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AEROSPACE STANDARD

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Superseding AS407C

Fuel Flowmeters

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

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1. SCOPE:

This Aeronautical Standard covers two basic types of instruments, or combinations thereof, intended for use in indicating fuel consumption of aircraft engines as follows:

TYPE I - Measure rate of flow of fuel used.
TYPE II - Totalize amount of fuel consumed or remaining.

1.1 Purpose:

To specify minimum requirements for Fuel Flowmeters for use primarily in reciprocating engine powered civil transport aircraft, the operation of which may subject the instruments to the environmental conditions specified in Section 3.3.

2. REFERENCES:

NACA Report 1235

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 component (Fuel Flowmeters)
b. SAE AS407C
c. Manufacturer's part number
d. Manufacturer's serial number or date of manufacture
e. Manufacturer's name and/or trademark
f. Range (Transmitters only)
g. Rating (Electrical - if required)

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

TABLE 1

INSTRUMENT LOCATION	A	B
Heated Areas (Temp. Controlled)	-30 to 50 °C	-65 to 70 °C
Unheated Areas (Temp. Uncontrolled)	-55 to 50 °C	-65 to 70 °C
Power Plant Compartment	-55 to 70 °C	-65 to 100 °C
Power Plant Accessory Compartment	-55 to 70 °C	-65 to 100 °C

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 32 °C.

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

TABLE 2

Instrument Location in Air Frame	Cycles Per Second	Maximum Double Amplitude (Inches)	Maximum Acceleration
Power Plant Mounted	5 - 150	0.100	20 g
Wings & Empennage	5 - 500	0.036	10 g
Fuselage	5 - 500	0.036	5 g
Panel or Rack (Vibration Isolated)	5 - 50	0.020	1.5 g

3.3.4 Altitude: The instrument shall function and shall not be adversely affected when subjected to a pressure and temperature range equivalent to -1000 feet to 40,000 feet standard altitude, per NACA Report 1235, except as limited by the application of paragraph 3.3.1. The instrument shall not be adversely affected following exposure to an ambient pressure of 50 in Hg absolute.

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 electronic equipment installed in the same aircraft as the instrument.

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. DETAIL REQUIREMENTS:

4.1 Indicating Method:

One or a combination of the following methods of indication shall be employed.

4.1.1 Type I Instruments: Rotating pointer with fixed graduated dial or counter type indication. Clockwise pointer motion shall indicate increasing rate of flow.

4.1.2 Type II Instruments: A counter shall be employed to indicate either the fuel consumed or quantity remaining.

4.2 Dial Markings:

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

4.2.2 Numerals: Sufficient numerals shall be marked to positively and quickly identify all graduations. Numerals shall distinctly indicate the graduations to which each applies.

4.2.3 Graduations: Major graduations shall be used at intervals not to exceed 10% of full scale value.

4.2.4 Counters: When counters are incorporated in the instrument they shall indicate increments no larger than every 10 pounds or 2 gallons.

4.2.5 Visibility: The pointer and all dial markings or counters shall be visible from any point within the frustum 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 0.25 inch.

4.3 Flow Direction:

The direction of flow through the transmitter shall be permanently and legibly marked thereon.

4.4 Fuel Characteristics:

Unless otherwise specified, the fuel flowmeter shall be designed to meet the performance requirements included herein when used with 100 octane aviation gasoline with a specific gravity of 0.715 ± .003 at a temperature of 15 to 25 °C.

4.5 Power Variations:

Unless otherwise specified, the fuel flowmeter shall properly function with ±15% variation in DC voltage and/or ±10% variation in AC voltage and ±5% in frequency.

4.6 Safety Provisions:

Each transmitter shall provide adequate flow in case of malfunctioning in flight either by means of an automatic by-pass or a non-flow restricting mechanism.

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 25 °C and a relative humidity not greater than 85%. When tests are conducted with the atmospheric pressure or the temperature substantially different from these values, allowances shall be made for the variations from the specified conditions.

5.2 Vibration (to minimize friction):

Unless otherwise specified, all tests for performance may be conducted 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 the 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 3.3.3 with the following characteristics:

5.3.1 Linear Motion - Vibration: Vibration equipment shall be such as to allow vibration to be applied along each of three mutually perpendicular axes of the instrument.

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

5.4 Power Conditions:

Unless otherwise specified, all tests shall be conducted at the power rating recommended by the manufacturer.

5.5 Position:

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

6. INDIVIDUAL PERFORMANCE REQUIREMENTS:

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 where applicable.

6.1 Scale Errors:

The instrument scale error shall be determined at all major graduations. This test shall be conducted by subjecting the instrument first with rates of flow increasing, then with rates of flow decreasing. With the rate of flow increasing, the rate shall be brought up to, but shall not exceed, the rate specified to give the desired reading, and with the rate of flow decreasing, the rate shall be brought down to, but shall not fall below, the rate specified to obtain the desired reading. The error at each major graduation shall not exceed 3% of full scale reading. The difference between the reading on increasing rate of flow and the reading on decreasing rate of flow at each major graduation shall not exceed 1% of full scale reading.

6.2 Dielectric:

Each instrument shall be tested by the methods of inspection listed in paragraphs 6.2.1 and 6.2.2.

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

6.2.2 Overpotential Tests: Equipment shall not be damaged by the application of a test potential between electrical circuits and between electrical circuits and the metallic case. The test potential shall be a sinusoidal voltage of a commercial frequency with an RMS value of five times the maximum circuit voltage or per paragraphs 6.2.2.1 or 6.2.2.2 whichever applies. 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.

Since these tests are intended to assure 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, etc.

6.2.2.1 Hermetically sealed instruments shall be tested at 200 volts RMS.

6.2.2.2 Circuits that operate at potentials below 15 volts are not to be subjected to Overpotential tests.

6.3 Leak Test:

The transmitter shall be tested for leaks immediately after the scale error test while the flow chamber is still moist from gasoline, but with all free gasoline drained out. The flow chamber shall be subjected t an air pressure of 40 psi and sealed off. During a five-minute period, there shall be no change in pressure indicated on a test gage capable of accurately distinguishing minimum changes of 0.125 psi.

6.4 Position Error:

The difference in indicator reading when the indicator is rotated from the normal position to any other position shall not exceed 2-1/2% of full scale reading.

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.

7.1 Low and High Temperature:

The instrument shall be subjected to the applicable low and high temperatures as specified in paragraph 3.3.1, Column A for 3 hours. The scale errors determined for the indicator with gasoline also at the same temperature shall not exceed 6% of full scale value. Following this test and while still at the same temperature, the leak test of paragraph 6.3 shall be repeated.

7.2 Extreme Temperature Exposure:

The instrument shall, after alternate exposures to the applicable low and high temperatures specified in paragraph 3.3.1, Column B 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 paragraph 6.1. There shall be no evidence of damage as a result of exposure to the extreme temperatures specified herein.

7.3 Magnetic Effect:

The magnetic effect of the indicator shall be determined in terms of the deflection of a free magnet, approximately 1-1/2 inches long, in a magnetic field with a horizontal intensity of 0.18, plus or minus 0.01 gauss, when the indicator is held in various positions on an east-west line with its nearest part five 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 magnet shall not exceed one degree for any pointer deflection.