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AERONAUTICAL STANDARD

AS 393 A

AIRSPPEED TUBES ELECTRICALLY HEATED

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1. **PURPOSE:** The purpose of this Aeronautical Standard is to specify minimum requirements for pitot-static type of electrically heated Airspeed Tubes 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 two basic types of instruments as follows:
 - Type I - Pitot Pressure, straight and L-shaped, 12 and 14 volt nominal, 2 wire circuit.
 - Type II - Pitot and Static Pressured, straight and L-shaped, 12 and 24 volt nominal, 2 wire circuit.
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 the purpose intended.
 - 3.1.2 **Workmanship:** Workmanship shall be consistent with high-grade aircraft instrument manufacturing practice.
 - 3.2 **Identification:** The following information shall be legibly and permanently marked on the units or attached thereto:
 - a. Name of instrument (Airspeed Tubes)
 - b. Aeronautical Standard AS 393A
 - c. Manufacturer's part number
 - d. Manufacturer's name and/or trademark
 - e. Manufacturer's serial number or date of manufacture
 - f. Rating (Nominal Voltage)
 - 3.3 **Environmental Conditions:** The following conditions have been established as design requirements only. Tests shall be conducted as specified in Sections 6 and 7.
 - 3.3.1 **Temperature:** When the instrument is mounted in accordance with manufacturer's instructions, it shall function over the range of ambient temperatures of -65 to 70C and shall not be adversely affected by exposure to temperatures of -65C to 70C.
 - 3.3.2 **Altitude:** The instruments should function and should 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 of this AS.

Section 8.3 of the SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

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

Instrument Location in Airframe	Cycle Per/Sec	Double Amplitude (In.)	Maximum Acceleration
Wings, Empennage and Fuselage	5-50	0.250	32.5g

- 3.3.4 Radio Interference: The instrument shall not be the source of objectionable interference under operating conditions at any frequencies used on aircraft, either by radiation or feedback, in radio sets installed in the same aircraft as the instrument.

4. DETAIL REQUIREMENTS:

- 4.1 Drainage: The tube shall be designed to provide maximum drainage of water, resulting from rain or melting ice, consistent with maintaining the calibration specified in paragraphs 7.3, 7.4, and 7.5.
- 4.2 Marking: Pitot pressure and static pressure lines shall be identified by the letters "P" and "S" respectively; stamped, etched, engraved or otherwise permanently marked on the lines or fittings. The top of the tube shall be identified.

5. TEST CONDITIONS:

- 5.1 Atmospheric Conditions: Whenever the pressure, temperature and relative humidity are not specified, it is understood that the test is to be made under the following conditions:

Atmospheric Pressure: approximately 29.92 In. Hg.

Room Temperature: approximately 25C

Relative Humidity: not exceeding 85%

When tests are made under atmospheric conditions differing substantially from the above values, proper allowances shall be made for the discrepancies.

6. INDIVIDUAL PERFORMANCE TESTS: All instruments shall be subjected to whatever tests the manufacturer deems necessary to demonstrate specific compliance with this Aeronautical Standard, including the following requirements, where applicable.

- 6.1 Leakage: With a pressure of 10 inches of mercury applied separately to the pitot pressure and/or the static pressure line, there shall be no apparent leak in a period of one minute when the corresponding pitot or static pressure openings and drain holes are sealed.

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- 6.2 Dielectric: The insulation shall withstand, without evidence of damage, the application of a sinusoidal voltage at a commercial frequency between the terminals of the heater circuit and the shell (case) for a period of 5 seconds. The RMS value of the sinusoidal voltage applied shall be 500 volts.
- 6.3 Heater Operation: When mounted in its normal position, the tube shall be tested for heater operation by applying the nominal rated voltage (12 or 24 volts) for a period of 2 minutes. The power consumption at the time shall be within $\pm 30\%$ of the power consumption at rated voltage.
7. QUALIFICATION TESTS: As many instruments as deemed necessary to demonstrate that all instruments will comply with the requirements of this section shall be tested in accordance with the manufacturer's recommendations, where applicable.
- 7.1 Vibration: The tube shall be subjected to vibration for three hour periods in each of the three perpendicular reference planes, such that a point on the tip of the tubes will oscillate 1/4 inch. The test shall be conducted such that each period of three hours shall consist of one hour at 15, 35, and 50 cycles per second. Rated voltage shall be applied to the terminals continuously during this test. Ambient temperature shall be 20 to 30C. There shall be no failure of any kind.
- 7.2 Endurance: The tubes shall be made to operate continuously in still air at 15 or 30 volts (as applicable) for at least five hours. Ambient temperature shall be 70C. There shall be no damage of any kind except discoloration, which will not affect corrosion resistance.
- 7.3 Scale Error at Zero of Attack: The tube shall be mounted in a wind tunnel in line with the airflow and tested separately for pitot pressure and for static pressure at the values for airspeeds specified in Table I. The test shall be made by comparison with the results obtained under similar conditions with a calibrated tube. The error of the tube expressed in terms of indicated airspeed shall not exceed 1% of the indication or 1 knot, whichever is greater, and the static pressure shall be within the tolerances specified in Table I.
- 7.4 Scale Error at Various Angles of Attack: The tubes shall be tested as specified for "Error at Zero Angle of Attack" at approximately 125 knots except that the Angle of Attack shall be varied by 2 degree intervals from +16 to -10 degrees inclusive. The indicated error expressed in terms of indicated airspeed shall not differ from the indicated error at zero angle of attack by more than 3 knots, and the error in static pressure shall not differ from the static pressure at zero angle of attack by more than 0.20 inch of water.
- 7.5 Scale Error at Various Angles of Yaw: The tube shall be tested as specified in Section 7.3 at approximately 125 knots except that the angle of yaw shall be varied between plus and minus five degrees. The indicated error expressed in terms of indicated airspeed shall not differ from the error at zero angle of yaw by more than 3 knots and the error in static pressure shall not differ from the static pressure at zero angle of yaw by more than 0.20 inch of water.

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- 7.6 Magnetic Effect: The magnetic effect of the tube shall be determined in terms of the deflection of a free magnet approximately $1\frac{1}{2}$ inches long in a magnetic field with a horizontal intensity of 0.18 ± 0.01 gauss, when the tube is held in various positions and with rated voltage applied on an east-west line with its nearest part 12 inches from the center of the magnet. (An aircraft compass with the compensating magnets removed therefrom may be used as the free magnet for this test.) The maximum deflection of the free magnet shall not exceed 5 degrees from any indication or reference position.
- 7.7 De-icing: The tube shall be tested in an icing wind tunnel at a temperature of -10 and -20C and at an indicated tunnel airspeed of 200 knots. When the tube is coated with $\frac{1}{4}$ inch of ice at the nose, the minimum rated voltage shall be applied to the terminals. The time required to clear the ice cap shall not be more than 2 minutes after the potential is applied. No re-icing shall occur.
- 7.8 Cold Resistance: The tube shall be subjected to a temperature of -65C or colder for a minimum period of 48 hours. There shall be no evidence of damage. After this test, the tube shall be capable of successfully passing all tests described heretofore.