

# European Aviation Safety Agency

## European Technical Standard Order

**Subject:** Crewmember Portable Protective Breathing Equipment

### 1 — Applicability

This ETSO provides the requirements which Crewmember Portable Protective Breathing Equipment that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

### 2 — Procedures

#### 2.1 — General

Applicable procedures are detailed in CS-ETSO, Subpart A.

#### 2.2 — Specific

None.

### 3 — Technical Conditions

#### 3.1 — Basic

##### 3.1.1 — Minimum Performance Standard

Standards set forth in the SAE AS8047, Performance Standard for Cabin Crew Portable Protective Breathing Equipment for Use During Aircraft Emergencies, dated 6/1/2002, as modified by Appendix 1 to this ETSO.

Crew member portable PBE are separated into four classes suitable for use by crew members during the following scenarios:

Class 1: For an in-flight cabin or accessible compartment smoke/fire conditions at normal cabin altitude (up to 8 000 ft equivalent).

Class 2: In addition to the requirements of Class 1, protection against a subsequent depressurisation to 40 000 ft while wearing the unit.

Class 3: Emergency ground evacuation of the aircraft during fire/smoke conditions, operating escape systems and assisting passengers.

Class 4: In-flight emergency and ground evacuation during smoke/fire conditions (as per Class 1 & 3 combined).

##### 3.1.2 — Environmental Standard

See paragraph 6.3 of Appendix 1 to this ETSO.

**ETSO-C116a**

3.1.3 — Computer Software

None.

3.1.4 — Electronic Hardware Qualification

None.

3.2 — Specific

None.

3.2.1 — Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

**4 — Marking**

4.1 — General

Marking as detailed in CS-ETSO, Subpart A, paragraph 1.2.

4.2 — Specific

In addition, the crew member's portable PBE shall be marked permanently and legibly with the class (see paragraph 3.1.1 above).

**5 — Availability of Referenced Document**

See CS-ETSO, Subpart A, paragraph 3.

**Appendix 1**

**MPS FOR CREWMEMBER PORTABLE PBE**

The applicable standard is SAE AS8047, Performance Standard for Cabin Crew Portable Protective Breathing Equipment for Use During Aircraft Emergencies, dated 6/1/2002. It shall be modified as follows:

<b>SAE AS 8047 section:</b>	<b>Action:</b>
Section 1.1 Scope:	To be disregarded.
Paragraph 2.1 Applicable Documents:	<p>The following documents shall be added:</p> <p>AS 8026A, Crewmember Demand Oxygen Mask for Transport Category Aircraft</p> <p>AS 1303A, Portable Chemical Oxygen</p> <p>To be revised:</p> <p>CS-25, Certification Specifications Large Aeroplanes</p> <p>AS 8010C, Aviator’s Breathing Oxygen Purity Standard</p> <p>AS 8031A, Personal Protective Devices for Toxic and Irritating Atmospheres, Air Transport Crew Members</p> <p>ETSO-C99a, Flight Deck (Sedentary) Crewmember Protective Breathing Equipment</p> <p>ETSO-C69c, Emergency Evacuation Slides, Ramps and Slide/Ramp Combinations</p> <p>ASTM D1149, Standard Test Method for Rubber Deterioration — Surface Ozone Cracking in a Chamber</p> <p>ASTM D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers</p> <p>ASTM D750, Standard Test Method for Rubber Deterioration Using Artificial Weathering Apparatus</p> <p>ASTM D228, Abrasion Resistance</p> <p>ASTM D1922-REVA, Standard Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method</p> <p>ASTM D1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting</p> <p>ASTM D2582, Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting</p>

