Society of Automotive Engineers, Inc.
29 West 39th Street
New York City

AERONAUTICAL STANDARD AS404A

ELECTRIC TACHOMETER: MAGNETIC DRAG (Indicator and Generator)

Issued 11-1-48
Revised 12-15-54

1. PURPOSE: To specify minimum requirements for Electric Tachometers for use in aircraft, the operation of which may subject the instruments to the environmental conditions specified in Section 3.3.

2. SCOPE: This Aeronautical Standard covers magnetic drag tachometers with or without built-in synchroscopes.

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.

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

a. Name of Instrument.

b. SAE Aeronautical Standard, AS 404.

c. Manufacturer's Part Number.

d. Manufacturer's serial number or date of manufacture.

e. Manufacturer's name and/or trade mark.

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 instruments shall function over the range of ambient temperatures shown in Column A below and shall not be adversely affected by exposure to the range of temperatures shown in Column B below:

Instrument Location	A	B
Powerplant Accessory Compartment	-30 to 70C	-65 to 100C
Heated Areas (temperature controlled)	-30 to 50C	-65 to 70C

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3.3.2 Humidity: The instrument shall function and shall not be adversely affected when exposed to any relative humidity in the range from 0 to 95% at a temperature of approximately 32C.

3.3.3 Altitude: The instrument shall function and shall not be adversely affected when subjected to a pressure and temperature range equivalent to -1000 to +40,000 feet standard altitude, except that the instrument temperature shall not be lower than -30C.

3.3.4 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:

Type of Component Mounting	Cycles/Minute	Amplitude	Max. Accel.
Airframe Structure-Mounted	300 - 30,000	.036"	10 g.
Shock-Mounted Panel	300 - 3,000	.020"	1.5 g.
Powerplant-Mounted	300 - 30,000	.060"	20 g.

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 feed-back, in electronic equipment installed in the same aircraft as the instrument.

4. DETAIL REQUIREMENTS:

4.1 Indicator:

4.1.1 Indication: Engine speed shall be indicated by means of one or more moving pointers or dials. Relative movement of the pointer with respect to the dial shall be clockwise for increasing RPM.

4.1.2 Dial Visibility: The pointer(s) and all dial markings shall be visible from any point within the frustum of a cone whose side makes an angle of not less than 30° 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 0.200".

4.1.3 Dial Markings:

4.1.3.1 Finish: Unless otherwise specified, luminescent material (self-activating) shall be applied to all the pointers, all major graduations, and numerals.

4.1.3.2 Graduations: All graduations shall be multiples of 10 RPM. The increment between graduations shall not exceed 2-1/2% of full scale, above 600 RPM.

4.1.3.3 Numerals: Sufficient numerals shall be marked to identify positively and quickly all graduations.

4.1.3.4 Instrument Name: The designation "RPM", plus such other nomenclature as may be necessary, shall be legibly marked on the dial and may be of the same finish as the numerals.

4.2 Generator: The generator shall be designed to operate in either direction of rotation and in any position.

5. TEST CONDITIONS:

5.1 Atmospheric Conditions: Unless otherwise specified all tests required by this Aeronautical Standard shall be conducted at an atmospheric pressure of approximately 29.92 inches of mercury and at an ambient temperature of approximately 22C. When tests are conducted with the atmospheric pressure or the temperature substantially different from these values, allowance shall be made for the variation from the specified conditions.

5.2 Vibration (to minimize friction): Unless otherwise specified all tests for performance may be made with the instrument subjected to a vibration of 0.002 to 0.005 inch double amplitude at a frequency of 1500 to 2000 cycles per minute. The term double amplitude as used herein indicates total displacement from positive maximum to negative maximum.

5.3 Vibration Equipment: Vibration equipment shall be used which will provide frequencies and amplitudes consistent with the requirements of section 3.3.4 with the following characteristics:

5.3.1 Linear Motion Vibration: Vibration equipment for airframe structure-mounted or powerplant-mounted instruments or equipment shall be such as to allow vibration to be applied along each of three mutually perpendicular axes of the test specimen.

5.3.2 Circular Motion Vibration: Vibration equipment for shock-mounted panel instruments shall be such that a point on the instrument case will describe, in a plane inclined 45 degrees to the horizontal plane, a circle, the diameter of which is equal to the double amplitude specified.

5.4 Position: Unless otherwise specified, all tests shall be conducted with the instrument mounted in its normal operating position.

6. INDIVIDUAL PERFORMANCE REQUIREMENT: All instruments or components of such shall be subjected to whatever tests the manufacturer deems necessary to demonstrate specific compliance with this Aeronautical Standard, including the following requirements when applicable.

6.1 Indicator Tests:

6.1.1 Scale Error at Room Temperature: The tachometer indicator shall be connected to its generator and the generator operated at the shaft speeds within the ranges specified in Table I. The scale error at any speed shall not exceed the values specified in Table I, with the speeds increasing or decreasing. When the speed is held constant at any point on the scale, the pointer shall not oscillate over a range greater than 20 RPM from 600 RPM to full-scale indication.

TABLE I

SCALE ERROR

Gen. Drive Shaft Speed RPM	Correct Indicated Speed RPM	Scale Error Tolerance RPM
300 - 1400	600 - 2800	25
1500 - 2250	3000 - 4500	40

6.1.2 Dielectric: The insulation shall withstand, without any evidence of damage, an application of a sinusoidal voltage of 500 volts RMS at a commercial frequency for a minimum period of 5 seconds between any of the connector pins and any metal part of the case or electrical connector shell. The insulation resistance shall not be less than 5 megohms. On grounded components this test shall be performed prior to grounding of any leads.

6.1.3 Position Error: The change in pointer indication with change in instrument position from normal position shall not exceed 25 RPM.

7. QUALIFICATION TESTS: As many instruments as may be 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.

7.1 Low Temperature: The instrument shall be subjected to -30C for three hours. The change in indication from the reading obtained at room temperature shall not exceed one percent of full scale. The instrument may be operated at 2000 RPM or half scale, whichever is higher, for a period of 10 minutes before making this scale error test. The force required to turn the generator shaft while and after it has been subjected to a temperature of minus 55C for two hours, shall not exceed 8 pound inches. No damage to the generator shall result from this test.

7.2 High Temperature: The instrument shall be subjected to a temperature of 70C for a period of three hours. The change in indication from the readings obtained at room temperature shall not exceed one percent of full scale for the range 600-2800 RPM, and shall not exceed one and one-half percent of full scale for the range from 3000 to 4500 RPM.

7.3 Extreme Temperature Exposure: The instrument shall, after alternate exposure to ambient temperatures specified in Column B of Section 3.3.1 for a period of 24 hours each and a delay of 3 hours at room temperature following completion of the exposure, meet the requirements of Section 6.1.1. During the high temperature exposure, the generator shall be operating at a shaft speed equivalent to half-scale indicator reading and shall be supplying full-rated electrical load for that speed. There shall be no evidence of damage as a result of exposure to the extreme temperatures specified herein.