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| Issued        | 1956-12 |
| Revised       | 1961-05 |
| Reaffirmed    | 1991-05 |
| Noncurrent    | 1996-11 |
| Reaf. Noncur. | 2008-02 |

**Maximum Allowable Airspeed Instruments  
(Reciprocating Engine Powered Aircraft)**

**FOREWORD**

This document has been declared "NONCURRENT". It is recommended, therefore, that this document not be specified for new designs. "NONCURRENT" refers to those documents which have previously been widely referenced and may continue to be required on some existing designs. "NONCURRENT" documents are available from SAE upon request.

**1. PURPOSE:**

This Aeronautical Standard establishes the essential minimum safe requirements for pitot-static type of Maximum Allowable Airspeed Instruments primarily for use in reciprocating engine powered civil transport aircraft, the operation of which may subject the instruments to the environmental conditions specified in paragraph 3.3.

**2. SCOPE:**

This Aeronautical Standard covers the basic types of maximum allowable airspeed instruments which give a continuous indication of both indicated airspeed and maximum allowable airspeed not exceeding 650 knots.

**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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**SAE WEB ADDRESS:**

## 3.2 Identification:

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

- a. Name of instrument (Maximum Allowable Airspeed Instruments)
- b. SAE Aeronautical Standard AS 418
- c. Manufacturer's part number
- d. Manufacturer's serial number or date of manufacture
- e. Manufacturer's name and/or trademark
- f. Range

## 3.3 Environmental Conditions:

The following conditions have been established as design requirements only. 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 -30 to 50C ambient temperature range, and shall not be affected adversely by exposure to temperatures in range of -65C to 70C.
- 3.3.2 Humidity: The instrument shall function and shall not be affected adversely when exposed to any relative humidity in the range of 0 to 95 percent at a temperature of approximately 32C.
- 3.3.3 Altitude: The instrument shall function and shall not be affected adversely when subjected to a pressure temperature range equivalent to -1,000 to 40,000 feet standard altitude, per NACA Report Number 1235, except as limited by the application of paragraph 3.3.1. The indicator shall withstand an external case pressure of 50 inches Hg absolute when installed properly and vented to an atmospheric pressure of approximately 29.92 inches Hg absolute.
- 3.3.4 Vibration: When installed in accordance with the instrument manufacturer's instructions, the instruments shall function and shall not be affected adversely when subjected to vibrations having following characteristics:

| <u>Instrument Location<br/>in Airframe</u>         | <u>Cycles/Sec.</u> | <u>Maximum Double<br/>Amplitude (in.)</u> | <u>Maximum<br/>Acceleration</u> |
|----------------------------------------------------|--------------------|-------------------------------------------|---------------------------------|
| Instrument Panel or<br>Vibration Isolated<br>Mount | 5-50               | 0.020                                     | 1.5g                            |

- 3.3.5 Magnetic Effect: The magnetic effect of the indicator shall not adversely affect the operation of other instruments installed in the same aircraft.

## 4. DETAILED REQUIREMENTS:

## 4.1 Indicating Method:

Indicated airspeed and maximum allowable airspeed shall be displayed by means of pointer (s) moving over a fixed dial which may be supplemented by a rotating drum with fixed indices. Clockwise pointer motion and right to left drum movement (apparent left to right movement of the index) shall indicate increasing speed.

## 4.2 Dial Finish:

Unless specified otherwise by the user, matte white material shall be applied to major graduations, numerals and pointers. Non-functional surfaces shall be durable dull black.

## 4.3 Visibility:

All pointer, drum and dial markings shall be visible from any point within the frustrum of a cone whose side makes an angle of not less than 30 degrees with the perpendicular to the dial, and whose small diameter is the aperture of the instrument case. The distance between the dial and the cover glass shall be a practical minimum and shall not exceed .250 inch.

## 4.4 Calibration:

4.4.1 The indicated airspeed pointer shall indicate airspeed in accordance with the following equation:

$$V_i = C_{s_0} \sqrt{\frac{2}{\gamma - 1} \left[ \left( 1 + \frac{q_c}{P_o} \right)^{\frac{\gamma - 1}{\gamma}} - 1 \right]}$$

Where:

$V_i$  = Indicated Airspeed in Knots.

$C_{s_0}$  = Standard Speed of Sound at Sea Level (15°C) = 661.48 Knots.

$\gamma$  = Ratio of Specific Heats =  $C_p/C_v$  = 1.40.

$q_c$  = Differential (Impact) Pressure = Stagnation (Total) Pressure Minus Static Pressure.

$P_o$  = Standard Pressure at Sea Level (15°C) = 29.92126 inches Hg Absolute.

- 4.4.2 The maximum-allowable-airspeed pointer shall indicate the maximum allowable airspeed for any preset Mach number within the range of the instrument in accordance with the following equation:

$$V_m = C_{s_o} \sqrt{\frac{2}{\gamma-1} \left\{ \left[ \frac{P}{P_o} \left( 1 + \frac{\gamma-1}{2} M_m^2 \right)^{\frac{\gamma}{\gamma-1}} - 1 \right] + 1 \right\}^{\frac{\gamma-1}{\gamma}} - 1}$$

Where:

$V_m$  = Maximum Allowable Indicated Airspeed in Knots.

$C_{s_o}$  = Standard Speed of Sound at Sea Level (15°C) = 661.48 Knots.

$\gamma$  = Ratio of Specific Heats =  $C_p/C_v$  = 1.40.

$P$  = Ambient Static Pressure in Inches Hg Absolute.

$P_o$  = Standard Pressure at Sea Level (15°C) = 29.92126 inches Hg Absolute.

$M_m$  = Maximum Allowable Mach Number.

#### 4.5 Adjustments:

- 4.5.1 Maximum-Allowable-Airspeed Pointer: An adjustable stop shall be provided in the instrument for limiting the movement of the maximum allowable airspeed pointer. The design of this adjustment shall be such that it will not affect the indication of the pointer when the altitude pressure conditions and Mach number setting are such that the limiting speed will be lower than that set by the adjustable stop.
- 4.5.2 Mach Number Setting: The preset value shall be visible from the front of the instrument when a readily accessible means is provided for setting the instrument at any desired Mach number within the range of the instrument. When the instrument does not contain an external Mach Number setting adjustment, the value of the permanent Mach number setting need not be visible from the front of the instrument, but shall be marked on the instrument nameplate.

#### 4.6 Limitation of Indicated Airspeed Pointer Movement:

The pointer movement shall be limited by stops in the mechanism in such a way that the pointer will not rotate more than 10 degrees beyond the last graduation on the dial. Stops may also be incorporated in the instrument mechanism to limit counterclockwise motion of the pointer.