**Appendix 1**

**MPS FOR CREWMEMBER PORTABLE PBE (continued)**

<b>SAE AS 8047 section:</b>	<b>Action:</b>
Paragraph 3.1.1	<p>Following paragraphs to be added:</p> <p>3.1.1 Unit must be a self-contained device, (containing a supply or source of breathable gas) which will not increase the risk to the user or the aircraft during storage or use, and must satisfy the requirements of the applicable sections of CS 25.1439 and the required operational regulations.</p> <p>3.1.1.1 Breathable gas source may be either oxygen or air.</p> <p>3.1.1.2 Use of a chemical oxygen generator is an acceptable alternative.</p> <p>3.1.1.3 Breathable gas must meet the gas standard for purity, SAE AS8010 Rev C, Aviator's Breathing Oxygen Purity Standard. For air, compliance with the purity standards in AS8010C, Table 2, Constituent Maximum Concentrations for Chemical Oxygen, has to be shown. Type IV chemically-generated oxygen for emergency-use shall be used.</p>
Paragraph 3.1.2	<p>To be revised:</p> <p>3.1.2 Portable PBE unit must adequately protect any adult (within the 5th percentile female (107 lbs, 11.1-inch neck circumference) to 95th percentile male (220 lbs, 16.4-inch neck circumference) body dimensions), including spectacle users. To demonstrate compliance with spectacles, eyeglasses must be a minimum of 152 mm (6 inches) wide by 51 mm (2 inches) high.</p> <p>3.1.2.1 Facepiece designers should consider extremes of Naison-Menton, Bizygomatic, Bigonial and Naison-Supramentale measurements and other applicable anthropometric data to provide a device with adequate fit. Sources of data are listed in paragraph 2.</p> <p>3.1.2.2 Limitations/recommendations shall be included in the IM/CMM (required in paragraph 5.b of this ETSO) for using portable PBE with long hair and/or beards.</p> <p>3.1.2.3 The size of the portable PBE unit when donned must allow the wearer to pass through any access opening 18 inches (460 mm) × 18 inches (460 mm) to investigate and/or combat an in-flight fire.</p>

**MPS FOR CREWMEMBER PORTABLE PBE (continued)**

SAE AS 8047 section:	Action:
Paragraph 3.1.4	<p>To be revised:</p> <p>3.1.4 Failure of the unit to operate or to cease operation must be apparent to the user. This must be accomplished with aural and/or visual warning that also must activate at gas supply exhaustion.</p>
Paragraph 3.1.5	<p>To be disregarded.</p>
Paragraph 3.1.6	<p>To be revised:</p> <p>3.1.6 Unit must not cause a hazard when stored, in use, or during inadvertent operation.</p>
Paragraph 3.1.8	<p>To be revised:</p> <p>3.1.8 The portable PBE unit must have a 98 % minimum reliability factor at 90 % confidence level during its design service life. A shelf life, operational limit and/or maintenance interval must be established and included in the CMM.</p>
Paragraph 3.1.10	<p>To be revised:</p> <p>3.1.10 Portable PBE must wear comfortably in use leaving both hands free. It must not displace during normal tasks of locating and combating a fire, such as crawling, kneeling or running.</p>
Paragraph 3.1.11	<p>To be revised:</p> <p>3.1.11 Hoods, Full-Face Masks with Lenses, and/or Integral Goggles</p> <p>3.1.11.1 Range of Vision: Portable PBE must permit peripheral vision in the horizontal meridian of at least 120 degrees (60 degrees on each side of the centre point) and in the vertical meridian of at least 60 degrees (40 degrees above and 20 degrees below the centre point) when evaluated by standard arc perimeter techniques.</p> <p>3.1.11.2 Fogging: The portable PBE shall be designed to minimise moisture condensation on the inside surface, or include a means of preventing or removing any moisture that may condense on surfaces during use.</p>

