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Face Masks Particulate Filtration Efficiency PFE Tester

Product No: GLE-20

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GLE-20 is an oil-salt two-in-one Face Masks Particulate Filtration Efficiency PFE Tester. According to ASTM F1862-17, ASTM F2299-(, ASTM F2100-2019, BS EN14683-2019, BS EN 14387-2004+A1 2008, BS EN 136-1998, BS EN 140-1999, BS EN 143-2000 +C1-A1, BS EN 149-

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Standards:

1. It is designed and manufactured according to YY0469-2004 "Technical Requirements for Medical Surgical Masks" and GB2626-2006 "Respiratory Protective Equipment Self-Suction Filter Anti-Particle Respirator". At the same time, it also refers to the advanced design concepts of similar international equipment (such as the American TSI company), based on the principle of " European standard EN1822-3: 1998 single-sheet filter material test ", but it is suitable for the test status of domestic related industries
2. GB / T 32610-2016 "Technical Specifications for Daily Protective Masks"
3. GB / T 19082-2009 "Technical requirements for medical disposable protective clothing"
4. GB / T 19083-2010 "Technical Requirements for Medical Protective Masks"
5. GB 24539-2009 General technical requirements for protective clothing and chemical protective clothing
6. YY / T 0969-2013 "Standard for disposable medical masks"

Standard Requirement:

Using sodium chloride particles to detect KN filter elements, and use dioctyl phthalate or equivalent oil particles (or paraffin oil) to detect KP filter elements.

Test according to 6.3

During the test, the filtration efficiency of each sample should always meet the requirements of Table 2

Tags : GLE-20 , Particulate filtration efficiency tester

KN95	95.0%	
KN100	99.97%	Not Siut
KP90		90.0%
KP95		95.0%
KP100	Not Suit	99.97%

Specifications:

1. Filtration efficiency detection flowmeter range: (10 ~ 100) L / min, accuracy level 2.5
2. Filtration efficiency detection range: (0.001 ~999)%.
3. Filtering efficiency sampling frequency: 1-9999 times / min can be set arbitrarily.
4. Filtration efficiency Particulate concentration: (0.001-200) mg / m^3.
5. Differential pressure sensor range: 0 ~1000pa
6. Counting median diameter: salt particles (0.075 ±0.02) μm, oil particles (0.185 ± 0.02) μm. Geometric standard deviation of particle size distribution: salt particles≤1.86, oil particles≤1.60. Dynamic detection range: 0.001-100 mg / m^3, accuracy 1%.
7. Test area: 100cm^2.
8. Aerosol: NaCl (optionally with DOP, DEHS, paraffin oil, corn oil).
9. Aerosol concentration: 12-20mg / m^3 (Nacl), 50-200mg / m^3 (DOP).
10. The system contains two independent aerosol generators: oily and salty aerosol generators containing two particle counting sensors, one particle concentration sensor and one particle generator
11. Power: AC220V 50Hz(120V/60Hz can be customized)

GLE-20 Characteristics:

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1. The oil and salt two-in-one test and the two sets of test hardware systems are completely independent. The test does not interfere v other to ensure the accuracy of the oil and salt test.

6. Configure temperature and humidity sensor, real-time display of ambient temperature and humidity (temperature and humidity requirements: 25 ℃ ± 5 ℃, 30% RH ± 10% RH).
7. Equipped with glass rotor flowmeter, vacuum pump and gas electromagnetic flowmeter.
8. Control system: touch-screen computer and test software have been configured to automatically test gas concentration and filtration efficiency, save, output, query, copy and export test data, support A4 paper printing and small bill printing test results

公司名称： LISUN 公司地址： Shanghai

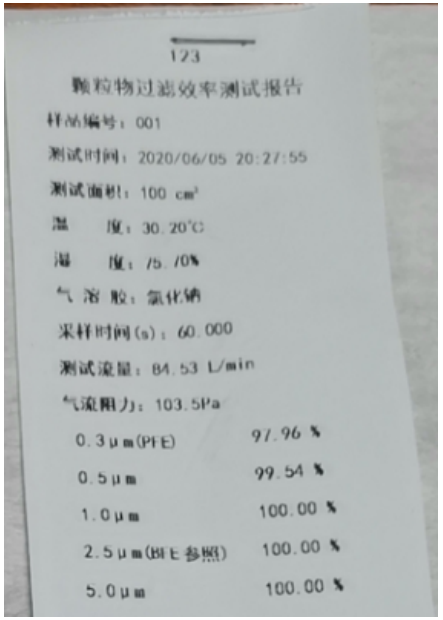
样品名称： 12306 样品编号： 002

测试人员： 测试标准： GB2626

测试时间： 2020/06/06 17:48:08 报告时间： 2020/06/06 17:50:40

测试条件			
测试面积：	100cm3	气溶胶：	油性 / 33.96 mg/m3
采样时间：	90	采样间隔：	2
测试流量：	94.80 L/min	气流阻力：	126.0Pa
温度（℃）：	29.00℃	湿度（%RH）：	84.40%

测试数据				
粒径	上游颗粒数	下游颗粒数	过滤效率（%）	穿透率（%）
0.3μm(PFE)	70914.00	573.00	99.19	0.81
0.5μm	15635.00	79.00	99.49	0.51
1.0μm	3320.00	3.00	99.91	0.09
2.5μm(BFE 参照)	230.00	0.00	100.00	0.00
5.0μm	2.00	0.00	100.00	0.00



检测员：_____ 审核人：_____ 复核人：_____

1

BRITISH STANDARD

BS EN 136:1998
Incorporating Corrigendum No. 1

Respiratory protective devices — Full face masks — Requirements, testing, marking

The European Standard EN 136:1998 has the status of a British Standard

ICS 13.340.30

BSI British Standards

National foreword

This British Standard is the English language version of EN 136:1998, including Corrigendum December 2003. It supersedes BS 7355:1990 and BS EN 136-10:1992 which are withdrawn.

The UK participation in its preparation was entrusted by Technical Committee PH/4, Respiratory protection, to Subcommittee PH/4/3, Facepieces, which has the responsibility to:

— aid enquirers to understand the text;
— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 38, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

This British Standard, having been prepared under the direction of the Health and Environment Sector Board, was published under the authority of the Standards Board and comes into effect on 15 June 1998

Amendments issued since publication

Amd. No.	Date	Comments
14996 Corrigendum No. 1	4 June 2004	Changes to Figure 9 and **10.4**

ISBN 0 580 29126 X

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 136

January 1998

ICS 13.340.30

Incorporating corrigendum December 2003

Descriptor: Respiratory protective equipment, accident prevention, safety masks, specifications, tests, marking

English version

Respiratory protective devices — Full face masks — Requirements, testing, marking

Appareils de protection respiratoire — Masques complets — Exigences, essais, marquage

Atemschutzgeräte — Vollmasken — Anforderungen, Prüfung, Kennzeichnung

This European Standard was approved by CEN on 1997-04-03.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 136:1998 E

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 79, Respiratory protective devices, the secretariat of which is held by DIN.

This European Standard replaces EN 136:1989 and EN 136-10:1992.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 1998, and conflicting national standards shall be withdrawn at the latest by July 1998.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

Introduction

A given respiratory protective device can only be approved when the individual components satisfy the requirements of the test specification which may be a complete standard or part of a standard, and successful practical performance tests have been carried out on complete apparatus where specified in the appropriate standard. If for any reason a complete apparatus is not tested then simulation of the apparatus is permitted provided the respiratory characteristics and weight distribution are similar to those of the complete apparatus.

1 Scope

This European Standard specifies minimum requirements for full face masks for respiratory protective devices.

Full face masks for diving apparatus are not included in the scope of this European Standard.

Laboratory and practical performance tests are included for the assessment of compliance with the requirements.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 132:1990, *Respiratory protective devices — Definitions.*

EN 134:1990, *Respiratory protective devices — Nomenclature of components.*

EN 148-1:1987, *Respiratory protective devices — Threads for facepieces — Standard thread connection.*

EN 148-2:1987, *Respiratory protective devices — Threads for facepieces — Centre thread connection.*

EN 148-3:1992, *Respiratory protective devices — Threads for facepieces — Thread connection M 45 × 3.*

ISO 6941:1984/AMD 1:1992, *Textile fabrics — Burning behaviour — Measurement of flame spread properties of vertically oriented specimens.*

ISO 6942:1993, *Clothing for protection against heat and fire — Evaluation of thermal behaviour of materials and material assemblies when exposed to a source of radiant heat.*

3 Definition

For the purposes of this standard the definitions given in EN 132 and the nomenclature given in EN 134 apply together with the following.

