frequency used on aircraft.

PREPARED BY
SAE COMMITTEE A-4, AIRCRAFT INSTRUMENTS

TABLE I

STATIC PRESSURE

Altitude Range Feet	Test Altitude Feet	Leak Tolerance Feet
20,000	10,000	25
50,000	23,000	40

TOTAL PRESSURE

Leak Tolerance -- 0.03 in. Hg

TABLE II

SCALE ERROR
TOLERANCE ENVELOPE FOR BOTH INCREASING AND DECREASING ALTITUDE

Test Pressure Feet Altitude	Tolerance Feet
-1,000	± 30
0	30
1,000	30
2,000	30
4,000	30
6,000	30
8,000	35
10,000	45
15,000	60
20,000	70
25,000	80
30,000	90
35,000	95
40,000	100
50,000	110