LAND SEA AIR SPACE

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE STANDARD

AS 8007

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Revised

MINIMUM SAFE PERFORMANCE OVER SPEED WARNING INSTRUMENTS

1. PURPOSE

This Aerospace Standard (AS) establishes the minimum performance Standards for Over Speed Warning Instruments for use in subsonic aircraft. It is intended that this Over Speed Warning Instrument operate an aural warning device to annunciate the attainment of a maximum permissible speed level.

2. SCOPE

This AS defines instruments which use inputs of static and pitot pressure equal to those which are utilized to establish the pressure altitude and speed of that aircraft. These pressures are applied to the instrument ports to provide means for generation of an aural warning whenever the aircraft reaches or exceeds the maximum operating limit speed. This Over Speed Warning Instrument function may be incorporated as part of an Air Data Computer, or an Air Speed Indicator, or an Air Speed/Mach Number Indicator, or other instruments. In those cases where the Over Speed Warning Instrument is part of another instrument, the standards contained herein apply only to the Over Speed Warning Instrument function. Each aircraft type and model has a defined maximum operating limit speed curve or curves which are a part of the airframe manufacturer's type certification approval data; this limit speed data shall be available from the subject airframe manufacturer as published in the operating manual for the aircraft type and model number and configuration.

3. GENERAL STANDARDS

3.1 Compatibility of Components: If components of the equipment require matching to meet the requirements of this standard, they shall be identified in a manner which will assure proper matching. Installation instructions issued by the Over Speed Warning Instrument manufacturer shall indicate matching requirements if any.

3.2 Accessibility of Controls: Controls which 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 which are identified with the same manufacturer's part or model number shall be completely interchangeable.

3.4 Over Speed Warning Circuit:

3.4.1 The electrical circuit shall be such that should the aircraft exceed the defined maximum operating speed, the internal circuit shall provide for a signal which shall operate an aural warning device.

3.4.2 The electrical circuit shall be designed so that no signal shall be present to operate the aural warning device for speeds below the maximum operating speed range and a signal shall be present upon attaining the maximum operating speed and shall remain on above the maximum operating speed.

3.5 Self-Test Provision: The instrument shall have test capabilities to confirm the operation of the electrical output signal to the aural warning device.

3.6 Maximum Speed Signal Accuracy:

3.6.1 The instrument shall generate and maintain its output signal when the maximum operating speed is achieved or exceeded, and shall operate to the following tolerance relative to that maximum operating speed curve. The output signal shall be removed when the speed falls below the maximum operating speed curve to the same tolerance.

a) For curve sections based on airspeed in knots, calibrated or equivalent, 0 to plus 6 knots (11 km/hr) in excess of the limit speed value.

b) For curve sections based on Mach Number, 0 to plus .010 Mach in excess of the limit Mach number value.

3.6.2 The above tolerances are applicable for a minimum environmental temperature range of +20° C through +55° C (+68° F through +131° F) and in the mounting position defined in the manufacturer's installation instructions.

3.6.3 For environmental temperatures from +20° to -30° C from +55° C to +71° C the tolerance of the output signal shall not exceed:

a) For curve sections based on airspeed in knots, calibrated or equivalent, 0 to plus 8 knots (15 km/hr) of the maximum speed value.

b) For curve section based on Mach number, 0 to plus 0.015 Mach of the maximum Mach number value.

3.6.4 In those cases where the Over Speed Warning Instrument function is part of an air speed or an air speed/Mach number indicator, the performance specified in 3.6.1, 3.6.2, and 3.6.3 shall be applied to the indicated air speed or Mach number displayed relative to the maximum speed displayed by the instrument. The performance tolerances specified in 3.6.1, 3.6.2, and 3.6.3 shall not be exceeded relative to the maximum operating speed curve for the instrument.

3.7 Operating Range:

3.7.1 The altitude range for all Over Speed Warning Instruments shall start at -1000 ft (-305 m) pressure altitude and the upper pressure altitude limit shall be applicable to the aircraft and shall be indicated on the nameplate.

3.7.2 The working airspeed range shall start at least 30 knots (55.56 km/hr) below the lowest airspeed value defined in the maximum operating speed curve, and shall extend at least 50 knots (93 km/hr) above the highest airspeed value defined in the maximum operating speed curve.

3.8 Aircraft Identification: The aircraft type, model number, and configuration for which the Over Speed Warning Instrument has been calibrated and for which it performs its intended function, shall be clearly marked on the instrument nameplate and in the manufacturer's installation instructions. Each aircraft type, model and configuration has a defined maximum operating limit speed curve.

3.9 Power Loss:

3.9.1 If electrical power is used as the means to operate any portion of the Over Speed Warning Instrument, provisions shall be incorporated in the instrument to detect the loss of this power. An indication of the loss of electrical operating power shall be provided in a positive manner. An output signal equivalent to a maximum speed limit warning is one acceptable means of indicating the loss of power.

3.9.2 Power loss to the instrument from an external source, e.g. aural warning power, shall not require a power loss signal from the instrument as in 3.9.1.

