

British Standard: Aerospace Series
Specification for

**Full face mask assemblies for use in
contaminated atmospheres**

	Page		Page
Foreword	1	3.4 Wearer requirements	3
		3.5 Environmental	3
Specification		Appendices	
1. Scope	2	A. Vibration transmissibility: mechanical vibration transmitted to the mask assemblies when worn by a seated subject.	5
2. Design and construction of mask	2	B. Conversion of units of measurement	6
2.1 General requirements	2		
2.2 Sizing	2	Figure	
2.3 Materials	2	1. Vibration transmission to a mask assembly when worn by a seated subject	5
2.4 Design	3		
3. Performance	3		
3.1 Mechanical	3		
3.2 Pneumatic	3		
3.3 Acoustics	3		

Foreword

With the possibility of the interiors of aircraft becoming contaminated during flight, e.g. toxic fume or smoke filled, it is necessary for personnel to be provided with adequate means to breathe and protection of the eyes in order to locate and dispel the source of contamination as well as to enable flight personnel to fly and operate the aircraft. Under these conditions flight personnel may use oral-nasal oxygen masks complying with British Standard N 1, 'Oxygen masks for use in demand systems', together with goggles. Other personnel dispelling the source of contamination may require a full face covering mask assembly connected to a supply of respirable gas. This specification lays down requirements to ensure proper flow, leakage, comfort and strength characteristics of mask assemblies to satisfy these conditions.

It is not intended that face mask assemblies complying with this British Standard should be worn by ground personnel when employed in dispelling such contamination; under these circumstances breathing apparatus normally used in terrestrial applications should be provided. Guidance on the type of respiratory protection that should be provided for particular conditions is given in BS 4275, 'Recommendations for the selection, use and maintenance of respiratory protective equipment'.

NOTE. Information concerning SI units is given in BS 350, 'Conversion factors and tables', BS 3763, 'The International System of units (SI)', and PD 5686, 'The use of SI units'. For approximate conversions of the SI units quoted in this standard refer to Appendix B.

Gr 3

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N4:1974

This standard makes reference to the following British Standards:

- BS 2050 Electrical resistance of conductive and antistatic products made from flexible polymeric material
- BS 4667 Breathing apparatus
 - Part 3. Fresh air hose and compressed air line breathing apparatus
- BS N 100 General requirements for aircraft oxygen systems and equipment
- BS 3G 100 General requirements for equipment in aircraft
 - Part 2. All equipment
 - Section 1. Construction
 - Section 3: Subsection 3.1. Vibration requirements
 - Subsection 3.2. Temperature-pressure
 - Subsection 3.4. Differential pressure
 - Subsection 3.6. Acceleration requirements
 - Subsection 3.12. Fluid contamination

Specification

1. Scope

This British Standard contains minimum performance requirements for the manufacture of full face mask assemblies intended for use by aircraft flight personnel whilst dispelling the source of atmospheric contamination during flight. The mask assemblies are suitable for use with respirable air or oxygen supplied by demand, continuous flow or re-breathing systems.

2. Design and construction of mask

2.1 General requirements

2.1.1 The mask assembly shall comply with all relevant requirements selected from British Standard N 100 and the composite British Standard 3G 100 as specified in this specification and the individual specification.

2.1.2 The mask face piece shall be designed for respiration through the nose and the mouth, and to effect an efficient face seal. The quality of seal shall be unaffected by the wearing of spectacles specifically designed for use with face masks.

2.1.3 A transparency shall be part of the mask face piece, and means of preventing misting and icing shall be provided.

2.1.4 Under active use in a confined space the mask assembly shall not restrict head movement, nor shall the face seal be impaired by such movement.

2.1.5 The mask assembly may be fitted with a demand regulator which is supplied by respirable air or oxygen, or may incorporate a flexible tube for connection to an external supply.

2.1.6 The mask face piece shall be fitted with a speech diaphragm.

2.1.7 The mask assembly shall:

- (1) not impair essential vision;
- (2) not impart unacceptable facial loading;
- (3) be as light in weight as possible.

2.1.8 The mask assembly may be fitted with the following:

- (1) an inspiratory valve;
- (2) an expiratory valve;
- (3) a microphone or means of two-way communication.

2.2 **Sizing.** To ensure a consistent face seal it may be necessary to provide a range of sizes. To restrict the number of sizes required, facilities for individual adjustment may be embodied.

2.3 **Materials.** The mask assembly shall be constructed of materials that conform to the general requirements of British Standards N 100 and 3G 100: Part 2: Section 1 (particularly in respect of flammability) and in addition:

- (1) shall withstand the effect of ultra violet radiation;
- (2) shall withstand the long term effects of contaminants likely to be encountered in the aircraft stowed position;
- (3) shall withstand the short term effects of exposure to contaminating fluids (see 3.5.5);

- (4) shall resist the accumulation of an electrostatic charge*;
- (5) shall withstand reasonable wear and tear over a period of not less than four years.

