ETSO-C116
Date : 24.10.03

European Aviation Safety Agency

European Technical Standard Order

Subject: CREWMEMBER PROTECTIVE BREATHING EQUIPMENT

1 - Applicability

This ETSO gives the requirements that new models of crewmember protective breathing equipment must meet in order to be identified with applicable ETSO marking.

2 - Procedures

2.1 - General

Applicable procedures are detailed in CS-ETSO Subpart A.

3 - Technical Conditions

3.1 - General

3.1.1 - Minimum Performance Standard

Standards set forth in the attached „Federal Aviation Administration Standard for Crewmember Protective Breathing Equipment“.

3.1.2 - Environmental Standard

See CS-ETSO Subpart A paragraph 2.1.

3.1.3 – Computer Software

None

3.2 - Specific

None

4 - Marking

4.1 - General

Marking is detailed in CS-ETSO Subpart A paragraph 1.2.

4.2 - Specific

None

5 - Availability of Referenced Document

- See CS-ETSO Subpart A paragraph 3.

APPENDIX 1. FEDERAL AVIATION ADMINISTRATION STANDARD PROTECTIVE BREATHING EQUIPMENT DATED

1.0 Purpose. This appendix provides minimum standards for crewmembers protective breathing equipment.

2.0 Scope. These standards apply to protective breathing equipment that provides any crewmember with the ability to locate and combat a fire within the airplane cabin or any other accessible compartment at normal cabin altitudes (up to 8000 feet equivalent).

3.0 Minimum Performance Standards.

3.1 The PBE unit must contain a supply of breathable gas (allows the use of any breathable gas instead of requiring only oxygen and does allow the use of a chemical oxygen generator).

3.2 The unit shall adequately protect any adult, within the 5th percentile female (neck size circumference 11.1 inches) and 95th percentile male (neck size circumference 16.4 inches) body dimensions (including spectacle users). Any recommendations addressing long hair and/or beards shall be included in the instructions furnished with the manufactured units.

3.3 The unit shall have a means for any crewmember to determine the serviceability of the unit in its stowed condition.

3.4 Failure of the unit to operate or to cease operation shall be readily apparent to the user.

3.5 The supply of breathable gas shall meet the applicable SAE gas standard for purity.

3.6 The unit shall not result in a hazard when stored, in use, or during an inadvertent operation.

3.7 The stowed unit shall not be adversely affected by environmental extremes. The applicable sections of RTCA DO-160C shall be used to demonstrate unit compliance.

3.8 The unit shall have a stated reliability with an appropriate confidence level to establish any shelf life, operational limit and/or maintenance interval.

3.9 The unit shall wear comfortably in use leaving both hands free. It shall not be displaced during the normal tasks of locating and combating a fire (i.e., crawling, kneeling, running actions, etc.).

3.10 The unit shall provide adequate vision capability for its intended use, including the consideration of fogging and/or condensation.

3.11 The unit must allow intelligible two-way communication, including the use of airplane interphone and megaphone. The user must be able to communicate with a user or nonuser at a distance of at least four meters. A background noise of 65db and a user communication sound level of 85db or equivalent method is recommended.

3.12 The unit shall be capable of being easily donned and activated, after gaining

access to the stowed unit within 15 seconds. It must be easy to doff.

4.0 Performance Requirements. The following shall apply to the approval of any crewmember PBE design to be identified and manufactured to this TSO:

4.1 The unit shall provide the required protection for the following work load profile, at an ambient temperature of 21°C for adults within the 5th percentile female (107 lbs) and 95th percentile male (220 lbs) body weight, at sea level and 8000 feet altitude:

0 to 05 minutes at 0.33 watts per lb. body weight.
5 to 07 minutes at 0.66 watts per lb. body weight.
7 to 12 minutes at 0.50 watts per lb. body weight.
12 to 14 minutes at 0.66 watts per lb. body weight.
14 to 15 minutes at 0.33 watts per lb. body weight.

NOTE: This test is to be performed in sequence.

4.2 The mean inspiratory values shall be within the following limits:

4.2.1 The carbon dioxide concentration level at mouth/nose shall not exceed 4 percent at sea level. The concentration may increase to 5 percent at sea level for a period not to exceed 2 minutes.

4.2.2 The carbon monoxide level shall not exceed 50 ppm, time weighted average.

4.2.3 The chloride level shall not exceed 1 ppm, time weighted average.

4.3 Upon donning, the unit shall be self purging by a sufficient supply of breathable gas to ensure one complete dead volume displacement within 20 seconds of initial operation.