3.10 Fire Hazard: 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.

4. PERFORMANCE UNDER STANDARD CONDITIONS

4.1 Standard Atmospheric Conditions: Unless otherwise specified herein, all tests shall be conducted at atmospheric conditions specified in paragraph 3.4 of DO-160. (Environmental Conditions and Test Procedures for Airborne Electronics/Electrical Equipment and Instruments, dated Feb. 28, 1975).

4.2 Attitude: Unless otherwise specified herein, all tests shall be conducted with the instrument in its normal operating position as defined in the manufacturer's installation instructions.

4.3 Power Conditions: Unless otherwise specified herein, all individual performance tests shall be conducted at the power ratings defined by the manufacturer in the installation instructions for the instrument.

4.4 Vibration to Minimize Friction:

4.4.1 Reciprocating Engine Powered Aircraft: Unless otherwise specified, tests shall be conducted with the equipment subjected to a maximum vibration of 0.005 in. (0.127 mm) total excursion at any frequency from 20 to 35 Hertz, provided the equipment is mounted in its normal operating position.

4.4.2 Turbine Powered Aircraft: Unless otherwise specified, tests shall be conducted with the equipment subjected to a maximum vibration of 0.001 in. (0.025 mm) total excursion at any frequency from 10 to 60 Hertz, provided the equipment is mounted in its normal operating position.

NOTE: If vibration exceeding the values specified above is required during normal operation in order to meet the accuracy requirements specified in this performance standard, it shall be the responsibility of the equipment manufacturer to either provide such vibration internally to the equipment or notify the user that such vibration is required to be applied to the equipment, when installed in an aircraft.

4.5 Performance Tests: The instrument shall be tested to demonstrate compliance with 3.4, 3.5, 3.6, 3.9 of this standard.

4.5.1 The performance tests specified shall be conducted in accordance with the requirements specified by the manufacturer, and at least three test points in each maximum allowable speed curve section shall be included to assure conformance to the curve sections. When the curve contains reversal in direction, e.g., airspeed transition to Mach No., the reversal point shall be tested to assure that the transition occurs at the correct altitude level.

4.6 Balance Error (Attitude): If the instrument is subjected to Balance Error (Mechanical balance), the instrument shall be tested in the following positions, and the performance as specified in 4.6.1 and 4.6.1.1, shall be met.

1) Normal operating position (as specified by the instrument manufacturer)

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.

4.6 Continued

4) Instrument rotated counter clockwise around its X (longitudinal) axis, 90° from its normal position.

5) Instrument rotated about its Y (lateral) axis, 90° up from its normal operating position.

6) Instrument rotated about its Y (lateral) axis, 90° down from its normal operating position.

4.6.1 With a static pressure of approximately 12 in. of mercury absolute (305 mm) approximately 23,000 ft (7,000 m), applied to the static port and a differential pressure, approximately .015 Mach above the maximum operating speed of the curve, applied to the total pressure port, the instrument shall have generated an output signal. This signal shall be maintained for the attitudes defined in 4.6 while the instrument is being lightly vibrated.

4.6.1.1 For aircraft with maximum operating speed curves not related to Mach number and for aircraft altitude limitations below 20,000 ft (6,100 m) the applied static pressure should be 80% of the altitude limit for the aircraft and the differential pressure applied shall be 10 knots (18.5 km/hr) above the maximum speed limitation as defined by the maximum operating speed curve for the aircraft at the test altitude. The instrument shall have generated an output signal. This signal shall be maintained for the attitudes defined in 4.6.1 while the instrument is being lightly vibrated.

4.7 Electrical Insulation:

4.7.1 Insulation Resistance: The Insulation Resistance measured at 200 VDC for five seconds between all ungrounded electrical connector terminals connected together and the instrument case (metallic) shall not be less than 5 megaohms.

4.7.2 Overpotential: The instrument shall not be damaged by the application of a test potential between isolated electrical circuits and the metallic case. The test potential shall be a sinusoidal voltage of commercial frequency with an R.M.S. value of five times the maximum voltage defined for the instrument, not to exceed 500 volts. For instruments which are hermetically sealed, the voltage shall not exceed 200 volts.

4.7.2.1 The potential shall start from zero and be increased at a uniform rate to its test value. It shall be maintained at this value for five seconds, and then reduced at a uniform rate to zero.

4.7.3 Limitations: The above tests are to insure adequate isolation and insulation and are not to be applied to elements such as windings, resistors, capacitors, semi-conductors, etc. Circuits which contain solid state components are not to be subjected to overpotential testing.

4.7.3.1 Circuits that operate at potentials below 30 volts are not to be subjected to overpotential tests.

4.8 Case Overpressure (External): A pressure of 26 in. (660 mm) mercury differential (Gage) shall be applied to the case (exterior) for 5 min. with the pressure ports vented to ambient pressure. No damage or deformation shall result, nor shall the instrument fail to meet the performance requirements specified in 4.5, 4.9, 4.10.

