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AEROSPACE STANDARD

SAE AS400 REV. B

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Superseding AS400A

Cargo Compartment Fire Detection Instruments (Reciprocating Engine Powered Aircraft)

FOREWORD

Changes in this Revision are format/editorial only.

1. SCOPE:

This Aerospace Standard covers three basic types of cargo compartment fire detector instruments.

1.1 Basic Types - Definition of:

Type I Carbon Monoxide, an instrument which will actuate an alarm signal when the concentration of carbon monoxide in air exceeds a specified value.

Type II Smoke Detector, Electronic, an instrument operating on the principle of smoke particles modifying the relationship between a light beam and electronic light sensor which will actuate an alarm signal when the concentration of smoke in air exceeds a specified value.

Type III Smoke Detector, Visual, an instrument which, by visual means, will show in a positive manner the presence of smoke when the concentration of smoke in air exceeds a specified value.

1.2 Purpose:

This Aerospace Standard establishes the essential minimum safe performance standards for cargo compartment fire detector instruments primarily for use with reciprocating engine-powered transport aircraft, the operation of which may subject the instruments to the environmental conditions specified in Section 3.3.

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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 Instrument
b. SAE AS400B
c. Manufacturer's Part Number
d. Manufacturer's Serial Number or Date of Manufacture
e. Manufacturer's Name and/or Trade-mark
f. Rating (Electrical, Vacuum, Etc.)
g. Type Number
h. Alarm Setting

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 ranges 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.

TABLE 1

Instrument Location	A	B
Heated Areas (Temperature Controlled)	-30 to 50 °C	-65 to 70 °C
Unheated Areas (Temperature Uncontrolled)	-55 to 70 °C	-65 to 70 °C

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

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 Airframe	Cycles Per Second	Maximum Double Amplitude (Inches)	Maximum Acceleration
Wings or 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 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 a temperature of approximately 70 °C.

3.4 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.

3.5 Radio Interference:

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

3.6 Magnetic Effect:

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

4. DETAIL REQUIREMENTS:

4.1 Design:

4.1.1 The instrument shall consist of a means for:

Type I Testing air for carbon monoxide content, it shall be capable of actuating an alarm signal at a concentration of 0.020 ± 0.005 percent of carbon monoxide by volume.

Type II Testing air for smoke content of all colors or particle sizes, it shall be capable of actuating an alarm signal to indicate the presence of smoke particles at a concentration which reduces the light transmission to 70 ± 10 percent. Percentage of transmission is defined as the light falling on a Weston Model 594 or equivalent photo-electric cell through a one foot distance occupied by smoke particles in air, as compared to the light transmitted through one foot of clear air. The light intensity is to be so adjusted that the cell output with a 50 percent transmission screen is 50 percent of the output of the unobscured cell.

Type III Testing air for the presence of smoke of all colors or particle sizes, it shall include a visual display and an alarm signal to clearly indicate the presence of smoke particles of a concentration that would reduce light transmission to not less than 60 percent. Percentage of transmission is defined as the light falling on a Weston Model 594 or equivalent photo-electric cell through a one foot distance occupied by smoke particles in air, as compared to the light transmitted through one foot of clear air. The light intensity is to be so adjusted that the cell output with a 50 percent transmission screen is 50 percent of the output of the unobscured cell.

4.2 Indicating Method:

Instruments of all types shall be capable of actuating visual and aural alarm indicators.

4.3 Reliability:

The instrument shall be of such design to withstand the mechanical and thermal shocks, and stresses incident to its use in aircraft. It shall not alarm as a result of dust and haze as normally present in the cargo compartment. False alarm signals shall not be produced by the instrument as the result of variations in voltage between 0 and 125 percent of the rated value, abnormal attitudes, ambient light conditions, accelerations which could be encountered during flight, landing and takeoff.

4.4 Functional Test Means:

The instrument shall be of such design to provide a means for testing in flight the function of the instrument.

4.5 Calibration Means:

The instrument design shall be such that all calibration means be provided with tamper-proof seals.

4.6 Sampling Characteristics:

When an instrument is designed to sample the air from more than one sampling station on a cycling basis, it shall cycle at a rate sufficient to sample all stations within a total time of one minute. The dwell at each station shall be at least twice the response time of the specific model detector being used with the sampler. Response time is that defined in Paragraph 6.2. Flow of air through all the sampling conduits shall be maintained continuously. In addition, when a smoke alarm signal is indicated, an alarm signal shall be actuated to indicate the location in which the smoke or gas is being generated and to continue to indicate the alarm signal until the condition is eliminated. It shall begin cycling in a normal manner within 30 seconds after the alarm signal is cleared.

4.7 Power Variation:

The instrument shall properly function with plus or minus 15 percent variation in DC voltage and/or plus or minus 10 percent variation in AC voltage and plus or minus 5 percent variation in frequency of rated values.