**Appendix 1**

**MPS FOR CREWMEMBER PORTABLE PBE (continued)**

<b>SAE AS 8047 section:</b>	<b>Action:</b>
Paragraph 3.1.12	<p>To be revised:</p> <p>3.1.12 Portable PBE must allow intelligible two-way communication, including the use of airplane interphone (handset or microphone) and megaphone. User must be able to communicate with another user or non-user at a distance of at least four meters. Use a background noise of 65db and a user communication sound level of 85db or equivalent method.</p>
Paragraph 3.1.15	<p>New paragraph to be added:</p> <p>3.1.15 Material used to fabricate the unit must be puncture/tear-resistant.</p>
Paragraph 3.2.1	<p>To be revised:</p> <p>3.2.1 Average inspiratory limits must be within the following:</p> <ul style="list-style-type: none"> <li>— Carbon dioxide concentration level at mouth/nose must not exceed 4 % at sea level. Concentration may increase to 5 % at sea level for a period not to exceed 2 minutes.</li> <li>— Carbon monoxide level must not exceed 50 ppm, time-weighted average.</li> <li>— Chloride level must not exceed 1 ppm, time weighted-average.</li> </ul>
Paragraph 3.2.2	<p>To be revised:</p> <p>3.2.2 When a user puts on portable PBE, the unit must be self-purging by enough breathable gas to ensure one complete dead volume displacement within 20 seconds of initial operation.</p>
Paragraph 3.2.3	<p>To be revised:</p> <p>3.2.3 Portable PBE must protect the user against toxic fumes and smoke. The test procedures in AS 8031A shall be used. An alternative challenge gas may be used. Aerosols, such as sodium chloride (NaCl) or corn oil are not acceptable as an alternative. Component sensitivity to particle size and the potential to precipitate on the unit surface make aerosols unacceptable to measure a contaminant protection factor. User's eyes, nose, and mouth must be protected to 0.05 mean contaminant protection factor during the work profiles specified in paragraph 3.2.4.</p>

**Appendix 1**

**MPS FOR CREWMEMBER PORTABLE PBE (continued)**

<b>SAE AS 8047 section:</b>	<b>Action:</b>
Paragraph 3.2.4	First sentence to be revised:  3.2.4 Portable PBE must provide the minimum required protection for the following work profiles, at an ambient 70 °F (21.1 °C) for the intended population (generally 107 to 220 lb).
Paragraph 3.2.5	To be revised:  3.2.5 Internal temperature of the portable PBE must not exceed 104 °F (40 °C) wet bulb at an ambient temperature of + 70 °F (21.1 °C).
Paragraph 3.2.6	To be revised:  3.2.6 Portable PBE must function satisfactorily in a 212 °F (100 °C) environment, where the internal temperatures must not exceed 122 °F (50 °C) wet bulb for a 2-minute exposure.
Paragraph 3.2.9	To be revised:  3.2.9 Portable PBE must operate at a mean positive pressure and incorporate a relief valve(s) to prevent over-pressurisation.
Paragraph 3.2.10	To be revised:  3.2.10 Portable PBE must support peak flows of 250 liters per minute (LPM) and must be capable of supporting a minute breathing volume of 80 litres for a 30-second period at any time throughout its operation.
Paragraph 3.2.11	To be revised:  3.2.11 Portable PBE must be easily put on and activated, after the user gains access to the stowed unit within 15 seconds. The unit shall be designed so it can be donned and worn by users wearing eyeglasses, as specified in paragraph 3.1.2. Unit face must not displace eyeglasses or be flexible enough to allow adjustment of eyeglasses.
Section 4 CONSTRUCTION	To be disregarded.
Paragraph 6	To be revised:  TESTING PROCEDURES:

**Appendix 1**

**MPS FOR CREWMEMBER PORTABLE PBE (continued)**

<b>SAE AS 8047 section:</b>	<b>Action:</b>
Paragraph 6.1	<p>First sentence to be revised:</p> <p>Manufacturer of the portable PBE is responsible for performing the required tests in paragraph 3.2 to verify its performance.</p>
Paragraph 6.2	To be disregarded.
Paragraph 6.2	<p>New paragraph to be added:</p> <p>6.2 FLAMMABILITY. All materials used in the portable PBE and any stowage container/case (including insulation on electrical wires) in a typical installed arrangement must be self-extinguishing. Materials must comply with CS 25.853(a), Appendix F, Part I (a)(1)(iv).</p> <p>6.2.1 Any exposed portions of the portable PBE and stowage container/case must withstand a radiant heat flux of 1.0 BTU/ft<sup>2</sup> per second for 60 seconds, and remain functional when exposed to it.</p> <p>6.2.2 Radiant heat flux source must be of sufficient size so the portable PBE, any stowage container/case, and exposed parts of the unit are exposed in a manner that creates the heat flux at all the surfaces, in a typical as installed arrangement.</p> <p>6.2.3 Portable PBE must protect the user's head and neck from dripping 392 °F (200 °C) plastic materials and withstand an 1 832 °F (1 000 °C) flame for 5 seconds without material penetration while operating.</p> <p>6.2.3.1 Protection from dripping plastic material may be tested by several methods. One is to ignite a polypropylene rod and allow the drops to impinge on the various external materials, seams, and transparency. Adjust the drop height so that the drop contact temperature is at least 392 °F (200 °C).</p>



