SAE Aerospace
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AEROSPACE STANDARD

SAE AS8026

REV. A

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Crewmember Demand Oxygen Mask For Transport Category Aircraft

1. SCOPE:

This standard covers oxygen masks and breathing valves used with both panel mounted and mask mounted demand and pressure-demand oxygen regulators. Mask mounted oxygen regulators are covered under other standards, but when the mask mounted regulator incorporates an integral exhalation valve, the performance of this valve shall meet the requirements of this standard.

1.1 Purpose:

This standard establishes the minimum performance standards for the manufacture of demand type crewmember oxygen masks to be used with straight demand, diluter-demand and pressure-demand oxygen systems.

2. REFERENCES:

The following documents provide reference and background information related to this Aerospace Standard:

2.1 SAE Documents:

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

AS8031	Personal Protective Devices for Toxic and Irritating Atmospheres, Air Transport Aircraft
AIR825B	Oxygen Equipment for Aircraft
AS1194	Regulator, Oxygen, Diluter Demand, Automatic Pressure Breathing
AS1046	Minimum Standard for Portable Gaseous Oxygen Equipment
AIR1176	Oxygen Systems and Components, Cleaning & Packaging
AS8027	Crewmember Oxygen Regulators, Demand

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http://www.sae.org/technical/standards/AS8026A

2.2 Other Publications:

FAA TSO C78	Crew Member Demand Oxygen Masks
FAA TSO C89	Oxygen Regulators, Demand
FAA TSO C99	Smoke Protective Equipment
FAA TSO C58	Microphones
FAR Part 25	Airworthiness Standards, Transport Category Aircraft
FAR Part 91	General Operating Flight Rules
FAA AM-78-41	FAA Report, Optical Properties of Smoke Protective Devices
ASTM Documents	As listed in paragraph 3.1.1, below

An Anthropometric Sizing Program for Oral Nasal Oxygen Masks Based on 1967 US Air Force Survey Data, AMRL Technical Report 75-51, J. T. McConville and Milt Alexander.

Anthropometric Sizing and Fit-Test of MC-1 Oral-Nasal Oxygen Mask, WADC Technical Report 58-505, March 1959, Emanual, M. Alexander and E. Churchill.

Anthropometry of Air Force Women, AMRL Technical Report 70-5, April 1972, C. D. Clauser, et al.

Recommended Subject Selection and Test Procedure for Quantitative Respirator Testing, J. T. McConville, E. Churchill and A. Hack, HEW Contract HSM-99-75-15, November 30, 1973.

Anthropometry for Respirator Sizing, J. T. McConville, E. Churchill and L. L. Lauback, HEW Contract HSM-099-71-11, April 30, 1972.

2.3 Definition:

The oxygen masks to be used for transport aircraft shall be of the oronasal type covering the mouth and nose, or a full face type which includes coverage of the eyes as well as the mouth and nose.

2.4 Classification:

This standard covers, but is not limited to the following types of oxygen masks:

Type I - Quick donning mask with integral breathing valve(s),
Type II - Quick donning mask without integral breathing valve(s),
Type III - Non-Quick donning mask with integral breathing valve(s),
Type IV - Non-Quick donning mask without integral breathing valve(s),
Type V - Other.

3. GENERAL REQUIREMENTS:

3.1 Materials:

3.1.1 General: Materials shall be of a type, grade and quality which experience and/or tests have shown to be suitable for the purpose intended. Materials which contaminate oxygen or are adversely affected by continuous service with oxygen shall not be used. The following are suggested test methods which may be used to verify compliance with materials requirements established in a design specification.

a. Resistance to Flammability

FAR 25.853 (b-3)
U.L. 94 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (Self Extinguishing).
Any further testing would be performed on assembled devices.

b. Resistance to Ozone Degradation

ASTM D 1149-86, "Rubber, Deterioration-Surface Ozone Cracking in a Chamber".
MIL-STD-417, "Rubber Composition, Vulcanized General Purpose, Solid".

c. Resistance to Ultra Violet Degradation

ASTM D 750-85, "Rubber Deterioration in Carbon-Arc Weathering Apparatus".

d. Resistance to Wear and Tear (Abrasion)