2.4 Design

- 2.4.1 The mask assembly shall be designed to keep re-breathing of expired gas to a minimum. It is desirable that the effective dead space shall be less than 200 ml BTPS (body temperature and pressure saturated).
- 2.4.2 The mask assembly shall be designed to withstand the declared range of environmental conditions to which it will be or is likely to be subjected in operational use. Precautions shall be taken against the effect of ice and moisture accumulation.
- 2.4.3 All couplings shall be designed to preclude inadvertent disconnection.

3. Performance

NOTE. The values of gas flow and gas pressure quoted below are those obtained at 15°C and at one standard atmosphere, i.e. 101.3 kPa (1013 mbar).

3.1 Mechanical

- 3.1.1 The mask assembly shall be capable of withstanding a tensile force on each of the suspension device attachment fittings of not less than 100 N in the direction of maximum pull in operational use for a period of not less than 15 s.
- 3.1.2 The gas supply tube when coupled to the mask assembly shall be capable of withstanding a tensile force of not less than 100 N exerted along the axis of symmetry of the tube for a period of not less than 15 s when the tube is subjected to its maximum working pressure.

3.2 Pneumatic

- 3.2.1 The mask gas supply hose assembly shall be capable of withstanding an internal pressure of 3 times the maximum working pressure without failure, and 1.5 times the maximum working pressure without leakage or permanent distortion.
- 3.2.2 The tube shall also be capable of withstanding without damage a negative pressure of 6 kPa (60 mbar).
- 3.2.3 Inward leakage into the mask, with its associated supply system, shall be kept to a minimum. The requirements stated in BS 4667: Part 3 are acceptable in this respect.
The inward leakage may be reduced or eliminated by maintaining a positive or safety pressure in the mask face piece, which will also tend to compensate for poor fitting of the mask to the user's face.
- 3.2.4 Where an inspiratory valve is installed in a mask assembly any reverse flow through that valve shall be less than 10 ml/min when the valve is subjected to mask cavity pressures up to 200 Pa (2 mbar) after having been subjected to a differential pressure of 35 kPa (350 mbar).
- 3.2.5 The inspiratory resistance, defined as the pressure drop between the inlet to the mask assembly, including mask tube, and the mask cavity, shall not exceed 500 Pa (5 mbar) with gas flows up to 150 litres/min.
- 3.2.6 The expiratory resistance of the assembly, defined as the pressure drop between the mask cavity and the pressure outlet of the expiratory valve shall not exceed 900 Pa (9 mbar) at flow rates up to 150 litres/min.
- 3.2.7 The mask assembly shall not suffer damage at inspiratory and expiratory gas flows up to 180 litres/min.
- 3.2.8 The mask assembly shall operate satisfactorily in the presence of speech and gas flow noises.

3.3 Acoustics

- 3.3.1 The design of the speech diaphragm, and mask microphone if fitted, when used with associated communication systems, shall permit vocal communication during normal use.
- 3.3.2 Where a microphone is fitted care should be taken to ensure that external and internal noises have minimal effect (some noise attenuation facilities may be required to achieve this).
- 3.4 **Wearer requirements.** The mask assembly shall be so designed that instruments in the cockpit can be seen clearly and all round head movement for visual search is not significantly impaired.

3.5 Environmental

- 3.5.1 The performance of the mask assembly shall not deteriorate, nor shall it be deranged, when subjected to the appropriate vibration requirements of British Standard 3G 100: Part 2: Subsection 3.1, specified in the individual specification and suitably adjusted in accordance with the information given in Appendix A of this standard.

* Suitable limits of electrical resistance of antistatic and conductive flexible materials and tests to determine the resistance are stated in BS 2050.

N4:1974

In addition the mask assembly shall not suffer damage in the stowed position experienced under the appropriate aircraft vibration conditions of British Standard 3G 100: Part 2: Subsection 3.1 specified in the individual specification.

3.5.2 The mask assembly shall function satisfactorily after being subjected to the appropriate acceleration requirements of British Standard 3G 100: Part 2: Subsection 3.6 specified in the individual specification.

3.5.3 The mask assembly shall function satisfactorily over the appropriate range of temperatures and pressures given in British Standard 3G 100: Part 2: Subsection 3.2 and specified in the individual specification.

3.5.4 The performance of the mask assembly shall not deteriorate during and after exposure to rapid decompression, as required by the appropriate grade of British Standard 3G 100: Part 2: Subsection 3.4 specified in the individual specification.

3.5.5 The mask assembly shall remain serviceable for a minimum of 30 min after exposure to a spray of contaminating fluid in accordance with British Standard 3G 100: Part 2: Section 3: Subsection 3.12. The individual specification shall specify the selected fluid groups and other special test requirements.