A full face mask is a facepiece which covers the eyes, nose, mouth and chin and provides adequate sealing on the face of the wearer of a respiratory protective device against the ambient atmosphere, when the skin is dry or moist, and even when the head is moved or when the wearer is speaking.

4 Description

Air enters the full face mask through the connector(s) and passes either directly to the nose and mouth area or via the eye (visor) area of the full face mask.

The exhaled air flows back either through the connector into the breathing apparatus (closed-circuit breathing apparatus, pendulum breathing) or directly to the ambient atmosphere, via the exhalation valve(s), or by other appropriate means in other types of respiratory protective devices.

An inner mask may be used to separate the nose and mouth from the eye (visor) area(s) of the full face mask.

5 Classification

Three classes of full face masks are described, each providing the same level of respiratory protection but having some differences which reflect intended areas of application.

Class 1: Full face masks for light duty use.

Class 2: Full face masks for general use.

Class 3: Full face masks for special use.

6 Designation

Designation of a full face mask meeting the requirements of this standard:

Full face mask EN 136 (Class) (Options).

7 Requirements

7.1 General

In all tests, all test samples shall meet the requirements.

7.2 Nominal values and tolerances

Unless otherwise specified, the values stated in this standard are expressed as nominal values. Except for temperature limits, values which are not stated as maxima or minima shall be subject to a tolerance of ±5 %. Unless otherwise specified, the ambient temperature for testing shall be (24 ± 8) °C, the temperature limits shall be subject to an accuracy of ±1 °C and the relative humidity shall be (50 ± 30) %.

7.3 Visual inspection

The visual inspection shall include that of the marking and of any information to be supplied by the manufacturer.

Testing shall be done in accordance with **8.3**.

7.4 Materials

For class 2 and class 3 full face masks exposed parts i.e. those which may be subjected to impact during use of the apparatus shall not be made of aluminium, magnesium, titanium or alloys containing such proportions of these metals as will, on impact, give rise to frictional sparks capable of igniting flammable gas mixtures.

Testing shall be done in accordance with **8.3**.

7.5 Resistance to temperature

Before and after this test the full face mask shall meet the requirement of **7.16**.

Following the conditioning in accordance with **8.2** and after being allowed to return to ambient temperature the full face mask shall show no appreciable deformation and any incorporated threaded connector to EN 148-1, EN 148-2 or EN 148-3 shall be gauged and shall comply with the appropriate standard.

In addition with class 3 full face masks, the threads specified in EN 148-1, EN 148-2 or EN 148-3 as appropriate shall also be accurate according to the gauge, at the end of the conditioning period in accordance with **8.2**b).

Testing shall be done in accordance with **8.3**, **8.4**, **8.13** and **8.16**.

7.6 Flammability

7.6.1 *General*

Before and after these tests the full face mask shall meet the requirement of **7.16**.

7.6.2 *Class 1 full face masks*

Parts of the full face mask that might be exposed to a flame during use shall not burn or continue to burn for more than 5 s after removal from the flame.

Testing shall be done in accordance with **8.3** and **8.5.1**.

7.6.3 *Class 2 and class 3 full face masks*

Parts of the full face mask that might be exposed to a flame during use shall not burn or continue to burn for more than 5 s after removal from the flame.

Testing shall be done in accordance with **8.3** and **8.5.2**.

7.7 Resistance to thermal radiation

Class 3 full face masks shall be resistant to thermal radiation. This may be achieved in one of two ways, i.e.:

The full face mask is considered to be resistant to thermal radiation in accordance with this standard if it remains leaktight after a test period of 20 min although it may be deformed.

Alternatively the full face mask can be considered to be resistant to thermal radiation if the visibility becomes impaired after a test period of ≥ 4 min and the facepiece is still leaktight after a further minute.

Before and after the thermal radiation test the full face mask shall meet the requirement of **7.16**.

Testing shall be done in accordance with **8.6**.

7.8 Cleaning and disinfecting

The materials used shall withstand the cleaning and disinfecting agents and procedures as recommended by the manufacturer.

Testing shall be done in accordance with **8.7**.

7.9 Finish of parts

The finish of any part of the full face mask likely to be in contact with the wearer shall be free from sharp edges and burrs.

Testing shall be done in accordance with **8.3** and **8.18**.

7.10 Replaceable components

This requirement applies to class 3 full face masks only.

Unless integral with the full face mask the following components (when fitted) shall be replaceable:

Inner mask, head harness, lens/visor, connector(s), inhalation and exhalation valves, check valves, speech diaphragm, lens wiper.

Testing shall be done in accordance with **8.3**.

7.11 Head harness

7.11.1 The head harness shall be designed so that the full face mask can be donned and removed easily.

Testing shall be done in accordance with **8.3** and **8.18**.

7.11.2 The head harness shall be adjustable or self-adjusting and shall hold the full face mask firmly and comfortably in position.

Testing shall be done in accordance with **8.3** and **8.18**.

7.11.3 *Strength*

7.11.3.1 For class 1 full face masks each strap of the harness shall withstand a pull of 100 N applied for 10 s in the direction of pulling when the full face mask is donned.

Buckles and attachment lugs (if present) shall withstand the same pull.

Testing shall be done in accordance with **8.3** and **8.8.1**.

7.11.3.2 For class 2 and class 3 full face masks each strap of the head harness shall withstand a pull of 150 N applied for 10 s in the direction of pulling when the full face mask is donned.

Buckles and attachment lugs (if present) shall withstand the same pull.

Testing shall be done in accordance with **8.3** and **8.8.1**.

7.11.4 There shall be no permanent linear deformation of each strap of more than 5 % after having been tested at a pull of 50 N for 10 s.

Testing shall be done in accordance with **8.3** and **8.8.2**.

7.11.5 For class 3 full face masks once fitted the head harness shall be easily adjustable by the wearer or self-adjusting.

Testing shall be done in accordance with **8.3** and **8.18**.

7.12 Connector

7.12.1 *General*

The connection between the full face mask and the apparatus may be achieved by a permanent or special type of connection or by a threaded connection.

If more than one connector is fitted the design of the facepiece or of the remainder of the equipment shall be such that the use of different types or combinations of respiratory protective devices does not present a risk.

All demountable connections shall be readily connected and secured, where possible by hand. Any means of sealing used shall be retained in position when the connection is disconnected during normal maintenance.

Correct and reliable connection between facepiece and other parts of the equipment shall be assured.

Testing shall be done in accordance with **8.3**, **8.16** and **8.18**.

7.12.2 *Class 1 full face masks*

Class 1 full face masks shall not have threaded connectors defined in EN 148-1, EN 148-2 and EN 148-3.

Testing shall be done in accordance with **8.3**.

7.12.3 *Class 2 and class 3 full face masks*

Full face masks shall have only one threaded connector defined in EN 148-1, EN 148-2 or EN 148-3.

If any other connector is used it shall not be possible to connect it to the threads defined in EN 148-1, EN 148-2 or EN 148-3.

Testing shall be done in accordance with **8.3**.

7.12.4 *Strength of connection*

7.12.4.1 Before and after this test the full face mask shall meet the requirement of **7.16**.

7.12.4.2 For class 1 full face masks the connection between the faceblank and the connector shall be sufficiently robust to withstand axially a tensile force of 250 N.

Testing shall be done in accordance with **8.9** and **8.13**.

7.12.4.3 For class 2 and class 3 full face masks the connection between the faceblank and the connector shall be sufficiently robust to withstand axially a tensile force of 500 N.

Testing shall be done in accordance with **8.9** and **8.13**.

7.13 Speech diaphragm

7.13.1 Where the facepiece includes a speech diaphragm the latter shall be protected against mechanical damage as assessed by visual inspection in accordance with **8.3**.

The speech diaphragm shall withstand a differential pressure of 80 mbar (static pressure) with the positive pressure on the outside (ambient atmosphere).

Testing shall be done in accordance with **8.3** and **8.10.1**.

7.13.2 When a speech diaphragm assembly can be subjected to an external force it shall withstand axially a tensile force of 150 N applied for 10 s. The test shall be repeated nine times at 10 s intervals.

Testing shall be done in accordance with **8.3** and **8.10.2**.

7.13.3 After a class 3 full face mask has been subjected to the thermal radiation test in accordance with **8.6** and allowed to return to ambient temperature, the requirements of **7.13.1** and **7.13.2** shall be met.

Testing shall be done in accordance with **8.3** and **8.10.3**.

7.14 Eyepieces/visor

7.14.1 Eyepieces/visor and anti-mist discs designed to serve as visors shall be attached in a reliable and gastight manner to the faceblank.

Testing shall be done in accordance with **8.3**.

7.14.2 Eyepieces and visors shall not distort vision as determined in practical performance tests.

Testing shall be done in accordance with **8.18**.

