

FUEL AND OIL QUANTITY GAGES

1. **PURPOSE:** To specify minimum requirements for Fuel and Oil Quantity Gages for use on aircraft, the operation of which may subject the instrument to the environmental conditions specified in Section 3.3.

2. **SCOPE:** This specification covers:

Type I - Float Gages

Type II - Capacitance Gages

3. **GENERAL REQUIREMENTS:**

3.1 **Material and Workmanship:**

3.1.1 **Materials:** Materials shall be of a quality which experience 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 each of the major components, or attached thereto:

- (a) Name of Component
- (b) SAE Spec. AS-405
- (c) Rating
- (d) Manufacturer's Part Number
- (e) Manufacturer's Serial Number or Date of Manufacture
- (f) Manufacturer's Name and/or Trademark

3.3 **Environmental Conditions:** The following conditions have been established as design requirements only. Test 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 unit shall function over the range of ambient temperatures shown in Column A below and shall not be adversely affected by exposure to the temperatures shown in Column B below:

<u>Instrument Location</u>	<u>"A"</u>	<u>"B"</u>
Heated Areas (Temperature Controlled)		
Components of both fuel and oil quantity gages	-30 to 50 C	-65 to 70 C
Unheated Areas (Temperature Uncontrolled)		
Components of fuel quantity gages	-55 to 70 C	-65 to 70 C
Components of oil quantity gages	-55 to 100 C	-65 to 100 C

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

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3.3.3 Altitude: The instrument shall function and not be adversely affected when subjected to a pressure and temperature range equivalent to -1000 to 40,000 feet standard altitude, except as limited by application of Section 3.3.1.

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

<u>Type of Component Mounting</u>	<u>Cycles Per Minute*</u>	<u>Amplitude*</u>	<u>Maximum Acceleration</u>
Shock Mounted Components	500 - 3000	0.005 inch	0.8 g
Unshock Mounted Panel Components	500 - 3000	0.010 inch	1.3 g
Structure Mounted Components	500 - 3000	0.030 inch	3.8 g
Engine Compartment Mounted Components	500 - 3000	0.20 inch	25.0 g

*Note: It is understood that the component shall withstand vibration at higher frequencies, but the acceleration values need not exceed those shown above.

When specified by the purchaser for use in rotary wing aircraft, the frequency range shall be 150 - 3000 cycles per minute.

3.3.5 Fire Hazard: The electrical circuit shall be so designed that the tank unit assembly shall not constitute a fire hazard in the airplane fuel or oil tank.

3.3.6 Seal: The tank unit connector head shall be an enclosed compartment designed to prevent fuel or oil leakage.

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 radio sets installed in the same aircraft as the instrument.

4. DETAIL REQUIREMENTS:

4.1 Dial Markings:

4.1.1 Increments: The intervals employed shall be determined by the capacity of the tank and the scale length in order to have a scale having sufficient graduations and numerals for easy reading without overcrowding.

4.1.2 Visibility: Pointer position and dial markings shall be visible from any point within the frustum of a cone the side of which makes an angle of 30° 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 and shall not exceed 0.25 inch.

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

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- 4.2 Power Variation: All units shall properly function with $\pm 15\%$ variation in D. C. voltage and/or $\pm 10\%$ variation in A. C. voltage and frequency, provided the A. C. voltage and frequency vary in the same direction.
- 4.3 Power Indication: Either a means shall be provided to permit the operation of a device to indicate whether the instrument is receiving power, or the pointer shall automatically move off scale at the "empty" end when the electric power to the instrument is "off".
5. TEST CONDITIONS:
- 5.1 Atmospheric Conditions: Unless otherwise specified, all tests required by this specification shall be made at an atmospheric pressure of approximately 29.92 inches of mercury and at an ambient temperature of approximately 22 C. When tests are made 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 amplitude at a frequency of 1500 to 2000 cycles per minute. The term amplitude as used herein indicates the total displacement from positive maximum to negative maximum.
- 5.3 Power: Unless otherwise specified, all tests for performance shall be conducted at a power rating recommended by the manufacturer.
- 5.4 Position: Unless otherwise specified, all tests shall be made with indicators and transmitters in normal operating position.
- 5.5 Vibration Stand: For vibration tests a stand shall be used which will vibrate at any desired frequency between 500 and 3000 cycles per minute and shall subject the instrument to vibration 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 amplitude specified herein.
- 5.6 Reference Liquid: If tests are to be conducted with liquid, the liquid shall be the type of fuel or oil for which the instrument is designed or its equivalent. If any tests are to be conducted with the liquid at a temperature other than that specified in paragraph 5.1, proper allowances may be made for the resulting variation in the characteristics of the liquid.
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 specification, including the following requirements where applicable.
- 6.1 Scale Error: The complete fuel or oil quantity gage shall be electrically connected and tested throughout the design range. The "empty" and "full" adjustments shall, if provided, be correctly made and shall not be further adjusted throughout the test. The percent of error at any point in the scale shall not exceed 5% of full scale indication in degrees for fuel gages and 6% for oil gages. The percentage of errors shall be calculated by comparison of readings taken from the design calibration of the system undergoing test.

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- 6.2 Friction: The indicator shall be tested for friction at the "empty" and "full" points and at three equally spaced intermediate points. The pointer shall be brought up to the desired reading and the input held constant while two readings are being taken. The first reading shall be taken before the indicator has been vibrated and the second one after the indicator has been vibrated. The difference between any two readings for the same point on the scale shall not differ by more than 2% of full scale indication in degrees.
- 6.3 Leak Test: The tank component shall be securely mounted in a suitable tank fixture. A test pressure of 15 lbs. per square inch shall be applied to the seal and there shall be no evidence of leakage.
- 6.4 Position Error: The change in pointer indication with change in indicator position shall not exceed 2% of full scale indication in degrees for both fuel and oil gages.
- 6.5 Power Variation Test: The input voltages and frequencies of the gage shall be varied between the limits specified under paragraph 4.2. The indication at any point on the scale shall not differ by more than 1% of full scale from the indication obtained with rated voltage and frequency.
- 6.6 Dielectric: The insulation shall be subjected to a dielectric test with an RMS voltage at a commercial frequency applied for a period of five seconds equivalent to five times normal circuit operating voltage, except where circuits include components for which such a test would be inappropriate the test voltage shall be 1.25 times normal circuit operating voltage. The insulation resistance shall not be less than 5 megohms at that 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.
- 7.1 Temperature Characteristics of the Gage: The indicator and interconnected component electrical accessories shall be subjected successively to a temperature of -55° C. and 70° C, with the tank unit held at room temperature for a period of not less than 4 hours each. At the completion of each of these periods, the change in fuel gage indication shall not exceed 2%, (oil gage 4%) of full scale indication in degrees from that obtained with all components at room temperature. The above tests shall be repeated with the identical units, except that those units previously subjected to extreme temperature shall be held at room temperature and those units which were at room temperature shall be subjected to the extreme temperatures.
- 7.2 Water Immersion Test (Type II Instruments): The complete gage assembly shall be electrically connected and the pointer adjusted to some midscale position. That portion of the tank unit exposed to fuel or oil shall then be completely immersed in distilled water for a five minute period. At the completion of this period the tank unit shall be withdrawn vertically from the water and allowed to drain for a two minute period without shaking, wiping, or artificial drying. At the end of this two minute interval the indication shall be within 10% of its reading prior to immersion. After drying, the assembly shall meet the requirements of Section 6.1.