Appendix A

Vibration transmissibility: mechanical vibration transmitted to the mask assemblies when worn by a seated subject

Mask assemblies are subjected to different vibration from that at the seat structure due to the characteristics of the seat cushion, the body and the mask suspension. The transmission factor T is defined as

$$T = \frac{\text{amplitude of vibration at the mask assembly}}{\text{amplitude of vibration at the seat structure}}$$

and typical values of T versus frequency for vertical and fore and aft sinusoidal vibration are given in Fig. 1. For lateral vibration of the seat, negligible vibration will generally be transmitted to the head. It is emphasized that the values given were obtained from tests on subjects in one type of military aircraft ejection seat, and if vibration effects on a particular mask assembly prove critical then it may be necessary to measure the transmission characteristics of the seat and mask assembly in question.

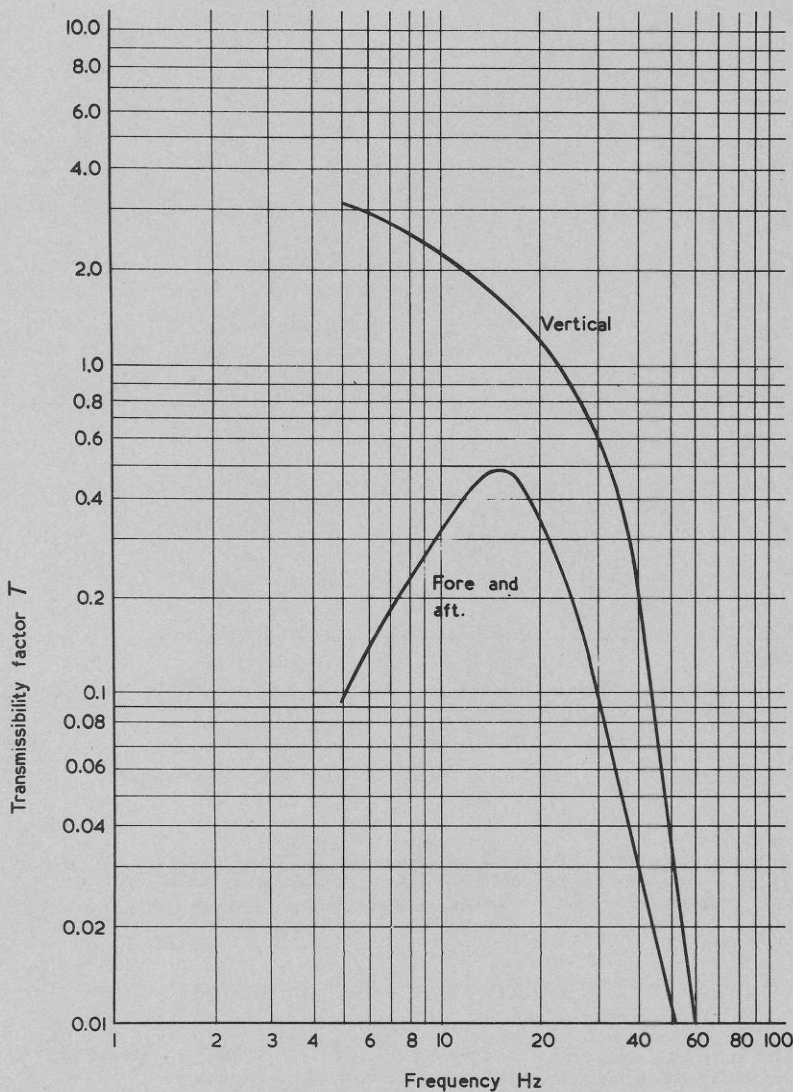


Fig. 1. Vibration transmission to a mask assembly when worn by a seated subject

Appendix B

Conversion of units of measurement

Approximate conversions of the SI units in the standard may be selected from the following tables. Accurate conversions may be made by reference to BS 350.

Force

N	lbf
100	22.5

Pressure

1 standard atmosphere = 101.3 kPa = 101.3 kN/m² = 1013 mbar = 760 mmHg = 29.92 inHg.

Pa	N/m ²	mbar	mmH ₂ O	inH ₂ O
200	200	2	20.32	0.8
500	500	5	50.80	2.0
900	900	9	91.44	3.6

kPa	kN/m ²	mbar	mmH ₂ O	inH ₂ O
1	1	10	101.6	4.0
6	6	60	612.1	24.1
35	35	350	3683.0	145.0

Volume

1 litre = 10⁻³ m³ = 10³ cm³ = 1 dm³

1 ml = 10⁻⁶ m³ = 1 cm³

ml	in ³	litre	ft ³
10	0.6	150	5.3
200	12.2	180	6.4

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Contract requirements

Attention is drawn to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

Revision of British Standards

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following BSI references relate to the work on this standard:

Committee reference ACE/38 Draft for comment 72/37268DC