7.14.3 The manufacturer shall provide means to reduce misting of the eyepieces or visors so that vision is not interfered with when the apparatus is tested in the practical performance tests.

Where anti-fogging compounds are used as intended or specified by the manufacturer, they shall not be known to be likely to cause irritation or any other adverse effect to health.

Testing shall be done in accordance with **8.3** and **8.18**.

7.14.4 After the test for mechanical strength of the eyepiece(s) or visor the facepiece shall not be damaged in any way that may make it ineffective or cause injury to the wearer. The effectiveness shall be tested by comparing the tightness of the full face mask before and after the test. The full face mask shall meet the requirements of **7.16** both before and after the test for mechanical strength of the eyepiece or visor.

Testing shall be done in accordance with **8.3**, **8.11** and **8.13**.

7.15 Inhalation valves and exhalation valves

7.15.1 *General*

Valve assemblies shall be such that they can be readily maintained and if intended by the manufacturer correctly replaced.

It shall not be possible to fit an exhalation valve assembly into the inhalation circuit or an inhalation valve assembly into the exhalation circuit.

Inhalation and exhalation valve assemblies, sub-assemblies and piece parts that are designed by the manufacturer to be identical, are acceptable.

Differently designed inhalation and exhalation valve assemblies, sub-assemblies and piece parts are acceptable if a precise and comprehensible description is given in the information supplied by the manufacturer. This information should be supported by illustrations (photographs, drawings) on how to assemble the unit correctly.

To enable correct assembling, the parts shall be unambiguously described or marked.

Means to check the correct assembly shall be described (visual inspection, simple check by wearer, test by maintenance personnel — whatever may be appropriate).

Testing shall be done in accordance with **8.3**.

7.15.2 *Inhalation valves*

7.15.2.1 Inhalation valves shall function correctly in all orientations and meet the requirements of **7.19**.

7.15.2.2 A full face mask with a threaded connection to EN 148-2 shall not have an inhalation valve.

If a threaded connection to EN 148-1 is used, an inhalation valve shall be incorporated in the full face mask.

If a full face mask has to be used with filters it shall be provided with an inhalation valve, if there is no valve in the filter.

Testing shall be done in accordance with **8.3**.

7.15.3 ***Exhalation valves***

7.15.3.1 A full face mask with a threaded connection to EN 148-2 shall not have an exhalation valve.

Testing shall be done in accordance with **8.3**.

7.15.3.2 Exhalation valves shall function correctly in all orientations and meet the requirements of **7.19**.

Testing shall be done in accordance with **8.3** and **8.15.1**.

7.15.3.3 A full face mask fitted with a threaded connection to EN 148-1 or EN 148-3 and a full face mask class 1 shall have at least one exhalation valve or other appropriate means to allow the escape of exhaled air and/or excess air.

Testing shall be done in accordance with **8.3**.

7.15.3.4 Exhalation valves (if fitted) shall be protected against or be resistant to dirt and mechanical damage. They may be shrouded or include any other device that may be necessary to comply with **7.20**.

Testing shall be done in accordance with **8.3**.

7.15.3.5 Exhalation valves shall continue to operate correctly and meet the requirements of **7.19** after (a) a continuous exhalation flow of 300 l/min and (b) a negative pressure (static) in the facepiece of 80 mbar (30 s for each test).

Testing shall be done in accordance with **8.3** and **8.12.1**.

7.15.4 ***Tensile force***

7.15.4.1 *Class 1 full face masks*

Before and after the test the full face mask shall meet the requirement of **7.16**.

When the exhalation valve housing is attached to the faceblank it shall withstand axially a tensile force of 50 N applied for 10 s.

The test shall be repeated 9 times at 10 s intervals.

Testing shall be done in accordance with **8.3** and **8.12.2**.

7.15.4.2 *Class 2 and class 3 full face masks*

Before and after the test the full face mask shall meet the requirement of **7.16**.

When the exhalation valve housing is attached to the faceblank it shall withstand axially a tensile force of 150 N applied for 10 s.

The test shall be repeated 9 times at 10 s intervals.

Testing shall be done in accordance with **8.3** and **8.12.2**.

7.16 Leaktightness

The leakage of the full face mask shall not exceed that indicated by a change of pressure of 1 mbar in 1 min, when tested with 10 mbar negative pressure.

Testing shall be done in accordance with **8.13**.

7.17 Compatibility with skin

Materials that may come into contact with the wearer's skin shall not be known to be likely to cause irritation or have any other adverse effect to health.

Testing shall be done in accordance with **8.3** and **8.18**.

7.18 Carbon dioxide content of the inhalation air

The carbon dioxide content of the inhalation air (dead space) shall not exceed an average of 1 % (by volume).

Testing shall be done in accordance with **8.14**.

7.19 Breathing resistance

7.19.1 According to its class and type including the kind of connection a full face mask (except for positive pressure breathing apparatus) shall meet the requirements specified in **7.19.2** or **7.19.3**.

When the facepiece has a special connection for use only with positive pressure breathing apparatus, its breathing resistance is not assessed separately but as a part of the complete apparatus, which shall meet the requirements of the appropriate standard for breathing apparatus.

7.19.2 Facepieces with connections other than those in **7.19.3** and **7.19.4** shall meet the requirements given in Table 1.

Testing shall be done in accordance with **8.15.1**.

Table 1

Inhalation resistance mbar			**Exhalation resistance** mbar
30 l/min continuous flow	**95 l/min continuous flow**	**160 l/min continuous flow or 50 l/min sinusoidal (25 cycles/min, 2,0 l/stroke)**	**160 l/min continuous flow or 50 l/min sinusoidal (25 cycles/min, 2,0 l/stroke**
≤ 0,5	≤ 1,5	≤ 2,5	≤ 3,0

7.19.3 Class 2 and class 3 facepieces with threaded connection to EN 148-2 and without valve(s) shall meet the requirements given in Table 2.

Table 2

Inhalation resistance mbar	**Exhalation resistance** mbar
160 l/min continuous flow or 50 l/min sinusoidal (25 cycles/min, 2,0 l/stroke)	**160 l/min continuous flow or 50 l/min sinusoidal (25 cycles/min, 2,0 l/stroke)**
≤ 0,6	≤ 0,6

Testing shall be done in accordance with **8.15.1**.

7.19.4 Class 2 and class 3 full face masks with a threaded connection in accordance with EN 148-3, for use with positive pressure breathing apparatus, shall meet the requirements of Table 3.

Testing shall be done in accordance with **8.15.3**.

Table 3

Inhalation resistance mbar	**Exhalation resistance** mbar		
100 l/min sinusoidal (40 cycles/min, 2,5 l/stroke)	**100 l/min continuous flow**	**50 l/min sinusoidal (25 cycles/min, 2,0 l/stroke)**	**100 l/min sinusoidal (40 cycles/min, 2,5 l/stroke)**
≤ 3,5	≥ 4,2	≤ 7,0	≤ 10,0

7.20 Inward leakage

A full face mask shall fit against the contours of the face. The inward leakage of the test agent shall not exceed an average value of 0,05 % of the inhaled air for any of the ten test subjects in any of the test exercises.

Testing shall be done in accordance with **8.16**.

7.21 Field of vision

A full face mask equipped with a single visor shall be designed so that the effective field of vision shall be not less than 70 %, related to the natural field of vision, and the overlapped field of vision, related to the natural overlapped field of vision, shall be not less than 80 %.

A full face mask with two eyepieces shall be designed so that the effective field of vision shall be not less than 70 %, related to the natural field of vision, and the overlapped field of vision, related to the natural overlapped field of vision, shall be not less than 20 %.

Testing shall be done in accordance with **8.17**.

7.22 Practical performance

The full face mask shall meet all laboratory tests except flammability and inward leakage before practical performance testing.

The complete apparatus shall undergo practical performance tests under realistic conditions. These general tests serve the purpose of checking the equipment for imperfections that cannot be determined by the tests described elsewhere in this standard. In addition to the tests described in this standard details of practical performance tests for respiratory protective devices are given in the relevant European Standard.

Where practical performance tests show the apparatus has imperfections related to wearer's acceptance the test house shall provide full details of those parts of the practical performance tests which revealed these imperfections. This will enable other test houses to duplicate the tests and assess the results thereof.

Testing shall be done in accordance with **8.18**.

8 Testing

8.1 General

Before performing tests involving human subjects account shall be taken of any national regulations concerning the medical history, examination or supervision of the test subjects.

All samples shall meet all requirements.

If no special measuring devices and methods are specified commonly used devices and methods shall be used.

For tests involving positive pressure devices, all testing should be carried out on the complete apparatus including facepiece, as submitted by the applicant.