4.9 Case Leakage: A total volume of 25 $in.^3$ (0.41 L) within the pressure system (case volume lines and other equipment), shall be implemented and thermal equilibrium shall be maintained for these tests.

4.9.1 Static Pressure (With the static and total pressure ports tied together): The external pressure surrounding the case shall be approximately 29.921 in. (760 mm) of mercury absolute (sea level). Apply 12 in. (304 mm) of mercury absolute to the pressure ports. The change in pressure at the static connection shall not exceed .020 in. (0.5 mm) of mercury per minute. The same test shall be done by applying 38 in. (965 mm) of mercury absolute to the ports and the same leak rate shall apply.

4.9.2 Total Pressure (With the static port vented to ambient static pressure): A pressure equal to the maximum differential pressure plus the maximum static pressure that the instrument will be exposed to for the maximum operating speed curve applicable to subject aircraft shall be applied to the total pressure port. With the total pressure source closed off, there shall be no indication of leakage on the total pressure side after a one minute period.

4.10 Output Signal Generation: For a period of not less than 1 hr the instrument shall not have been exposed to pressures other than ambient (sea level). The instrument shall be tested at sufficient altitude levels, but not at intervals greater than approximately 5,000 ft (1524 m); and at appropriate airspeed values to adequately represent the maximum operating speed curve for the subject aircraft, as defined below.

4.10.1 For MOS curve sections based on air speed, at each specified altitude level the applied static pressure shall be held constant and the applied differential pressure varied. First by slowly increasing the differential pressure (airspeed) until an output signal is generated. The output signal shall be generated within the requirements of 3.6.1 (a) or 3.6.1 (b) as applicable. Then the airspeed shall be increased by 20 knots (37 km/hr) and the signal shall remain on. The differential pressure shall then be slowly decreased until the warning signal just goes off. The output signal shall have gone off for values below the nominal maximum speed as defined by the maximum operating limit speed curve.

4.10.2 For selected values of maximum operating Mach number and altitude, the altitude level shall be held constant and the differential pressure shall be increased until an output signal has just been generated. The differential pressure shall be readjusted so that the output signal just goes off and the differential pressure shall now be held at that point. The altitude level shall then be increased (pressure lowered) until the output signal just comes on. The requirements of 3.6.1 (b) shall be met. The altitude level shall then be lowered (pressure increased) until the output signal just goes off. The output signal shall have remained on for the performance as defined by 3.6.1 (b).

5. PERFORMANCE STANDARD UNDER ENVIRONMENTAL CONDITIONS

5.1 When the Over Speed Warning Instrument forms part of an aircraft system, such as an Air Data Computer, the Over Speed Warning function shall meet the performance requirement specified in Sections 3 and 4 herein for the environmental conditions specified for that aircraft system.

5.1.1 When the Over Speed Warning Instrument is independent of any aircraft system, the manufacturer shall define the exact environmental conditions and/or categories of R.T.C.A. DO-160 Appendix "A" under which the equipment will perform to the requirements of this standard. The applicable environmental condition and categories shall be specified in the manufacturer's installation instructions or on the equipment nameplate.

5.1.2 Unless otherwise specified by the manufacturer, the measurement procedures applicable to a determination of the performance of the instrument under environmental conditions shall be as set forth in R.T.C.A., Document DO-160, entitled "Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments," dated 28 February 1975.

5.2 Environmental Categories: The environmental categories appropriate to the installation of this instrument in the individual airframe shall be defined by the manufacturer in the installation instructions and/or as marked on the instrument in accordance with R.T.C.A., DO-160, Appendix "A" as applicable, and shall be the environmental categories to which the instrument shall have been tested and approved to. Environmental conditions and categories which differ from those defined in Appendix "A" of DO-160 shall be clearly defined in the manufacturer's installation instructions.

5.2.1 Performance tests which are required after subjection to test environments may be conducted after exposure to several environmental conditions.

5.2.2 The equipment shall be subjected to the specified environmental conditions as per the procedures defined in R.T.C.A., DO-160, and shall not be damaged by being subjected to these environmental tests.

5.2.3 The following list of environmental test categories and conditions are considered as the minimum test requirements:

a) Temperature/Altitude Tests (DO-160 applicable categories, paragraph section 4.0).

b) Temperature Variation Tests (DO-160, paragraph section 5.0).

c) Humidity Test (DO-160, paragraph section 6.0).

d) Shock Tests (DO-160, paragraph section 7.0).

e) Vibration Tests (DO-160 Applicable categories, paragraph section 8.0).

f) Magnetic Effect (DO-160 applicable class, paragraph section 15.0).

g) Power Input Test (DO-160 applicable categories, paragraph section 16.0).

h) Voltage Spike Conducted Test (DO-160 applicable categories, paragraph section 17.0).

i) Audio Frequency Conducted Susceptibility Test (DO-160, paragraph section 18.0).

j) Induced Signal Susceptibility Test (DO-160, applicable categories, paragraph section 19.0).

k) Decompression (DO-160, paragraph section 4.6.2).

PREPARED BY
SAE COMMITTEE A-4, AIRCRAFT INSTRUMENTS