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An SAE International Group

AEROSPACE RECOMMENDED PRACTICE

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Superseding ARP4001A

Lavatory Smoke Detectors

RATIONALE

This technical report covers technology, products, or processes which are mature and not likely to change in the foreseeable future.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE S-9 Cabin Safety Provisions Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. SCOPE:

1.1 The purpose of this SAE Aerospace Recommended Practice (ARP) is to describe key features that should be incorporated in the lavatory smoke detector system. Consideration has been given to existing requirements of the FAA and to recommendations of aircraft operators and manufacturers. This document is deliberately not specific in all areas in order to maximize the freedom to use state-of-the-art design and manufacturing technologies. Safe, reliable, and effective lavatory smoke detectors remain the primary goal of the document.

1.2 The intent of installing smoke detectors in aircraft lavatories is to enhance, through auditory and visual signals, the ability of flight attendants to detect fires in the cabin, and not to serve as primary detectors such as those used in isolated cargo compartments.

2. REFERENCES:

2.1 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.

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

ARP1315 Lavatory Installation

2.1.2 RTCA Publications: Available from Radio Technical Commission for Aeronautics, Inc., 1140 Connecticut Avenue, NW, Suite 1020, Washington, DC 20036.

DO-160	Environmental Conditions and Test Procedures for Airborne Equipment
DO-178	Software Consideration in Airborne Systems and Equipment Certification

2.1.3 Underwriters Laboratories Publications: Available from Underwriters Laboratories Publications, 333 Pfingsten Road, Northbrook, IL 60062.

UL217	Single and Multiple Station Smoke Detectors
UL268	Smoke Detectors for Fire Protection Signaling Systems

2.1.4 U.S. Government Publications: Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-HDBK-217F	Reliability Prediction of Electronic Equipment

2.2 Related Publications:

The following publications are provided for information purposes only and are not a required part of this SAE Aerospace Technical Report.

2.2.1 Fire Protection Handbook, Section 15-3, 15-4 - National Fire Protection Association, Quincy, Mass.

3. GENERAL RECOMMENDATIONS:

Classification: Type I of this document describes a single station, stand alone smoke detector unit similar to those found in commercial-type (e.g., hotel) applications. Type I smoke detectors should include provisions for connection to a power source. The detector's purpose is to sense the presence of smoke and activate appropriate visual and/or aural alarm indicators.

Type II describes a system, which consists of an assembly of electrical components that would provide smoke detection, signaling, and optional remote control circuitry under the command of a central control panel.

A detector may be approved as both Type I and Type II device.

As applicable, the same design criteria shall be applied to both Type I and Type II detectors.

The following recommendations apply to both Type I and Type II detectors.

3.1 Mechanical:

3.1.1 The weight of the smoke detector and/or system shall be minimized, consistent with prudent design requirements and practices.

3.1.2 Detector design shall preclude unauthorized deactivation, tampering, and/or theft. Sensitivity adjustments shall be possible only prior to installation.

3.1.3 The sensing chamber shall be screened or designed to preclude false activation of the detector by insects, airborne dust or aerosol accumulations.

3.1.4 The detectors shall be installed on the lavatory compartment ceiling or on a sidewall no more than 12 in from the ceiling. The effectiveness of the location shall be validated by test or similarity analysis to a previously tested installation.

NOTE: Applicable for ambient air smoke detectors only. Duct types can be installed outside the compartment.

3.1.5 Materials, except electrical system components, used in the Type I and Type II smoke detection systems must meet all requirements of FAR 25.853(a). Electrical system components must meet the requirements of FAR 25.869(a).

3.2 Electrical:

3.2.1 The insulation resistance between mutually insulated parts of circuits and between circuits and housing components shall be 100 MΩ, minimum, when measured at 500 V DC.

3.2.2 When a 1500 V AC, 60 Hz, test voltage is applied at a uniform rate of 250 to 500 V, maximum, per second and maintained for a period of 1 min, detectors shall show no evidence of current leakage flow in excess of 0.5 mA or sparkover or insulation breakdown at 1500 V AC or lower between two mutually insulated parts of circuits and between circuits and equipment chassis or case ground.

3.2.3 Detectors should be physically protected against reverse polarity.

3.2.4 When installed and activated, the detectors shall show, through indicators (including aural alert) or response to automatic tests, that electrical power is continuously on.

3.3 Maintenance and Reliability:

3.3.1 Routine maintenance and functional testing of the smoke detector shall not require its removal from the aircraft or from the detector system. Access to maintenance/test switches shall be protected from unauthorized or untrained personnel. Specialized tooling for maintenance/testing shall be kept to a minimum.

3.3.2 In the case of photoelectric smoke detectors, the self-test feature shall test not only the electronics of the detectors, but also the sensing chamber.

3.3.3 Detectors that contain radioactive materials are subject to the safety requirements of local or state radiation control agencies and/or the U.S. Nuclear Regulatory Commission. It will be the manufacturer's responsibility to certify compliance with all requirements - including proper labeling - prior to the detector's installation on the aircraft.

3.3.4 Reliability shall be defined as the mean time between failures (MTBF) in aircraft flight hours. It can be calculated per MIL-HDBK-217F or superseding document. MTBF may also be calculated based on operating experience.

3.3.5 Detectors shall be designed to allow periodic cleaning of the sensor chamber without extensive dismantling of the detector. The manufacturer shall provide complete cleaning instructions.

3.3.6 The manufacturer shall provide a standard for the detector's sensitivity and a method to verify that sensitivity.

3.3.7 The smoke detector shall be tested at an interval that will assure its operational availability considering the designed service life and MTBF of the unit.

3.4 Markings:

3.4.1 Markings shall be required on each Type I smoke detector or on each major component of a Type II smoke detector system. These markings can be permanently stamped/molded into the units, or the information can be presented on permanently attached placards.

3.4.2 As a minimum, the following information is required:

a. Manufacturer's name
b. Device name and part number (model number)
c. Serial number or date of manufacture
d. Electrical data (e.g., voltage, current, etc.)
e. Weight
f. Smoke sensitivity rating
g. Appropriate and required warnings on those devices which contain radioactive materials (Reference UL268)

3.4.3 Additional markings may include:

a. Mounting position of device (e.g., FWD, THIS SIDE UP, etc.)
b. Identification of major components (e.g., diodes, relays, switches, microelectronics, etc.)
c. Maximum environmental operating parameters (e.g., temperatures, DO NOT PAINT, etc.)
d. References to other technical bulletins or installation wiring diagrams

3.5 Computer Software:

If the equipment design implementation includes embedded software, the computer software must be verified and validated in accordance with RTCA Document D0-178. The applicant must submit suitable software documentation for review and approval.

4. TYPE I RECOMMENDATIONS - SINGLE STATION, COMMERCIAL SMOKE DETECTORS:

4.1 The units can be electronically latching or non-latching devices. As a minimum, Type I detectors will provide an aural warning in the presence of smoke. The recommended aural level is at least 10 db above background noise outside the lavatory.

4.2 Auxiliary contacts included on the Type I detectors may activate remote control circuitry (e.g., attendant call light). The suggested minimal rating for these contacts is 1A resistive for 28 V DC and 0.5 A for 115 V AC.

4.3 An optional heat sensor may be incorporated as part of the Type I detector. It would normally be open and would close at a predetermined level (e.g., 165 °F).

4.4 If a battery is used as a source of power, the battery should be accessible for replacement without removal of the detector from the lavatory.

4.5 Thermoplastics used in Type I detectors shall conform to the specifications defined by UL268, Section 55.