

TRUE MASS FUEL FLOW INSTRUMENTS

FOREWORD

Changes in the revision are format/editorial only.

1. SCOPE:

This SAE Aerospace Standard (AS) covers three basic types of true mass flow indicating instruments. Each may consist of an indicator, transmitter and other auxiliary means such as a power supply or amplifier as required.

1.1 Purpose:

This Aerospace Standard establishes the essential minimum safe performance standards for True Mass Fuel Flow Instruments primarily for use with turbine powered, subsonic transport aircraft, the operation of which may subject the instruments to the environmental conditions specified in Section 3.3.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP461

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SAE WEB ADDRESS:

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2.2 NTIS Publications:

Available from NTIS, Springfield, VA 22161.

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 instrument
- b. SAE, AS431
- c. Manufacturer's part number
- d. Manufacturer's serial number or date of manufacture
- e. Manufacturer's name and/or trademark
- f. Range
- g. Rating
- h. Explosion category

3.3 Environmental Conditions:

The following conditions have been established as minimum design requirements. 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 temperatures listed in Column A below and shall not be adversely affected by exposure to the range of temperatures listed in Column B below:

TABLE 1

Instrument Location	A	B
Power Plant Accessory Compartment	-30 to 150 °C	-65 to 150 °C
Pressurized Areas	-30 to 50 °C	-65 to 70 °C
Non-pressurized or External Areas	-55 to 70 °C	-65 to 70 °C

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- 3.3.2 Altitude: When installed in accordance with the instrument manufacturer's instructions, the instrument shall function from sea level up to the altitudes and temperatures listed below. Altitude pressure values are per NACA Report 1235.

TABLE 2

Instrument Location	Altitude Feet	Temperature
Power Plant Accessory Compartment	60,000	80 °C
Pressurized Areas	15,000	50 °C
Non-pressurized or External Areas	60,000	40 °C

The instrument shall not be adversely affected following exposure to extremes in ambient pressure of 50 and 3 inches Hg absolute, respectively.

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

TABLE 3

Instrument Location on Airframe	Cycles Per Second	Maximum Double Amplitude	Maximum Acceleration
Nacelle and Nacelle Mounts, Wings, Empennage and Wheel Wells	5-1000	0.036 inch	10 g
Fuselage			
Forward of Spar Area	5-500	0.036 inch	2 g
Center of Spar Area	5-1000	0.036 inch	4 g
Aft of Spar Area	(5-500	0.036 inch	7 g
	(500-1000	--	5 g
Vibration Isolated Rack	5-1000	0.030 inch	1.0 g
Instrument Panel	(5-30	0.020 inch	--
	(30-1000	--	0.25 g

- 3.3.4 Humidity: The instrument shall function and shall not be adversely affected following exposure to any relative humidity in the range from 0 to 95% at any temperature up to 70 °C.

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3.4 Explosion Category:

The instrument component, when intended for installation either in uninhabited areas of non-pressurized aircraft or in non-pressurized areas of pressurized aircraft, shall not cause an explosion when operated in an explosive atmosphere. The component shall meet the requirements applicable to the explosion category below. Specifically, any instrument component which can be an ignition source and is intended for installation in an area in which combustible fluid or vapor may result from abnormal conditions, e.g., fuel line leakage, shall meet the requirements of Category I. If the intended location is an area where combustible fluid or vapor can occur during normal operation, e.g., fuel tank, the instrument component shall meet the requirements of Category II, listed below:

TABLE 4

Category	Definition	Requirement
I	Explosionproofed: case not designed to preclude flame or explosion propagation.	Paragraph 7.13.1
II	Explosionproofed: case designed to preclude flame or explosion propagation.	Paragraph 7.13.2
III	Hermetically Sealed	Paragraph 6.3.7.7
IV	Instrument not capable of causing an explosion.	Shall not be capable of producing a capacitive or inductive spark of more than 0.2 millijoules of energy or a contact spark of more than 4.0 millijoules of energy.

3.5 Fire Hazard:

The instrument shall be so designed to safeguard against hazards to the aircraft in the event of malfunction or failure, and the maximum operating temperature of surfaces of any instrument component contacted by combustible fuel or vapor shall not exceed 200 °C due to self-heating.

3.6 Radio Interference:

The instrument shall not be the source of objectionable interference, under operating conditions at any frequencies used on the aircraft, either by radiation or feedback, in electronic equipment installed in the same aircraft as the instrument.

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3.7 Magnetic Effect:

The magnetic effect of the indicator shall not adversely affect the performance of other instruments installed in the same aircraft.

4. DETAIL REQUIREMENTS:

4.1 Indicating Method:

One of the following methods of indication shall be employed. A single instrument may be employed embodying the features of both the Type I and Type II instruments.

4.1.1 Type I Instruments: Rate of fuel flow shall be indicated by means of one or more moving pointers or dials and/or digital counter. Relative movement of the pointer with respect to the dial shall be clockwise for increasing rate of flow.

4.1.2 Type II Instruments: Fuel consumed or quantity remaining shall be indicated by means of a digital counter or one or more moving pointers or dials.

4.1.3 Type III Instruments: Rate of fuel flow shall be indicated by means of one or more moving pointers, dials, or counters. Relative movement of the pointer with respect to the dial shall be clockwise for increasing rate of flow.

Fuel consumed or quantity remaining shall be indicated by means of a digital counter or one or more moving pointers or dials.

4.2 Display Markings:

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

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

4.2.3 Numerals: The display shall include sufficient numerals to permit quick and positive identification of each graduation. Numerals shall distinctly indicate the graduation to which each applies.

4.2.4 Instrument Title: The instrument title when used shall be of the same approximate size, but no larger than the numerals. The title may be of the same finish as the numerals. The units of measure shall appear on the dial in lettering noticeably smaller than either the numerals or title.

4.2.5 Visibility: The indicating means and all markings shall be visible from any point within the frustum of a cone the side of which makes an angle of at least 30 degrees with the perpendicular to the dial and the small diameter of which is the aperture of the instrument case. The distance between the dial and the cover glass shall be a practical minimum.