8.2 Conditioning

Two full face masks shall be exposed during successive tests:

a) for 72 h to a dry atmosphere of (70 ± 3) °C;

b) for 72 h to an atmosphere of (70 ± 3) °C at 95 – 100 % relative humidity; and

c) for 24 h to a temperature of (−30 ± 3) °C.

The conditioning shall be carried out in a manner which ensures that no thermal shock occurs.

8.3 Visual inspection

All samples are subject to visual inspection as specified elsewhere in this standard.

The visual inspection shall be carried out prior to or during laboratory or practical performance tests.

8.4 Resistance to temperature

Two samples shall be tested: both in the state as received.

The threaded connectors shall be gauged at room temperature.

For class 3 full face masks the gauge test shall be completed within 30 s of removal.

8.5 Flammability

8.5.1 *Class 1 full face masks*

8.5.1.1 *Principle*

Three samples shall be tested: one in the state as received and two conditioned in accordance with **8.2** but after returning to ambient temperature.

The facepiece shall be mounted on a metallic dummy head, passed through a specified flame and the effects of the flame on the facepiece observed.

8.5.1.2 *Apparatus*

A metallic dummy head mounted on a support which enables it to be rotated by a motor to describe a horizontal circle (see Figure 1).

Gas supply rig consisting of a propane storage tank with flow control valve and pressure gauge and flashback arrester.

A gas burner, adjustable in height. The burner is a TEKLU burner or that described in ISO 6941:1984/AMD 1:1992[1)].

A mineral insulated thermocouple probe, 1,5 mm in diameter.

8.5.1.3 *Procedure*

The facepiece shall be fitted to the dummy head and it shall be ensured that a linear speed, measured at the flame position, of (60 ± 5) mm/s can be obtained.

The head, fitted with the facepiece, shall be rotated so that it is over the burner. The position of the burner shall be adjusted until the distance between the top of the burner and the lowest part of the facepiece which is to pass through the flame is (20 ± 2) mm.

The head and facepiece shall be rotated away from the burner.

The gas at the burner shall be ignited. It shall be ensured that the burner air vent is fully closed and the flow control valve shall be adjusted to give a flame height of (40 ± 4) mm above the burner top. These settings shall give a flame temperature of (800 ± 50) °C at a point (20 ± 2) mm above the burner top. This temperature shall be checked with the thermocouple probe.

The facepiece fitted to the dummy head shall be passed once through the flame at (60 ± 5) mm/s. The test shall be repeated to enable an assessment to be made of all materials on the exterior of the facepiece. Any one component/material shall be passed through the flame once only.

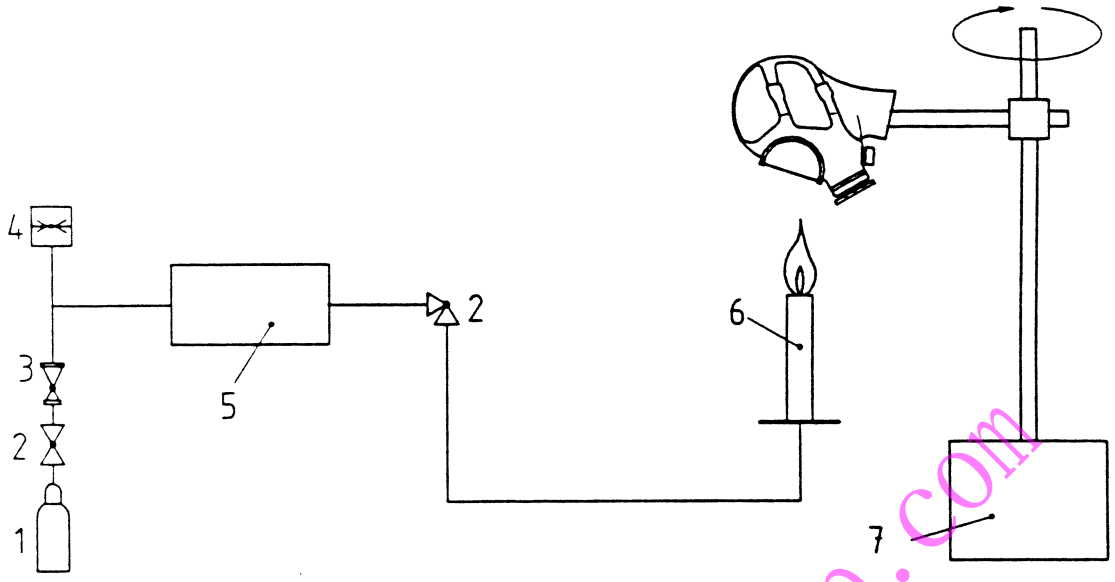
The facepiece or component shall be examined after it has passed through the flame and it shall be reported whether or not it continues to burn for more than 5 s.

8.5.2 *Class 2 and class 3 full face masks*

8.5.2.1 *Principle*

Three samples shall be tested: one in the state as received and two conditioned in accordance with **8.2** but after returning to ambient temperature.

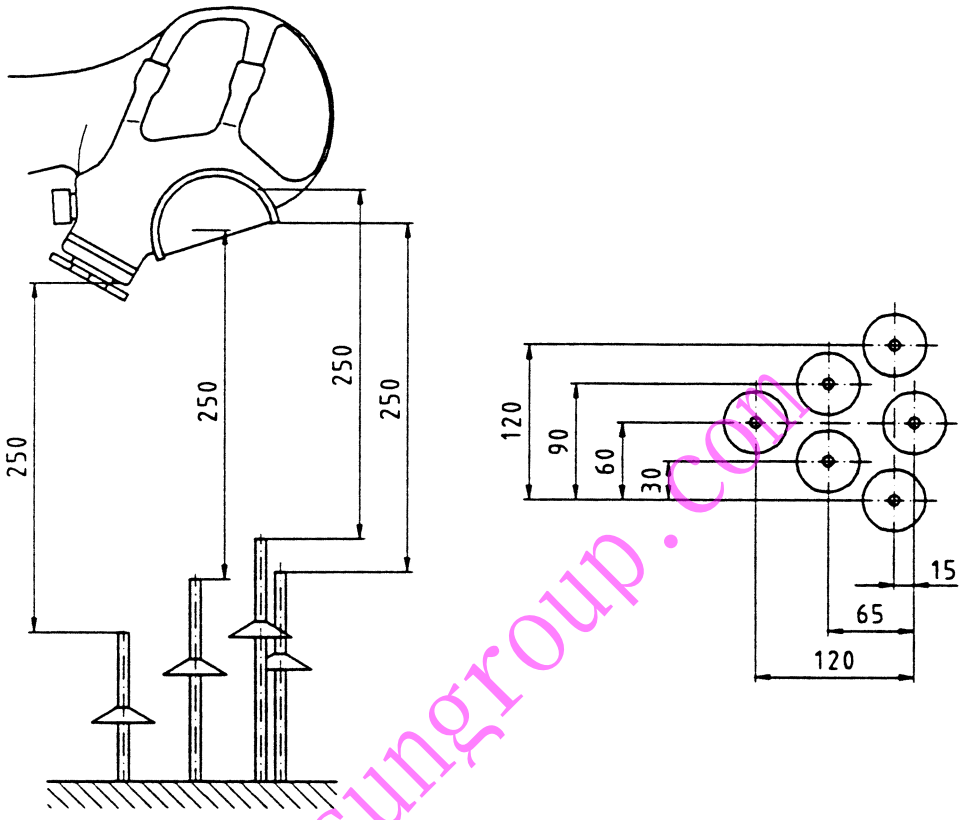
The facepiece shall be tested for flammability for a short period with a test rig as shown in Figure 2 and Figure 3.



1	Propane cylinder	5	Flame arrester
2	Valve	6	Burner
3	Pressure reducer	7	Rotation motor and speed control
4	Pressure gauge		

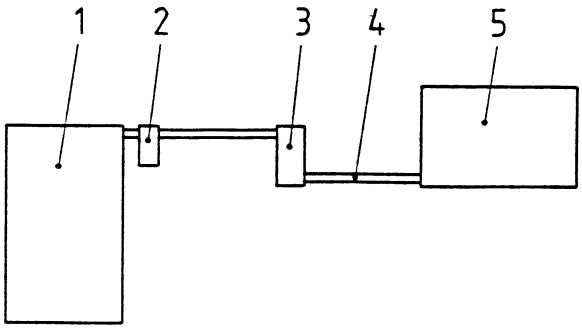
Figure 1 — Arrangement for testing flammability of class 1 full face masks

Dimensions in millimetres



Detail: Top view

Figure 2 — Arrangement of the six propane burners



1 Propane storage tank
2 Fine pressure gauge and control device
3 Flash back arrester
4 Connecting hoses (of same length) leading to the propane burners
5 Propane burner

Figure 3 — Arrangement for testing flammability of class 2 and class 3 full face masks

8.5.2.2 *Apparatus*

The test rig consists mainly of a propane storage tank with control device and fine pressure gauge, flash back arrester, six propane burners which are adjustable in height and a vertically and horizontally pivotable metal dummy head.

