



AEROSPACE STANDARD

AS8048

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Performance Standard for Passenger Smoke and Toxic Fumes Respiratory Protective Equipment

RATIONALE

AS8048 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

This SAE Aerospace Standard (AS) defines the performance requirements for equipment to be used by untrained cabin occupants for protection from toxic and irritant atmospheres while on board and during evacuation of an aircraft.

1.1 Purpose

This standard establishes the minimum requirements for the design, construction and performance of respiratory protective equipment for passengers in civil commercial aircraft.

1.2 Classification

This equipment is required to protect and to be suitable for use by passenger/cabin occupants during the following scenarios:

Class 1: Emergency ground evacuation of an aircraft during smoke/toxic fume conditions. The required protection shall be provided for a minimum of 3 minutes.

Class 2: In-flight smoke/toxic fume conditions at normal cabin pressure up to 10,000-ft equivalent cabin altitudes. The required protection shall be provided for a minimum of 17 minutes.

Class 3: In-flight smoke/toxic fume conditions [as per Class 2] followed by an emergency ground evacuation of the aircraft [as per Class 1]. The required protection shall be provided for a minimum of 20 minutes.

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<http://www.sae.org/technical/standards/AS8048>

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 issue or revision date of this document. 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 International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

ARP1109	Dynamic Testing Systems for Oxygen Breathing Equipment
ARP4259	Metabolic Simulator Testing for Aviation Breathing Equipment
AS8010	Aviators Breathing Oxygen Purity Standard
AS8031	Personal Protective Devices for Toxic and Irritating Atmospheres
AS8047	Performance Standard for Cabin Crew Portable Protective Breathing Equipment for Use During Aircraft Emergencies

2.1.2 FAR and FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

FAR PART 25 Airworthiness Standards: Transport Category Airplanes

TSO-C116 Crew Protective Equipment

2.1.3 RTCA Publications

Available from RTCA, Inc., 1828 L Street, NW, Suite 805, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

RTCA/DO-160 Environmental Conditions and Test Procedures for Airborne Equipment

2.2 Definitions

ATPD: Ambient Temperature and Pressure Dry

NTPD: Normal Temperature and Pressure Dry (21 °C and 760 mm Hg)

STPD: Standard Temperature and Pressure Dry (0 °C and 760 mm Hg)

BTPS: Body Temperature and Pressure Saturation (37 °C and 760 mm Hg)

POINT OF MINIMUM FLOW: Specific time during the course of the device test at which gas flow is lowest.

UNACCEPTABLE HAZARD: Probability of death or serious injury due to the equipment being used or installed should not be greater than a probability of more than 10^{-8} .

USEFUL LIFE: Combination of storage life and installed service life.

WET BULB TEMPERATURE: Temperature measured by a thermometer the bulb of which is covered by a water-saturated wick.

WORKLOAD: Reference to external work rates, defined as watts.

3. EQUIPMENT DESCRIPTION

3.1 Technical Requirements

This section defines the technical requirements for the equipment in order to ensure reliability, safety, and serviceability.

- 3.1.1 The equipment shall not cause an unacceptable hazard to the user or the aircraft during stowage or use and shall satisfy the applicable sections of the reference documents (see 2.1). Failure modes and effects analysis of the equipment shall be conducted in order to demonstrate that the equipment will function under conditions stated herein.
- 3.1.2 The equipment shall be supplied with a means to determine serviceability while in its stowed condition.
- 3.1.3 If a filter system is used for the equipment, the inspired gas shall meet the applicable performance requirements of this document. For non-filtered systems, the inspired gas shall be aviator's breathing oxygen per AS8010.
- 3.1.4 The equipment shall have a 98% minimum reliability factor at 90% confidence level during its useful life. The minimum useful life of the equipment shall be specified.
- 3.1.5 The equipment shall be capable of being donned by the user after minimal training that could be provided in a typical preflight briefing. The manufacturer must supply the customer with recommended training procedures. Donning shall take no more than 20 seconds after access is gained to the stowed equipment. It must be possible to don the equipment on children or incapacitated people by another individual with a minimum of effort. Failure or malfunction of the equipment must be apparent to the user such that appropriate and timely action can be taken. The equipment must be capable of being doffed within 3 seconds and the doffing procedure must not require training.
- 3.1.6 The equipment shall be targeted to afford protection to the required class for the 5% female (neck size circumference 11.1 inches) to 95% (neck size circumference 16.4 inches) male adult population and satisfy metabolic requirements demanding up to 25 liters of oxygen. Additional fitting adjustment may be permitted and external assistance afforded for children.
- 3.1.7 The equipment shall have a means to prevent over pressure of the breathing circuit and rupture protection of any pressurized container.

3.2 Performance Requirements

The equipment shall protect the respiratory system of the user from exposure to smoke, heat, particles, and toxic or irritating gases and fumes.

- 3.2.1 The average CO_2 partial pressure at mouth/nose shall not exceed 4 kPa (30.0 mm Hg) time weighted average over the specified protection period. The average CO_2 partial pressure at mouth/nose shall not exceed 5 kPa (37.5 mm Hg) time weighted average over any 2 minute period.

3.2.2 The mean inspired contamination within the device shall not exceed 5% of the level in ambient atmosphere.

3.2.3 The equipment shall provide the required protection for the work profile listed below:

Class 1: 1 minute at 160 Watts
2 minutes at 70 Watts

The order of work level accomplishment may be reversed.

Class 2: 17 minutes at 50 Watts

Class 3: The Class 1 profile can occur at any time in the 20-minute period. The remaining portion of the period is at Class 2 work profile.

3.2.4 The internal temperature of the unit shall not exceed 42 °C wet bulb at an ambient temperature of 21 °C.

3.2.5 Unit must function satisfactorily in a 100 °C environment, where the internal temperatures shall not exceed 50 °C wet bulb for a 2-minute exposure.

3.2.6 The equipment shall perform satisfactorily when donned at any time in the breathing cycle.

3.2.7 Inhalation resistance of the unit shall not exceed 1.33 kPa (10.0 mm Hg) at 100 liters NTPD per minute.

3.2.8 The equipment shall be capable of supporting an instantaneous flow of 3.3 L/s BTPS. Within 20 seconds of donning the equipment the inhalation atmosphere shall meet the required performance level defined in 3.2.1.

3.2.9 The equipment shall be capable of handling a total minute volume of 80 liters per minute at BTPS conditions for any 60-second period during its required operational cycle at an average tidal volume of 3 liters.

3.2.10 The equipment must satisfactorily operate up to 10,000-ft cabin altitude. It must present no additional hazard when subjected to rapid decompression from 10,000 to 40,000-ft altitude within 5 seconds with subsequent recompression within 2 minutes. The equipment need not provide hypoxia protection.

3.2.11 The equipment shall be worn leaving both hands free. It shall remain in place and not materially impede vision or movements during activities such as crawling, kneeling, or running when worn under evacuation conditions.

3.2.12 The equipment shall afford the level of protection specified in 3.2.2 when exposed to the challenge environment in Table 1. The integrity of the equipment's material and construction shall not be adversely affected by an exposure of 20 minutes to the challenge atmosphere.

During operation in Class 1 or the evacuation portion of Class 3, the equipment would be exposed to these concentrations for the entire 3-minute duration. During the in-flight portion of Class 2 and Class 3, it is likely that conditions in the passenger compartment will be somewhat less severe than those listed in Table 1. It is assumed that the gases found in the challenge atmosphere would be the same but that the average concentrations of both the gases and particulate would increase linearly from 0 to 50% of those specified during the 17-minute in-flight period.

In the case of a filter-based device, compliance of the filter with 3.2.2 is demonstrated by subjecting the filter element to the challenge gases in a laboratory environment, without use of human subjects. Compliance of other portions of a filter-based device and all portions of a device that does not utilize a filter is demonstrated by testing in accordance with AS8031.

TABLE 1 - CHALLENGE GAS CONCENTRATIONS²

Specific Gas	Challenger Concentrations
Carbon Dioxide (CO ₂)	35,000 ppm (3.5%)
Carbon Monoxide (CO)	10,000 ppm (1%)
Total Hydrocarbon (as Hexane)	5,000 ppm
Hydrogen Cyanide (HCN)	400 ppm
¹ Oxides of Nitrogen (N _x O _x)	200 ppm
¹ Acrolein	50 ppm
¹ Ammonia (NH ₃)	1,000 ppm
¹ Hydrogen Bromide (HBr)	1,000 ppm
¹ Sulfur Dioxide (SO ₂)	100 ppm
¹ Hydrogen Chloride (HCl)	1,000 ppm
¹ Hydrogen Fluoride (HF)	1,000 ppm
¹ Particulate (0.5 to 10 micron)	3.5 mg/l
Oxygen	17 to 21%
Water Vapor	10 to 95%
¹ Irritant substances that could affect vision.	
² The values in this table are representative of those collected from burn tests of materials similar to those found in aircraft.	

3.3 Construction and Material Requirements

This section defines the general requirements of construction and the materials used in order to ensure that the equipment will satisfy the environmental requirements. The eyes and surrounding areas shall be afforded basic protection from debris, particles, irritant gases, and smoke.

- 3.3.1 The equipment and its case or stowage means shall be constructed of materials that are flame retardant and satisfy the requirements of FAR 25.853.
- 3.3.2 The exposed portions of the equipment shall withstand a radiant heat flux level of (1.14 watts/cm²) for 60 seconds, dripping plastic at 200 °C, and a 900 °C flame for 3 seconds without penetration of the equipment.
- 3.3.3 The material/fabrication of the device shall be puncture and tear resistant as defined by current materials standards.
- 3.3.4 The equipment shall not prevent the wearer from passing through an opening 381 mm width by 508 mm in height.
- 3.3.5 The equipment shall not require manual means of adjustment, unless it can be demonstrated that the use of such means is intuitively apparent during the act of donning or as instructed during the preflight briefing.
- 3.3.6 The optical portion when present shall permit the following minimum binocular field of view:
Horizontal meridian: 120 degrees (60 degrees on each side of the centerline).
Vertical meridian: 60 degrees (40 degrees above and 20 degrees below the centerline).
- 3.3.7 The quality of any optics associated with the device shall be such that the standard single exit locator sign can be read at a distance of 6 meters under emergency lighting conditions.
- 3.3.8 The materials shall be shown to be compatible with the oxygen concentration of the supply gas.