ASTM D 2228-83, "Rubber Property-Abrasion Resistance (Pico Abrader)".

e. Oxygen Compatibility

Manufacturer's data on raw materials or on finished products, ASTM D 572-81, "Rubber-Deterioration by Heat & Oxygen" or ASTM D 1171-86, "Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (triangular specimens).

f. Odors

Sniff test by a panel of six different persons.

g. Resistance to Deformation while in Stored Condition

ASTM D 1171-86 or D 572-81, as noted in paragraph (e) above.

h. Optical Quality and Resistance to Shattering (Lenses)

American National Standard (ANSI) Z87.1-1979, "Practice for Occupational and Educational Eye and Face Protection" and Military Specification MIL-L-38169 (USAF).

3.1.2 Facepiece: Materials in contact with the skin shall be selected to be as non-irritating, non-allergenic, and as soft and compliant to the facial configuration as possible.

3.1.3 Cleaning and Sterilizing: The oxygen mask shall be made of materials which will permit cleaning and sterilizing without adverse effects and without major disassembly. The method of cleaning and sterilizing shall be recommended by the manufacturer or in accordance with SAE AIR1176.

3.1.4 Elastomeric Components: A tag or leaflet describing service life limits of elastomeric components and a suggested method for inspection and detection of any deterioration in these components which may adversely affect the performance of the oxygen mask shall be attached to the mask or included with the packaged mask as delivered to the user. Silicone rubber parts, because they have unlimited shelf life, are exempt from this requirement.

3.1.5 Fungus: Components of the oxygen mask assembly shall be fungus-proofed by selection of parts and materials that are non-nutrient to fungus, or by treating the parts and materials with a biocidal material that is compatible with human wear and activity.

3.1.6 Dissimilar Metals: Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in contact with each other.

3.2 Workmanship:

3.2.1 General: The oxygen mask shall be fabricated and finished in accordance with the highest grade practice in the manufacture of this type of life saving equipment. The finished mask and all internal parts shall be clean throughout and free of fins, burrs, scale, oils, foreign materials or other conditions which might adversely affect the safe operation of the mask. All components shall be resistant to snags, breaks, tears and other harmful actions which could lead to malfunction of the mask in the course of normal handling and use during its service life.

3.2.2 Finish: All materials which are not inherently corrosion resistant shall be finished with a protective treatment or coating to minimize the effect of exposure to environmental conditions which may be encountered in the service for which the oxygen mask is intended. The protective treatment or coating shall not chip, flake, powder or otherwise contaminate the mask.

3.3 Identification:

3.3.1 Required: The following minimum information shall be permanently marked in a readily visible location on the oxygen mask assembly:

Part Name
Manufacturer's Part Number
Manufacturer's Name and Address
Elastomer Cure Date (Except Silicone Rubber)
Size (If more than one size is offered)
Type (See paragraph 2.4)
Maximum Altitude to Which Qualified
Government Agency Approvals

3.3.2 Optional: The following additional information may appear on the oxygen mask identification label at the option of the manufacturer and or the purchaser:

Airframe Manufacturer's Approvals
Airline or other users Part Number
Instructions for use or Warning Labels

3.4 Facepiece Assembly:

3.4.1 Sizing Criteria: The professional flying population - male and female - presents a very wide range of facial type and sizes, thus the intended user of an oxygen mask must personally assure that a good fit can be achieved using the standard mask provided by the airplane operator. Aircraft operators should provide oxygen masks which offer an adequate fit and protective level to the widest possible range of their aircrewmembers. An individually fitted mask should be furnished when an aircrewmember cannot be fitted by the standard masks regularly supplied.

Manufacturers are encouraged to provide masks of universal size whenever feasible. When multiple sizes are required to fit the full range of anticipated users, the mask assembly is to be clearly marked or identified as to its size or intended user type.

Facepiece designers should consider extremes of Naison-Menton, Bizygomatic, Bigonial and Naison-Supramentale measurements and other applicable anthropometric information as required to provide a product with adequate fit. Suggested sources of anthropometric data are listed in Section 2.