5. TEST CONDITIONS:

5.1 Atmospheric Conditions:

Unless otherwise specified, all tests required by this Aerospace Standard shall be made at an atmospheric pressure of approximately 29.92 inches of mercury, an ambient temperature of approximately 25 °C and at a relative humidity of not greater than 85 percent. When tests are conducted with atmospheric pressure or temperature substantially different from these values, allowance 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 25 to 33 cycles per second. 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 3.3.3 and 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 degrees 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 in normal operating position.

5.6 Air Sample:

Unless otherwise specified, air samples shall be as follows:

Type I Air containing 0.020 percent plus or minus 0.005 percent of carbon monoxide.

Type II Air containing smoke having a light transmission value of 70 ± 10 percent of that of clear air measured through a one foot distance, as defined in Paragraph 4.1.1, Type II.

Type III Air containing smoke having a light transmission value of 70 ± 10 percent of that of clear air measured through a one foot distance, as defined in Paragraph 4.1.1, Type III.

6. INDIVIDUAL PERFORMANCE REQUIREMENTS:

All instruments shall be subjected to whatever tests the manufacturer deems necessary to demonstrate specific compliance with the Aerospace Standard, including the following requirements where applicable.

6.1 Dielectric:

Each instrument shall be tested by the method of inspection listed in Paragraphs 6.1.1 and 6.1.2.

6.1.1 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.

6.1.2 Overpotential Tests: The instruments 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 Paragraph 6.1.2.1 or 6.1.2.2, 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 insure 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.

6.1.2.1 Hermetically sealed instruments shall be tested at five times the maximum circuit voltage up to a maximum of 200 volts RMS.

6.1.2.2 Circuits that operate at potentials below 15 volts are not to be subjected to overpotential tests.

6.2 Response Time:

Instruments of Types I through III shall be tested so that when an air sample applicable to the type of instrument per Paragraph 5.6 is introduced into the instrument under standard atmospheric conditions, the alarm signal shall be actuated within a maximum time period of one minute.

7. QUALIFICATION TESTS:

As many instruments as deemed necessary by the manufacturer to demonstrate that all instruments will comply with the requirements of this section shall be tested in accordance with his recommendations. The tests of each instrument shall be conducted consecutively and after the tests have been initiated, no further adjustments of the instrument shall be permitted. For those instruments which employ a cycling device for testing a multiplicity of locations with one instrument, these tests shall be conducted on the basis of a single sample station. During these tests, if a false alarm signal occurs, the instrument is disqualified from further testing.

7.1 Stability:

The instrument shall be operated continuously for 24 hours at room temperature. At the end of the first and twenty-fourth hour at operation, the instrument shall meet the requirements of Paragraph 6.2.

7.2 Differential Pressure Variation:

The instrument, where pressure differential is employed, shall be operated continuously by varying the pressure differential from 25 percent below to 25 percent above the rated. At each of these values, the instrument shall meet the requirements of Paragraph 6.2.

7.3 Power Variation:

The instrument shall be operated with the power varying over the limits given in Paragraph 4.7 and for AC powered instruments shall include the worst combinations of voltage and frequency. The instrument shall, at the maximum and minimum and worst combination values, meet the requirements of Paragraph 6.2.

7.4 Low Temperature Operation:

The instrument shall be subjected to the applicable low ambient temperature listed in Column A of Paragraph 3.3.1 for a period of five hours without operating. The instrument shall meet, at that temperature, after five hours exposure, the requirements of Paragraph 6.2.

7.5 High Temperature Operation:

The instrument shall be subjected to the applicable high ambient temperature listed in Column A of Paragraph 3.3.1 for a period of five hours without operating. (Electrical equipment shall be energized.) The instrument shall meet, at that temperature, after five hours exposure, the requirements of Paragraph 6.2.

7.6 Extreme Temperature Exposure:

The instrument shall be exposed to the applicable low and high temperatures listed in Column B of Paragraph 3.3.1 for a period of 24 hours at each extreme temperature, without operating but energized. After a delay of 3 hours at room temperature, the instrument shall meet the requirements of Paragraph 6.2 at room temperature. There shall be no evidence of damage as a result of exposure to the extreme temperature specified.

7.7 Humidity:

The instrument, unless hermetically sealed, shall be mounted in a chamber maintained at a temperature of 70 ± 2 °C and a relative humidity of 95 ± 5 percent for a period of six 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 percent as the temperature decreases to not more than 38 °C. This complete cycle shall be conducted:

a. Five times for components located in uncontrolled temperature areas.
b. Once for components located in controlled temperature areas.

Immediately after recycling, there shall be no evidence of damage or corrosion which affects performance. Following this test, the instrument shall meet the requirements of Paragraph 6.2.