The test rig shall be adjusted as follows:

The distance between facepiece and burner tips shall be 250 mm.

The propane control valve on each of the six burners shall be fully open. Initially the air control valve on each of the six burners shall be closed. The propane cylinder output regulator shall be adjusted to a pressure such that a flowmeter in the main propane supply line indicates a total flow to all six burners of (21 ± 0,5) l/min propane.

A mineral insulated thermocouple probe, 1,5 mm in diameter, shall be used to measure flame temperature. The temperature shall be measured at a point 250 mm above the upper tip of any burner in the centre of the flame. All burners shall give flame temperatures within the tolerance required (950 ± 50) °C. The burners shall be adjusted to their correct position (heights) before measuring any flame temperature.

In order to achieve the correct temperature, it may be necessary to adjust the air control valve on each burner to an optimum and to shield the whole test apparatus from the effect of external air flows.

8.5.2.3 *Procedure*

For the test, the facepiece shall be put on the metallic dummy head and the free ends of the head straps shall be positioned between the dummy head and straps. The facepiece shall be exposed to the flames for a period of 5 s. When components such as valve(s), speech diaphragm(s) are arranged on other parts of the faceblank, the test shall be repeated with other samples of the facepiece orientated in the appropriate position.

For comparing the leaktightness of the full face mask before and after the flammability test it is recommended that the full face mask remains on the head of the flammability test rig.

8.6 Resistance to thermal radiation

8.6.1 ***Principle***

Five samples shall be tested: all in the state as received.

The full face mask is exposed to thermal radiation from a source with calibrated radiation output.

8.6.2 *Test equipment*

The test equipment consists mainly of a dummy head, a breathing machine and a source of thermal radiation. A calorimeter may be used for calibration.

A typical test arrangement is shown in Figure 4 (for general information only).

A suitable source of thermal radiation as shown schematically in Figure 4 provides a thermal energy flux of $8{,}0^{+0}_{-0{,}2}$ kW/m^2 at a distance of approximately 175 mm measured at the centre line. Any other suitable source of thermal radiation may be used.

The reference calorimeter is described in ISO 6942:1993. Any other suitable calorimeter may be used.

8.6.3 *Test conditions*

Energy flux:	$80^{+0}_{-0{,}2}$ kW/m^2 at a distance of 175 mm.
Breathing machine:	20 cycles/min, 1,5 l/stroke.

8.6.4 *Procedure*

After checking the leaktightness in accordance with **8.13** the full face mask shall be mounted securely and in a leaktight manner but without deformation on to a metallic dummy head and connected to the breathing machine.

By adjusting the dummy head the full face mask shall be positioned such that the centre of the visor is at the centre line of the source of thermal radiation at a distance of approximately 175 mm. The full face mask shall be vertical to the heat flux.

The dummy head with full face mask then shall be replaced by the calorimeter. The calorimeter shall be placed at a distance of approximately 175 mm from the source of thermal radiation in the position where the outer surface of the lens of the facepiece on the centre line will be during the exposure.

The source of thermal radiation shall be adjusted so that the thermal energy flux is $80^{+0}_{-0{,}2}$ kW/m^2 at the distance of approximately 175 mm. If necessary, the electrical supply shall be stabilized. Between the calorimeter and the source of thermal radiation an insulating separator shall be positioned.

Then the calorimeter shall be replaced by the dummy head with facepiece. The lens shall be at the position of the calorimeter. The test shall then be carried out under these conditions.

The breathing machine shall be switched on. After 3 min the separator shall be removed (= start of test time).

The full face mask shall be tested:

a) for 20 min; or

b) until the visibility is clearly impaired or any other indication of failure occurs which would be observed by the user plus an additional minute of exposure.

8.6.5 *Assessment of leaktightness*

Before and after the test leaktightness shall meet the requirements of **7.16**.

Testing shall be done in accordance with **8.13**.

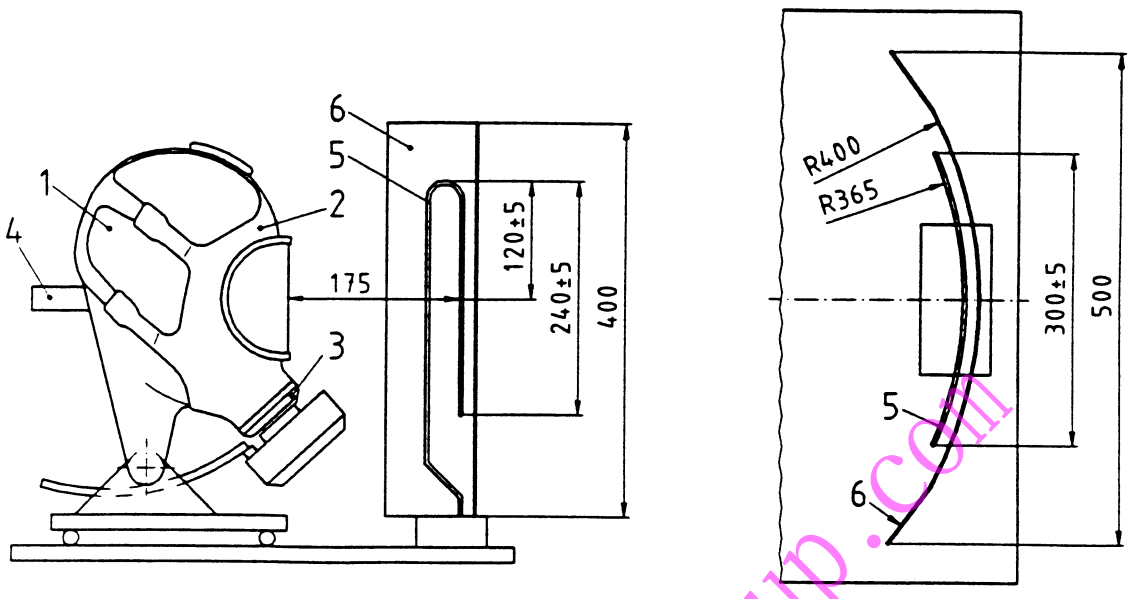
NOTE For comparing the leaktightness of the full face mask before and after the thermal radiation test it is recommended that the full face mask remains on the head of the thermal radiation test rig.

8.7 Cleaning and disinfecting

As many samples shall be cleaned and disinfected following the description in the manufacturer's information supplied by the manufacturer as are used for the inward leakage tests.

Compliance shall be assessed during the tests described in **8.16** and **8.18**.

Dimensions in millimetres



1	Metallic dummy head	4	Connector for breathing machine
2	Full face mask	5	Source of thermal radiation
3	Equipment connector	6	Reflector

Figure 4 — Arrangement for testing resistance to thermal radiation

8.8 Head harness

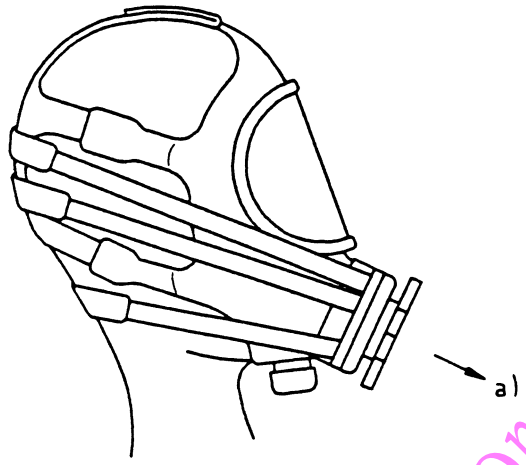
8.8.1 Three samples shall be tested: all in the state as received. The force shall be applied to the free end of the straps.

8.8.2 Three samples shall be tested: all in the state as received. The permanent linear deformation shall be measured 4 h after the pull test.

8.9 Connector

Three samples shall be tested: all in the state as received.

The facepiece shall be supported on a dummy head which can be adjusted so that the load can be applied axially to the connection. Additionally, a system of restraining straps or bands shall be fitted over the faceblank around the connection, so that the load is applied as directly as possible to the fitting of the connection in the faceblank and the restraining force is not applied wholly to the head harness (see Figure 5). Test time shall be 10 s.



a) tensile force

Figure 5 — Arrangement for testing the connector

8.10 Speech diaphragm

8.10.1 Three samples shall be tested: all in the state as received.

Only a sudden change in pressure shall be regarded as significant.