3.4.2 Fit: The oxygen mask facepiece shall be of sufficient resilience, size and shape as to conform readily to clean shaven facial contours using no more pressure than is supplied by the mask suspension device. In determining that a mask provides an acceptable fit under this Aerospace Standard, a mask need not demonstrate compliance with paragraph 4.1.1 - Mask Leakage, on test subjects with beards, heavy facial hair or deep wrinkles. Published studies have shown that all known masks will leak where beards or heavy facial hair lies between the skin and sealing surface of the mask, or where deep wrinkling prevents a seal.

3.5 Suspension:

The oxygen mask facepiece of Type I and Type II masks shall be attached to a suspension device which will permit the mask assembly to be donned using only one hand and operating in 5 seconds or less, without disturbing eyeglasses. After donning, the mask must not prevent immediate communication between crewmembers of the airplane intercommunications system.

The suspension device attached to Type III and Type IV oxygen mask assemblies may be of a design as to require use of two hands and/or more than 5 seconds to don.

3.6 Compatibility with Eyeglasses and Smoke Goggles:

All types of oxygen masks - quick donning or non-quick donning oronasal masks, oronasal masks with integral goggles, or full-face type masks - shall be designed so that it is possible to don and wear the mask while wearing corrective eyeglasses. Quick donning Type I and Type II masks and their suspension devices shall be designed to meet the one-hand, 5-second donning requirement of paragraph 3.5 when donning over eyeglasses. Oronasal type masks shall be designed to permit the wearing of smoke goggles with the mask and over eyeglasses. For purposes of demonstrating compliance with this paragraph, eyeglasses must be a minimum of 152 mm (6 inches) wide by 51 mm (2 inches) high.

3.7 Lenses in Full Face Masks and/or Integral Goggles:

The lens or lenses used in full face masks or goggles integrally attached to oronasal masks shall be free from defects or flaws that impair optical quality. The lens(es) shall be demonstrated to show compliance with the following:

3.7.1 Range of Vision: The lens(es) shall permit peripheral vision in the horizontal meridian of at least 120 degrees (60 degrees on each side of the center point) and in the vertical meridian of at least 60 degrees (40 degrees above and 20 degrees below the center point) when evaluated by standard arc perimeter techniques.

3.7.2 Fogging: Lens(es) of all full face masks or smoke goggles integrally attached to oronasal masks shall be designed to minimize moisture condensation on the inside surface or shall include a means for removing any moisture that may condense on surfaces essential to vision.

3.7.3 Optical Quality: Light transmission, refractive deviation, optical haze and distortion shall be tested in accordance with and meet the requirements of ANSI Standard Z87.1-1979, as described in FAA Report FAA-AM-78-41.

3.8 Frost:

The oxygen mask shall be designed to prevent the formation or accumulation of frost which would interfere with the function of the inhalation or exhalation valves, unless it can be demonstrated that the wearer can remove frost by external manipulation without removing the mask.

3.9 Oxygen Supply Tube:

Oxygen mask assemblies designed for use with remotely located oxygen flow regulators shall include a flexible, kink resistant oxygen supply tube.

3.10 Oxygen Supply Tube Connector:

Oxygen masks equipped with oxygen supply tubes designed for quick disconnection from the oxygen supply regulator shall incorporate a device to alert the user when his oxygen supply tube has been disconnected. When disconnected the device shall permit inhalation, but a noticeable resistance shall be introduced to indicate that disconnection has occurred. This paragraph does not apply if the quick disconnect device incorporates means to positively prevent inadvertent separation.

3.11 Accumulation of Expired Gasses:

Oxygen masks shall be designed to have the minimum practical internal volume to prevent the accumulation of more than 200 milliliters of expiratory gases within the facepiece chamber.

3.12 Communications:

Oxygen mask design shall permit the installation of a microphone and connecting communications cable. When microphones are furnished with the masks, these must conform to FAA TSO C58, or an FAA approved equivalent.