4.4 The unit shall protect the user against toxic fumes and smoke. The eyes, nose, and mouth must be protected to 0.05 mean contaminant protection factor during the work profile stated as item 1 of this paragraph. Aerospace Standards (AS) 8031 and 8047 (Class 1) may be used as references, as applicable. AS 8031, states that the test contaminant must be n-pentane or similar gas having a molecular weight less than 100. The use of sulphur hexafluoride (SF_6) is an acceptable alternative. The use of aerosols such as sodium chloride (NaC1) or corn oil are not considered acceptable as an alternative for a challenge gas. Component sensitivity to particle size and the potential to precipitate on the unit surface are considerations that make aerosols unacceptable to measure a contaminant protection factor.

4.5 The internal temperature of the unit shall not exceed 40° wet bulb at an ambient temperature of 21°C.

4.6 The internal temperature of the unit shall not exceed 50°C wet bulb. for a 2 minute exposure, at an ambient temperature of 100°C.

4.7 Breathing inspiration/expiration resistance shall not exceed ± 3 1/2 inches of water from sea level to 8000 feet altitude, as measured at the mouth.

4.8 The unit shall operate at a mean positive pressure and shall incorporate relief

valve(s) to prevent overpressure of the unit.

4.9 The unit shall be designed for peak breathing flows of 250 liters per minutes (LPM) and shall be capable of 80 liter-minute volume for a 30 second period at any time throughout its operation.

NOTE:

The test protocol to establish the combined performance requirement of the work load profile and contaminant levels shall be based upon the testing of 24 persons representative of the stated population range.

5.0 Construction Requirements. The following shall apply to the approval of any subject PBE design to be identified and manufactured to this TSO:

5.1 The unit and any stowage container/case shall be constructed of materials that are flame resistant that satisfy the requirements of FAR Section 25.853 and tested in accordance with Appendix F Part I (a) through (d) Vertical Test.

5.2 Any exposed portions of the unit and stowage case shall withstand and remain functional when exposed to a radiant heat flux of 1.0 BTU/ft^2 per second for 60 seconds. The unit shall also protect the head and neck of the user from dripping 200°C plastic materials and withstand a 1000°C flame for 5 seconds without material penetration while operational.

NOTE:

(1) The 1.0 BTU/ft^2 per second for 60 seconds criteria. A radiant heat source of sufficient size to expose the stowage case containing a PBE unit and any exposed portions of the unit in a manner to obtain the stated heat flux at the case surfaces, in a typical as installed arrangement, will be acceptable.

(2) Protection from dripping 200°C plastic material may be accomplished by a number of methods. One method is to ignite a polypropylene rod and allow the drops to impinge on the various external materials, seams, transparency, etc. The drop height should be adjusted so that the drop contact temperature is at least 200°C.

(3) The 5 second 1000°C test. This test is meant to protect a crewmember wearing the PBE from an unexpected flame lick. The two main concerns are failure of the unit that would injure the wearer and any leakage of the breathable atmosphere that could produce an explosion or hazard. The test rig shall expose the unit, while operating, to a 1000°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 will need to be adjusted to obtain the required temperature. In most cases the flame plume developed will not expose the complete unit. A segment may be passed through the flame plume to obtain the 5 seconds exposure period and then rotated to the next segment and passed through the flame plume, etc., until the complete unit has been tested. A visual (i.e., videotape) record to this test might be useful documentation, in addition to the measured parameters.

5.3 The size of the PBE unit when donned shall allow the wearer to pass through any access appropriate to the airplane type for which approval is requested, to investigate and/or combat an inflight fire. As a generic standard, the wearer must be able to pass through

460X460 mm^2 opening.

5.4 The material and fabrication of the unit shall cause the unit to be puncture/tear resistant. See ASTM references for suggested methods.

6.0 References. The following may be helpful in developing a PBE design and/or obtaining FAA approval of the basic design, they are not of themselves FAA requirements and may differ from the TSO requirements, which take precedence:

SAE AS 8047 (Class 1)	Performance Standard for Cabin Crew Portable Protective Breathing Equipment for Use During Aircraft Emergencies.
SAE AS 8031	Personal Protective Devices for Toxic and Irritating Atmospheres. Air Transport Crew Member.
SAE AS 8010	Aviators Breathing Oxygen Purity Standard.
FAA-AM-78-41	A Study of Workload and Oxygen Consumption for Airline Cabin Crew Member During a Simulated Inflight Smoke/Fire Emergency.
ASTM D1149	Accelerate Ozone Cracking of Vulcanized Rubber.
ASTM D624	Rubber Property-Tear Resistance.
ASTM D750	Rubber Deterioration.
ASTM D228	Abrasion Resistance.
ASTM D1922-67	Standard Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method.
ASTM D1004-86	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
ASTM D2582-67	Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting