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

AERONAUTICAL STANDARD

AS 408 A

PRESSURE INSTRUMENTS - FUEL, OIL, AND HYDRAULIC

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1. PURPOSE: To specify minimum requirements for pressure instruments 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 two basic types of pressure instruments. These are intended for use in measuring fuel, oil or hydraulic pressures as follows:

Type I	Direct Indicating
Type 2	Remote Indicating

This aeronautical standard does not apply to engine mounted torque meter systems.

3. GENERAL REQUIREMENTS:

3.1 Material 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 (Fuel, Oil or Hydraulic Pressure)

b. SAE Aeronautical Standard AS-408

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 (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 temperatures shown in Column "A" below and shall not be adversely affected by exposure to the range of temperatures shown in Column "B" below.

Component Location	"A"	"B"
Heated Areas (Temperature Controlled)	-30 to 50C	-65 to 70C
Unheated Areas (Temperature Uncontrolled)	-55 to 70C	-65 to 70C
Power Plant Compartment	-55 to 100C	-65 to 100C
Power Plant Accessory Compartment	-55 to 100C	-65 to 100C

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 feet to +40,000 feet standard altitude, except as limited by the application of paragraph 3.3.1.

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 Per Minute	Maximum Double Amplitude	Maximum Acceleration
Shock Mounted Panel	300- 3,000	.020"	1.5 g.

3.3.5 Overpressure: Pressure instruments shall not be adversely affected when subjected to overpressure as specified in the following table:

Maximum Indicating Pressure - PSI	Overpressure Percent Maximum Indicating Pressure Oil & Hydraulic	Fuel
0 to 199	150	120
200	200	120
201 to 1000	150	120
1001 to 2000	133	120
2001 up	125	120

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 Indicating Method: The pressure instrument shall indicate by means of a pointer moving over a fixed dial.

4.2 Dial Markings:

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

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

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

4.2.4 Instrument Name: The words "Fuel Pressure", "Oil Pressure" and/or "Hydraulic Pressure", or "Fuel PSI", "Oil PSI" and/or "Hydraulic PSI", whichever are applicable may be the same finish as the numerals. The inscription "PSI" or equivalent shall appear on the dial.

4.3 Visibility: The pointer 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 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 of an inch.

4.4 Connection Markings: The back of the case, where applicable, adjacent to the connections shall be distinctly marked to identify the pressure and vent connection.

4.5 Power Variations: All units shall properly function with ±15% variation in DC voltage and/or ±10% variation in AC voltage and frequency provided the AC voltage and frequency vary in the same direction.

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 25C. 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 paragraph 3.3.4 with the following characteristics:

5.3.1 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° to the horizontal plane, a circle, 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.

5.6 Test Liquid: The liquid used for applying pressure during the tests shall be the liquid with which the instrument is intended to be used or its equivalent.

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 Error: The instrument scale errors determined at any major graduation shall not exceed 5% of the full scale value. However, the instrument scale error determined at the mid-point major graduation shall not exceed 3% of the full scale value for instruments having a dial spread of 165 degrees or more.

6.2 Dielectric: Ungrounded instruments, or grounded instruments prior to connection of internal ground wire, shall be tested by either the method of paragraph 6.2.1 or 6.2.2.

6.2.1 Insulation Resistance: The insulation resistance measured at 500 volts D.C. (200 volts for hermetically sealed, helium filled instruments) between all electrical circuits connected together and the metallic case shall not be less than 20 megohms.

6.2.2 Dielectric Strength: The insulation shall withstand without evidence of damage the application of a sinusoidal voltage at a commercial frequency between all electrical circuits connected together and the metallic case, for a period of 5 seconds. The RMS value of the sinusoidal voltage applied shall be either five times the maximum instrument operating voltage, or 500 volts, whichever is the greater, except that on hermetically sealed, helium filled instruments the test voltage shall be 200 volts RMS.

6.3 Leak: There shall be no evidence of leakage after subjecting the instrument to a pressure of 80% of full scale value for a 15 minute period. The applied pressure shall be sealed off at a point within two inches of the instrument.

6.4 Position Error: The differences in instrument indication between tests in normal position and test in any other position shall not exceed 2½% of full scale value.

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 temperatures of paragraph 3.3.1, Column A, for 3 hours each, and while at these temperatures, the scale errors shall not exceed two times the scale error tolerances of paragraph 6.1.

7.2 Extreme Temperature Exposure: The instrument shall after alternate exposures to the applicable temperatures of paragraph 3.3.1, Column B, for periods of 24 hours each, and a delay of 3 hours at room temperature following completion of the exposure, meet the requirement 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: (Applicable only to components mounted outside of power plant). The magnetic effect of the instrument shall be determined in terms of the deflections of a free magnet, approximately 1½ inches long, in a magnetic field with a horizontal intensity of 0.18, plus or minus 0.01 gauss, when the instrument 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.

7.4 Humidity: The instrument shall be mounted in its normal operating position in a chamber maintained at a temperature of 70°C. plus or minus 2°C. and a relative humidity of 95% plus or minus 5% for a period of 6 hours. After this period, the heat shall be shut off and the instrument shall be allowed to cool for a period of 18 hours in this atmosphere in which the humidity rises to 100% as the temperature decreases to not more than 38°C. This complete cycle shall be conducted:

1. 15 times for instruments located in uncontrolled temperature areas.

2. 1 time for instruments located in controlled temperature areas.

Immediately after cycling the instruments shall be subjected to the scale error at room temperature test of paragraph 6.1. The change in reading between this test and the original scale error at room temperature test shall not exceed 2% of full scale reading.

7.5 Vibration: The instrument, while operating normally, shall be subjected to vibration of all frequencies within the appropriate range specified in paragraph 3.3.4 in order to determine if there exists any natural frequencies, of any parts, that lie within the specified range. The amplitude used may be any convenient value that does not exceed the maximum double amplitude specified in paragraph 3.3.4 and such as not to exceed the maximum acceleration specified in paragraph 3.3.4.

The instrument shall then be subjected to vibration at the appropriate maximum double amplitude or maximum acceleration specified in paragraph 3.3.4 at each of the above determined natural frequencies for a period of three hours. If no natural frequencies occurred in the appropriate frequency range, the appropriate frequency and double amplitude for this endurance test shall be determined from the following table:

	Cycles per Minute	Double Amplitude
Shock Mounted Panel	3000	.010

While the instrument is being vibrated, the maximum range of the pointer oscillation shall not exceed 5 degrees.

After completion of the exposure, no damage shall be evident and the instrument shall meet the requirements of Section 6.

7.6 Drift: The instrument shall be subjected to a pressure equivalent to half scale deflection for a period of one hour. At the end of that time the indicator reading shall not have changed by more than 1½%.