4. PERFORMANCE REQUIREMENTS:

4.1 Leakage:

4.1.1 Seal to the Face: The seal between the mask facepiece and the skin of the face, or of a suitable head/face form simulating a human face, shall be such that:

a. The inboard leakage into the mask cavity does not exceed 5% of the pulmonary ventilation when the mean pressure in the mask cavity is between 0 and 1 kPa (4 inches water gauge) less than that of the environment.

b. The outboard leakage does not exceed the limits given below at the indicated mean pressures in the mask cavity:

TABLE 1

Mean Pressure in Mask cavity relative to the environmental pressure		Maximum Outboard leakage
kPa	(Inches Water)	L/min (NTPD)[1]
1.0	(4.0)	1.8
3.0	(12.0)	6.0

NOTE: The 3.0 kPa requirement applies only to masks rated for operation above 12,200 m (40,000 ft)

[1] NTPD - Normal Temperature (21.1 °C, 70 °F), Normal Pressure (760 mm Hg, 14.7 psi, 1.013 bars, 101.3 kPa), dry.

4.1.2 Inhalation Valve Leakage: Inhalation valves installed in pressure demand oxygen masks shall not back-leak more than 0.016 L/min, NTPD, when subjected to a suction pressure differential of 25 Pa (0.25 mbar, 0.1 inches water) and not more than 0.16 L/min, NTPD, when subjected to a suction pressure differential of 2 kPa (20 mbar, 8.0 inches water).

4.1.3 Supply Tube Leakage: The oxygen supply tube assembly shall not leak when subjected to an internal pressure of 34.5 kPa (0.345 bar, 5.0 psig).

4.2 Strength:

4.2.1 Mask Assembly Strength: The oxygen mask assembly (suspension, facepiece and supply tube) shall be capable of sustaining a pull force on the suspension device attachment fittings of not less than 156 N (35 lb) in any direction for a period of not less than 3 seconds without visible damage or permanent deformation.

4.2.2 Supply Tube Strength: The oxygen supply tube assembly shall be capable of sustaining a pull force of not less than 133 N (30 lb) exerted along the axis of symmetry of the tube for a period of not less than 3 seconds without visible damage or permanent deformation.

4.2.3 Supply Tube Collapse: The oxygen supply tube shall not collapse when subjected to an internal vacuum of 17 kPa (170 mbar, 68 inches water) for a minimum of 3 seconds.

4.2.4 Rubber Tear Resistance: The rubber used in the oxygen mask facepiece and supply tube shall have a minimum tear resistance of 263 N/cm (150 lb/in) when tested in accordance with ASTM D 624-81, Die B.

4.3 Quick Disconnect Couplings:

4.3.1 Coupling Force: The force required to separate quick disconnect couplings which do not have a feature to prevent inadvertent separation shall be a minimum of 44 N (10 lb) exerted along the axis of symmetry of the oxygen supply tube.

4.3.2 Pressure Drop: When disconnected, the pressure drop through the quick-disconnect device shall be not less than 1 kPa (10 mbar, 4.0 inches of water) nor more than 1.5 kPa (15 mbar, 6.0 inches of water). Immediately prior to disconnection there shall be a test flow of 15 L/min into the mask.

4.4 Flow Resistance:

4.4.1 Inhalation Resistance: The inhalation resistance of the oxygen mask and oxygen supply tube, including the oxygen supply connector when inserted into an appropriate mating fitting shall not exceed the following negative differential pressure at the corresponding constant oxygen flow rates:

TABLE 2

Differential Pressure	Flow Rate NTPD or ATPD
150 Pa (1.50 mbar, 0.6 in/water)	21.6 L/min 20 L/min
375 Pa (3.75 mbar, 1.5 in/water)	75.6 L/min 70 L/min
625 Pa (6.25 mbar, 2.5 in/water)	108.0 L/min 100 L/min

4.4.2 Exhalation Resistance: The exhalation resistance of the mask shall not exceed the following positive pressure differential pressures at the corresponding constant oxygen flow rates:

TABLE 3

Differential Pressure	Flow Rate NTPD or ATPD
250 Pa (2.5 mbar, 1.0 in/water)	21.6 L/min 20 L/min
500 Pa (5.0 mbar, 2.0 in/water)	75.6 L/min 70 L/min
750 Pa (7.5 mbar, 3.0 in/water)	108.0 L/min 100 L/min

4.4.3 Pressure-Demand Exhalation Valve Performance: The exhalation valve installed in a pressure-demand oxygen mask must open when the pressure within the facepiece is no greater than 0.6 kPa (6.0 mbars, 2.4 inches water) higher than the supply tube pressure.