8.10.2 Three samples shall be tested: all in the state as received.

8.10.3 Three samples shall be tested: all in the state as received.

8.11 Eyepieces/visor

Five samples shall be tested: all in the state as received.

Mechanical strength shall be tested using a completely assembled full face mask mounted on a dummy head such that a steel ball [22 mm diameter, 43,8 g (approximately)] falls normally from a height of 1,30 m on the centre of the eyepiece or visor.

Leaktightness shall be tested in accordance with **8.13** before and after the test for mechanical strength.

8.12 Inhalation valves and exhalation valves

8.12.1 Three samples shall be tested: all in the state as received.

The negative pressure shall be maintained at 80 mbar by drawing off air (if necessary).

8.12.2 Three samples shall be tested: all in the state as received.

8.13 Leaktightness

All samples are subject to testing of leaktightness as specified elsewhere in this standard.

The test shall be carried out using a dummy head and a pressure of −10 mbar created in the cavity of the facepiece. When conducting this test the inhalation port shall be sealed and the exhalation valve disc shall be moistened.

The pressure shall be measured by usual test methods using a scale, divided in maximal 0,1 mbar steps.

8.14 Carbon dioxide content of the inhalation air

One sample in the state as received shall be tested in three separate tests.

The carbon dioxide level measured gives an assessment of the “dead space” of the facepiece rather than a “real life” measurement of the level of carbon dioxide in the inhaled air.

There shall be no “supplementary fan” used in the test (that is, there shall not be an air flow towards the facepiece of 0,5 m/s).

The apparatus consists essentially of a breathing machine with solenoid valves controlled by the breathing machine, a connector, a CO_2 flowmeter and a CO_2 analyser.

The apparatus subjects the facepiece to a respiration cycle by the breathing machine.

The facepiece shall be fitted to the Sheffield dummy head securely but without deformation and shall be leaktight. If necessary the facepiece can be sealed to the dummy head (see Figure 6) with, for example, PVC tape or other suitable sealant.

The "insert for measurement of breathing resistance" shown in Figure 6 shall not be used when carbon dioxide content is to be measured.

As in Figure 7 the concentric tubes shall end level with the "lips" of the dummy head and the sample tube shall be level with the end of the concentric tubes.

Air shall be supplied to it from the breathing machine adjusted to 25 strokes/min and 2,0 l/stroke and the exhaled air shall have a carbon dioxide content of 5 % by volume.

A typical test arrangement is shown in Figure 7.

To prevent a CO_2 build-up due to design of the test equipment a CO_2 absorber shall be used in the inhalation branch between solenoid valve and breathing machine.

The CO_2 shall be fed into the breathing machine via a flowmeter, a compensating bag and a non-return valve.

Immediately before the solenoid valve a small quantity of exhaled air shall be continuously withdrawn through a sampling line and then fed into the exhaled air via a CO_2 analyser. The samples shall be taken from the centre tube also when a twin cylinder equipment is used for the test.

To measure the CO_2 content of the inhalation air, 5 % of the stroke volume of the inhalation phase of the breathing machine shall be drawn off at the marked place by an auxiliary lung and fed to a CO_2 analyser. The total dead space of the gas path (excluding the breathing machine) of the test installation shall not exceed 2 000 ml.

The carbon dioxide content of the inhaled air shall be measured and recorded continuously.

The test shall be performed until a constant carbon dioxide content in the inhalation air is achieved.

The ambient carbon dioxide level shall be measured 1 m in front of and level with the tip of the nose of the dummy head. The ambient level shall be measured once a stabilized level for carbon dioxide in the inhalation air has been attained.

Alternatively the ambient level may be measured at the sampling tube with the carbon dioxide supply turned off.

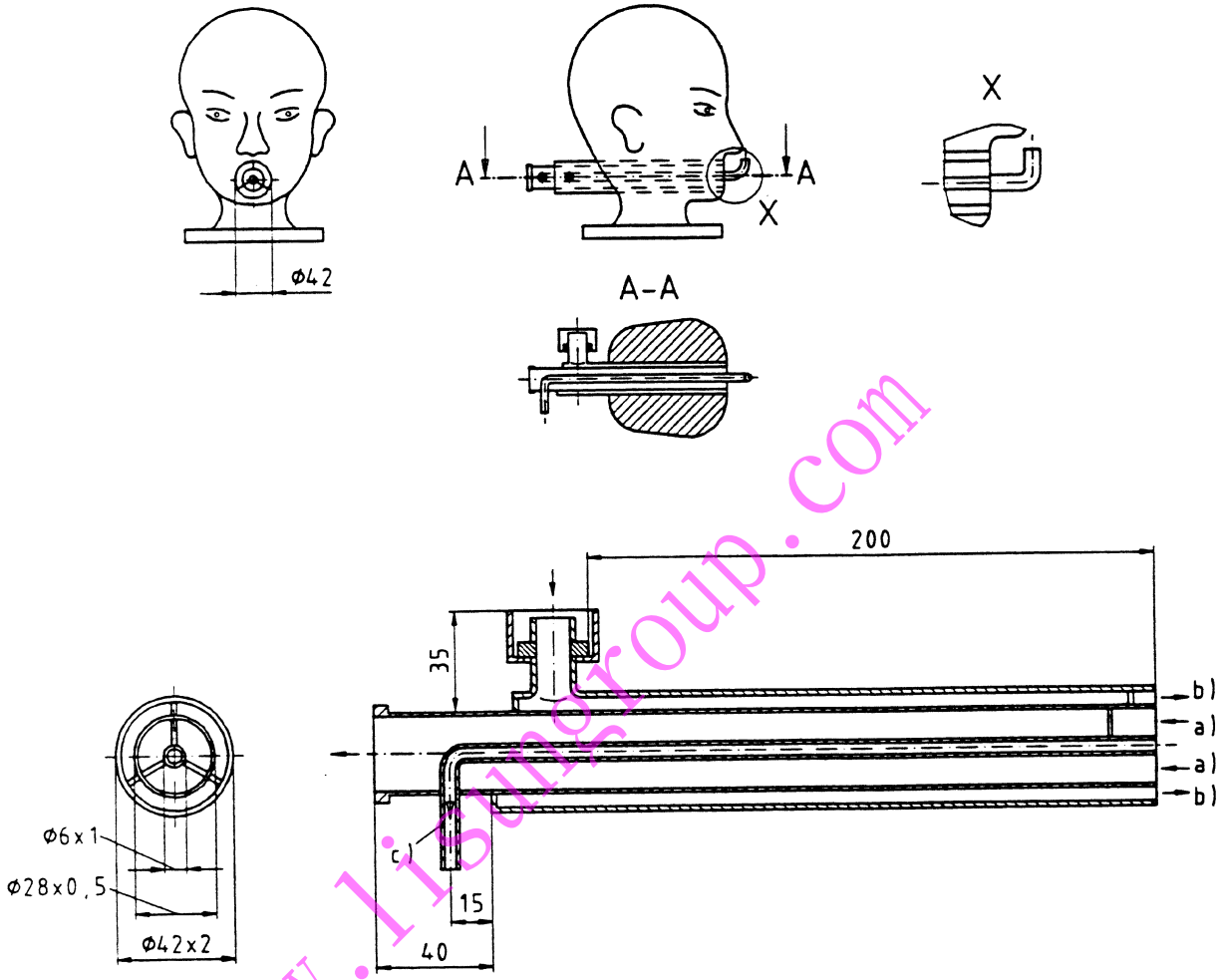
Results are deemed acceptable only if the measured value of the ambient level of carbon dioxide is less than 0,1 %.

The laboratory ambient carbon dioxide level shall be subtracted from the measured value.

The sample shall be subjected to three separate tests. The average of these tests shall be recorded as the carbon dioxide content of the inhalation air.

Facepieces without inhalation valves shall be tested together with the complete apparatus except those facepieces which are designed for use with closed-circuit breathing apparatus. This allows facepieces with or without inhalation and/or exhalation valves to be tested. Where deemed necessary by the manufacturer's design, the manufacturer reserves the right to stipulate complete apparatus testing only.

Dimensions in millimetres



X) Insert for measurement of breathing resistance

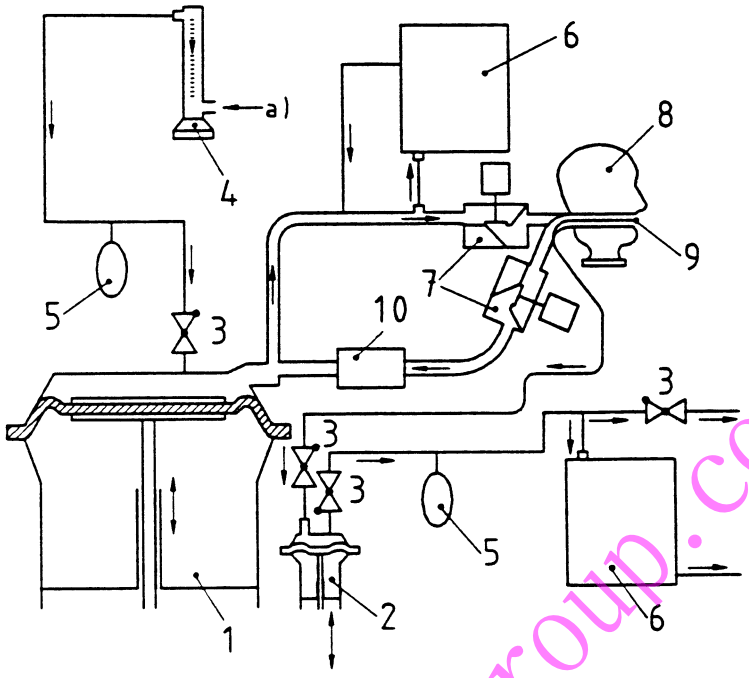
a) Inhalation

b) Exhalation

c) CO_2 measuring (during inhalation)

Figure 6 — Sheffield dummy head for testing carbon dioxide content of the inhalation air (dead space) and breathing resistance of a full face mask

Dimensions in millimetres



1	Breathing machine	7	Solenoid valve
2	Auxiliary lung	8	Dummy head
3	Non-return valve	9	Sampling tube for inhalation (see Figure 6)
4	Flowmeter	10	Carbon dioxide absorber
5	Compensator		
6	Carbon dioxide analyser	a)	Carbon dioxide

Figure 7 — Arrangement for testing carbon dioxide content of the inhalation air

8.15 Breathing resistance

8.15.1 *General*

Three samples shall be tested: all in the state as received.

The breathing resistance shall be measured with the facepiece fitted securely in a leaktight manner but without deformation on a Sheffield dummy head and measurements carried out successively in five defined orientations. These orientations are: with the facepiece looking ahead, vertically upwards, vertically downwards and then, with the normally vertical axis of the head horizontal, with the facepiece looking to the right and to the left. When measuring the breathing resistance, the insert shown as "X" in Figure 6 shall be used. The flow rate at which the breathing resistance is measured shall be corrected to 23 °C and 1 bar absolute.

8.15.2 *Full face masks with connections other than EN 148-3*

The breathing resistance shall be determined using a breathing machine adjusted to 25 cycles/min and 2,0 l/stroke or a continuous flow of 160 l/min.

The inhalation resistance shall also be measured at 30 and 95 l/min continuous flow.

8.15.3 *Full face masks with threaded connection to EN 148-3*

The breathing resistance shall be determined using a breathing machine adjusted to either 25 cycles/min and 2,0 l/stroke or 40 cycles/min and 2,5 l/stroke.

The exhalation resistance shall also be measured at 10 l/min continuous flow.

8.16 Inward leakage

8.16.1 *General test procedure*

The laboratory tests shall indicate that the facepiece can be used by the wearer to protect with high probability against the potential hazard to be expected.

The sodium chloride and sulfur hexafluoride methods are equally acceptable options.

Two samples shall be tested: one as received and one conditioned in accordance with **8.2** but after returning to ambient temperature.

8.16.1.1 *Inward leakage*

Prior to the test there shall be an examination that the facepiece is in good working condition and that it can be used without hazard.

For the test, persons shall be selected who are familiar with using such or similar equipment.

A panel of ten persons (clean shaven without beard or sideburns) shall be selected covering the spectrum of facial characteristics of typical users (excluding significant abnormalities). It is to be expected that exceptionally some persons cannot be satisfactorily fitted with a full face mask. Such exceptional subjects shall not be used for testing facepieces.

In the test report the faces of the ten test persons shall be described (for information only) by the four facial dimensions (in mm) illustrated in Figure 8.

If more than one size of facepiece is manufactured, the test subjects shall select the most appropriate size in accordance with the manufacturer's information.

8.16.1.2 *Test equipment*

a) *Test atmosphere*

The test atmosphere shall preferably enter the top of the hood/chamber through a flow distributor and be directed downwards over the head of the test subject at a flow rate of 0,1 – 0,2 m/s. The concentration of the test agent inside the effective working volume shall be checked to be homogeneous. The flow rate shall be measured close to the test subject's head.

The design of the hood/chamber shall be such that the test subject wearing the facepiece under test can be supplied with breathable air (free of test atmosphere).

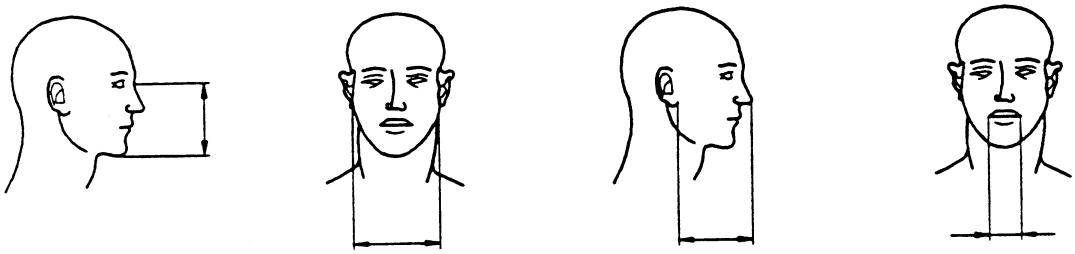
b) *Treadmill*

A level treadmill capable of working at 6 km/h.

c) *Filter simulator*

If the facepiece is to be used with a filter employing a thread complying with EN 148-1, a device (see Figure 9) is required to simulate the resistance of filters permitted for that type of facepiece. This simulator shall be connected to a clean air supply by an ultra-lightweight flexible hose.

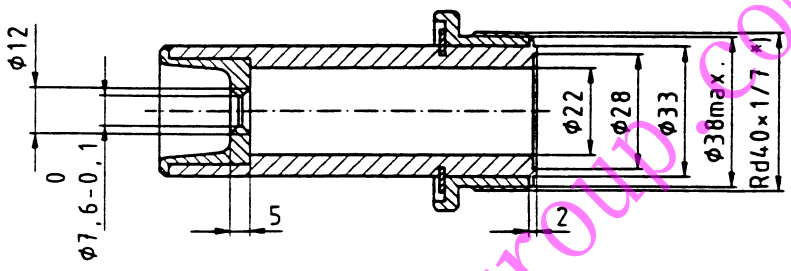
If the facepiece uses a special connection the clean air supply shall be attached to the filter with the highest weight and/or breathing resistance designed to be used with the facepiece as specified by the manufacturer in the information supplied by the manufacturer. It is important that the attachment of the clean air hose to the facepiece does not affect the fit of the facepiece on the test subject nor should its fitting replace any seals incorporated in the facepiece. If necessary the hose shall be supported.



Length of face (bridge of nose-chin) | Width of face (bizygomatic diameter) | Depth of face | Width of mouth

Figure 8 — Facial dimensions

Dimensions in millimetres



*) See EN 148-1.

Data of filter simulator:

Mass: 500 g, equally distributed along the length.

Pressure drop: 10 mbar at 95 l/min continuous flow. The dimension "7,6" shall be adjusted (if necessary) to achieve the correct pressure drop at the specified flow rate.
Total length: 96 mm.

Figure 9 — Filter simulator for filters/facepieces employing a thread complying with EN 148-1

8.16.1.3 *Test procedure*

The test subjects shall be asked to read the manufacturer's fitting information and if necessary shown by the test supervisor how to fit the facepiece correctly, in accordance with the fitting information.

After fitting the facepiece each test subject shall be asked "Does the mask fit?". If the answer is "Yes", the test shall be continued. If the answer is "No", the test subject shall be taken off the panel and the fact reported.

The test subjects shall be informed that if they wish to adjust the facepiece during the test they may do so. However, if this is done the relevant section of the test shall be repeated having allowed the system to re-settle.

The test subjects shall have no indication of the results as the test proceeds.

The test sequence shall be as follows.

1) It shall be ensured that the test atmosphere is OFF.

2) The test subject shall be placed in the hood/chamber. The facepiece sampling probe shall be connected up. The test subject shall then walk at 6 km/h for 2 min. The test agent's concentration inside the facepiece shall be measured to establish the background level.

3) A stable reading shall be obtained.

4) The test atmosphere shall be turned ON.

5) The subject shall continue to walk for a further 2 min or until the test atmosphere has stabilised.