**Appendix 1**

**MPS FOR CREWMEMBER PORTABLE PBE (continued)**

<b>SAE AS 8047 section:</b>	<b>Action:</b>
Paragraph 6.2 (continued)	<p>6.2.3.2 The 5-second 1 832 °F (1 000 °C) test is meant to protect a crew member wearing the portable PBE from an unexpected flame lick. Two main concerns are failure of the unit that would injure the wearer, and leakage of the breathable atmosphere that could produce an explosion or hazard. The test rig must expose the unit, while operating, to a 1 832 °F (1 000 °C) flame envelope. One company has used German Teklu burners with a flow rate of about 21 liters per minute. The flow rate and distance of the burner to the surface of the PBE unit being tested shall be adjusted to obtain the required temperature. In most cases the flame plume developed will not expose the complete unit. A segment can be passed through the flame plume to obtain the 5-second exposure period and then the unit can be rotated to the next segment and passed through the flame plume, and so forth, until the complete unit has been tested. Making a visual (videotape) record of this test might be useful documentation, in addition to the measured parameters.</p> <p>6.2.4 Heat Release and Smoke Density. Exposed panels/surfaces totalling more than one square foot in surface area must meet the heat release and smoke density requirements of CS 25.853, Appendix F, Parts IV and V. Guidance on these test requirements can be found in the Aircraft Materials Fire Test Handbook, DOT/FAA/AR-00/42, at <a href="http://www.fire.tc.faa.gov/handbook.stm">www.fire.tc.faa.gov/handbook.stm</a>.</p> <p>6.2.5 Battery Qualification. If the equipment uses a lithium battery as a power source, battery must meet the applicable battery standards:</p> <p>6.2.5.1 ETSO-C142a, Non-Rechargeable Lithium Cells and Batteries (see RTCA, Inc. document RTCA/DO-227, Minimum Operational Performance Standards for Lithium Batteries, dated June 23, 1995), or most current revision.</p> <p>6.2.5.2 ETSO-C179a, Rechargeable Lithium Cells and Lithium Batteries (see UL 1642, Standard for Safety for Lithium Batteries, fourth edition, dated September 19, 2005).</p>

**MPS FOR CREWMEMBER PORTABLE PBE (*continued*)**

<b>SAE AS 8047 section:</b>	<b>Action:</b>
Paragraph 6.3	<p>New paragraph to be added:</p> <p>6.3 Environmental Qualification</p> <p>6.3.1 High-Temperature Exposure: The portable PBE shall be soaked for 12 hours at not less than 160 °F (71.1 °C). Then the PBE shall be transferred to 70 °F (21.1 °C) ambient temperature. Within 30 minutes of doing this, the portable PBE shall be tested to the requirements of paragraph 3.2.</p> <p>6.3.2 Low-Temperature Exposure: The portable PBE device shall be soaked for 2 hours at not greater than – 65 °F (– 54 °C). Then the PBE shall be transferred to 0 °F (– 17.8 °C) for 2 hours to stabilise it. After this, the PBE shall be transferred to 70 °F (21.1 °C) ambient temperature. Within 30 minutes of doing this, the portable PBE shall be tested to the requirements of paragraph 3.2.</p> <p>6.3.3 Operational Shock: The PBE shall comply with the test requirements in RTCA DO-160 release defined in CS-ETSO, Subpart A, paragraph 2.1, Section 7, paragraph 7.2.</p> <p>6.3.4 Humidity: The PBE shall comply with the test requirements in RTCA DO-160 release defined in CS-ETSO, Subpart A, paragraph 2.1, Section 6, Category A.</p> <p>6.3.5 Waterproofness: The PBE shall comply with the test requirements in RTCA DO-160 release defined in CS-ETSO, Subpart A, paragraph 2.1, Section 10, Category R.</p> <p>6.3.6 Fungus Resistance: The PBE shall comply with the test requirements in RTCA DO-160 release defined in CS-ETSO, Subpart A, paragraph 2.1, Section 13, Category F.</p> <p>6.3.7 Decompression (Class 2 only): Devices covered by this document must meet the requirements of paragraph 3.2 when subjected to decompression testing.</p>