

**POWERPLANT FIRE DETECTION INSTRUMENTS - THERMAL & FLAME CONTACT
TYPES (RECIPROCATING ENGINE POWERED AIRCRAFT)**

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1. PURPOSE: To specify minimum requirements for powerplant fire detection instruments primarily for use in reciprocating engine powered civil transport aircraft, the operation of which may subject the instrument to environmental conditions specified in Paragraph 3.3.
2. SCOPE: This Aeronautical Standard covers the following basic types of fire detection instruments, or combinations thereof, intended for use in protecting aircraft powerplant installation, auxiliary powerplants, combustion heaters and other installations where fuel, oil or similar fires may occur.

2.1 Basic Types: Definition of

Type I Thermal - Fixed Temperature, an instrument which will actuate an alarm signal when exposed to any temperature above a definite pre-established level.

Type II Thermal - Rate of Rise, an instrument which will actuate an alarm signal when exposed to any rate of temperature change above a definite pre-established level.

Type III Flame - Contact, an instrument which will actuate an alarm signal when exposed to physical contact with flame.

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 (Powerplant Fire Detector)
- (b) SAE Aeronautical Standard AS 401B
- (c) Manufacturer's Part Number
- (d) Manufacturer's Serial Number or Date of Manufacture
- (e) Manufacturer's Name and/or Trademark
- (f) Type Number
- (g) Alarm Temperature (Sensing element, where applicable)
- (h) Rating (Electrical, Vacuum, etc.)

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.

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- 2 -

- 3.3.1 Temperature: When installed in accordance with the manufacturer's recommendations, 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 temperatures shown in Column B below:

<u>Instrument Location</u>	<u>A</u>	<u>B</u>
Powerplant Compartments	-30 to 100C	-65 to 100C
Pressurized Areas	-30 to 50C	-65 to 70C
Nonpressurized or external Areas	-55 to 70C	-65 to 70C

If instrument is intended for use in compartments where maximum ambient is higher than 100°C, appropriate special limits shall be selected for Column A and B, and specified by the manufacturer.

- 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 percent at a temperature of approximately 70°C.
- 3.3.3 Altitude: When installed in accordance with the instrument manufacturer's instructions, the instruments shall function from sea level up to the altitudes and temperatures listed below. Altitude pressures are per NACA Report 1235.

<u>Instrument Location</u>		
Powerplant Compartments	50,000'	(80 C)
Pressurized Areas	15,000'	(50 C)
Nonpressurized Areas	50,000'	(20 C)

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

- 3.3.4 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:

	<u>Frequency Cycles Per Sec.</u>	<u>Max. Double Amplitude - Inches</u>	<u>Maximum Acceleration</u>
Airframe Structure Mounted	5-500	.050	10g
Shock-Mounted Panel	5-50	.020	1.5g
Powerplant Mounted	5-500	.100	20g

- 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 -

- 3.5 Magnetic Effect: The magnetic effect of the instrument shall not adversely affect the operation of other instruments in the same aircraft.
- 3.6 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 200C due to self-heating.
4. DETAIL REQUIREMENTS:
- 4.1 Indication Means: The instrument shall be capable of actuating visual and/or aural alarm indicators.
- 4.2 Reliability: The instrument shall be of such design to withstand the mechanical and thermal shocks and stresses incident to its use in aircraft. False alarm signals shall not be produced by the instrument as the result of variations in voltage to be encountered during operation of the aircraft, abnormal attitudes, contaminating atmospheres, ambient light conditions, accelerations which could be encountered during flight, landing and take-off.
- 4.3 Integrity Test Means: The instrument shall be of such design to provide a means for testing the integrity of the instrument in flight.
- 4.4 Calibration Means: The instrument design shall be such that all calibration means be provided with tamper-proof seals.
- 4.4.1 Adjustable Detector Systems: Instruments which incorporate means for adjustment shall be tested to prove compliance with this standard, particularly paragraphs 7.2.1, 7.2.2, 7.2.3 and 7.12, throughout the range of adjustability.
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 at a relative humidity of not greater than 85 percent. 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 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 3.3.4 with the following characteristics:



- 4 -

- 5.3.1 Linear Motion Vibration: Vibration equipment for airframe structure-mounted or powerplant-mounted instrument components 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 instrument component shall be such that a point on the instrument case will describe, in a plane 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 a power rating recommended by the manufacturer.
- 5.5 Test Position: Unless otherwise specified, the instrument shall be mounted and tested in its normal operating position.
- 5.6 Flame Temperature Measurement and Flame Size: All flame temperatures shall be measured by using chromel-alumel thermocouples of 18 gauge wire. The thermocouple bead shall be at the center of the flame and the two wires leading to the bead shall be parallel and extend for a distance of 3 inches horizontally into the flame. The nature and size of the flame and the method of test shall be as specified in Figures 2-1, 2-2, 2-3 and 2-4. The thermocouple and the test article shall be the same distance from the burner face, to assure that the test article is exposed to the temperature measured.
6. INDIVIDUAL PERFORMANCE REQUIREMENTS: All instruments or components of such shall be subjected to whatever tests the manufacturer deems necessary to demonstrate that production articles comply with this Aeronautical Standard including the following requirements where applicable.
- 6.1 Sensitivity and Calibration: The sensor shall be tested as specified in Paragraph 7.1, or in an equivalent manner which will test the response sensitivity and calibration
- 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 D.C. 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.

- 5 -

- 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 R.M.S. 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 R.M.S.
- 6.2.2.2 Circuits that operate at potentials below 15 volts are not to be subjected to overpotential tests.

7. QUALIFICATION PERFORMANCE REQUIREMENTS: As many instruments as deemed necessary to demonstrate that the instruments comply with the requirements of this section shall be tested in accordance with the manufacturer's recommendations. The tests on each instrument shall be conducted consecutively in the order listed, and after the tests have been initiated, further adjustments to the instrument shall not be permitted. A false alarm signal occurring during any of the tests shall disqualify the instrument from further testing. A response time test per Section 7.1 shall be conducted after each test, except Sections 7.1.3, 7.2, 7.2.1, 7.2.3 and 7.12. In conducting the test of Section 7.12, the instrument(s) tested need not be the same instrument(s) being subjected to the entire series of qualification tests.

- 7.1 Response Time and Calibration: Each instrument shall be subjected to the response time and calibration tests listed below applicable to the particular type or combination thereof. Instruments shall be tested by the application of the test flame to a single unit type sensor or to a 6" length of a continuous type sensor. For instruments in which the sensitivity is affected by the number of sensing elements by the length of the sensing element (for continuous types) or by other factors which may be varied from one installation to another, all response time tests shall be conducted with the least sensitive configuration to be used. The unit sensor or segment of continuous sensor exposed to the test flame shall be that most critical for response time.

- 7.1.1 Response Time Test - Types I, II, and III: The sensor of the instrument shall be exposed to a maximum temperature test flame of 1100°C. as specified in Figure 2. The ambient temperature from which the test is started shall be room temperature, except a higher starting ambient temperature may be used if the sensor is specified for use only in locations where the ambient temperature will not, under continuous operating conditions, decrease below this value. The response time of all types shall not exceed five (5) seconds.

- 7.1.2 Calibration Test - Type I Only: The pre-adjusted operating temperature of the instrument specified by the manufacturer shall be that determined as the temperature at which an alarm signal occurs when the instrument is exposed in an essentially gradient free medium starting from room temperature with a low rate of temperature rise which will not affect the calibration.