6) Whilst still walking the subject shall perform the following exercises:

a) walking without head movement or talking for 2 min;

b) turning head from side to side (15 times), as if inspecting the walls of a tunnel for 2 min;

c) moving head up and down (15 times), as if inspecting the roof and floor for 2 min;

d) reciting the alphabet or an agreed text out loud as if communicating with a colleague for 2 min;

e) walking without head movement or talking for 2 min.

7) The following shall be recorded:

a) chamber concentration;

b) the leakage over each exercise period.

8) The test atmosphere shall be turned off and when the test agent has cleared from the chamber the subject shall be removed.

After each test the facepiece shall be cleaned, disinfected and dried before being used for its second inward leakage test.

8.16.1.4 *Equipment to be tested*

The above procedure applies to full face masks for use with filtering devices. It also applies to full face masks with connections meeting EN 148-1 for use with breathing apparatus. For full face masks with connections other than those meeting EN 148-1, the complete equipment shall be identified and used for testing.

8.16.2 ***Sulfur hexafluoride (SF_6) — method***

8.16.2.1 *Principle*

The subject wearing the apparatus under test shall walk on a treadmill over which is a hood/chamber. Through this hood/chamber shall flow a constant concentration of SF_6. The air inside the facepiece shall be sampled and analysed. The sample shall be extracted by punching a hole in the faceblank and inserting a probe through which the sample is drawn.

8.16.2.2 *Test equipment*

A typical test arrangement is shown in Figure 10.

a) *Test agent*

This method employs SF_6 as a test gas. The subject wearing the facepiece under test stands with his head surrounded by the SF_6 test atmosphere. Accurate determinations of leakage shall be possible within the range from 0,01 % to approximately 20 % dependent on the test challenge atmosphere.

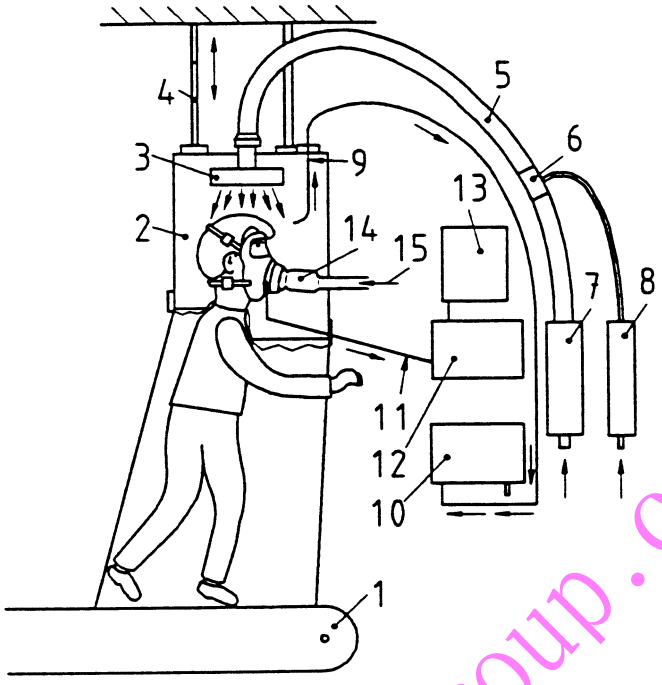
NOTE It is recommended to use a test atmosphere between 0,1 and 1 % by vol.

b) *Detection*

The test atmosphere shall be analysed for SF_6 preferably continuously by means of a suitable analyser (e.g. based on thermal conductivity or infrared spectroscopy).

The test atmosphere sampling probe shall not be positioned next to the exhalation valve. The SF_6 concentration inside the facepiece shall be analysed and recorded by an electron capture detector (ECD) or IR-system. This concentration, measured as near as possible to the mouth of the test subject (approximately 5 mm, in the centre of the facepiece), is a measure of the inward leakage.

The test shall be performed at ambient temperature and humidity.



1	Treadmill	9	Test atmosphere sampling probe
2	Test hood/chamber	10	Measuring instrument for test agent
3	Flow distributor	11	Sampling tube for the inhaled gas concentration
4	Suspension	12	Measuring instrument for inhaled gas concentration
5	Test agent supply hose	13	Recorder
6	Mixing point air/SF6	14	Filter simulator
7	Flow meter for air with associated control device	15	Breathable air
8	Flow meter for SF6 (100 % by volume) with associated control valve		

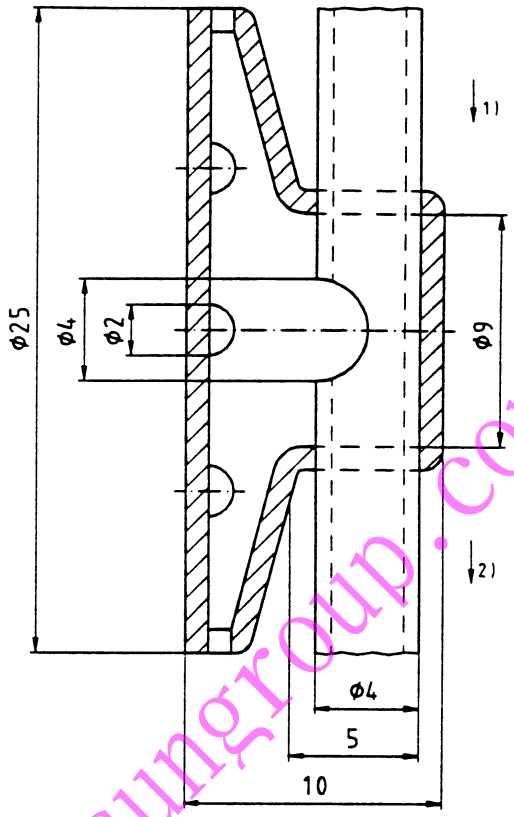
Figure 10 — Arrangement for testing inward leakage using sulfur hexaflouride

8.16.2.3 *Sampling*

In order to prepare the full face mask for the test the faceblank or visor and the inner mask (if fitted) have to be perforated. A thin tube, as short as possible, leading into the inner mask shall be connected in a leaktight manner to the analysing instrument. The sampling rate should be constant and the range between 0,3 and 1,5 l/min.

NOTE A multiple hole sampling probe is strongly recommended. Figure 11 shows a design that has been found suitable.

Dimensions in millimetres



1) Dry air
2) Sample plus dry air

Figure 11 — Suitable sample probe

8.16.2.4 *Calculation of leakage*

The leakage P shall be calculated from measurements made over the last 100 s of each of the exercise periods to avoid carry over of results from one exercise to the other.

$$P\,(\%) = \frac{C_2}{C_1} \times 100$$

C_1 challenge concentration;

C_2 measured mean concentration.

NOTE Measurement of C_2 is preferably made using an integrating recorder. The sample concentration taken inside the facepiece equals the measured concentration minus the background level.

8.16.3 ***Sodium chloride (NaCl) method***

8.16.3.1 *Principle*

The subject wearing the apparatus under test walks on a treadmill over which is an enclosure. Through this enclosure flows a constant concentration of NaCl aerosol. The air inside the facepiece is sampled and analysed during the inhalation phase of the respiratory cycle to determine the NaCl content. The sample is extracted by punching a hole in the faceblank and inserting a probe through which the sample is drawn. The pressure variation inside the facepiece is used to actuate a change-over valve so that inhaled air only is sampled. A second probe is inserted into the inner mask for this purpose.

8.16.3.2 *Test equipment*

A typical test arrangement is shown in Figure 12.

8.16.3.2.1 *Aerosol generator*

The NaCl aerosol shall be generated from a 2 % solution of reagent grade NaCl in distilled water. A single large Collison atomiser (see Figure 13) shall be used. The atomiser nozzles shall not point towards the cut-outs in the bottle.

This requires an air flow rate of 100 l/min at a pressure of 7 bar. The atomiser and its housing shall be fitted into a duct through which a constant flow of air is maintained. It may be necessary to heat or dehumidify the air in order to obtain complete drying of the aerosol particles.

8.16.3.2.2 *Test agent*

The mean NaCl concentration within the enclosure shall be (8 ± 4) mg/m^3 and the variation throughout the effective working volume shall be not more than 10 %. The particle size distribution shall be 0,02 µm to 2 µm equivalent aerodynamic diameter with a mass median diameter of 0,6 µm.

8.16.3.2.3 *Flame photometer*

A flame photometer shall be used to measure the concentration of NaCl inside the facepiece. Essential performance characteristics for a suitable instrument are the following.

a) It shall be a flame photometer specifically designed for the direct analysis of NaCl aerosol.

b) It shall be capable of measuring concentrations of NaCl aerosol between 15 mg/m^3 and 0,5 ng/m^3.

c) The total aerosol sample required by the photometer shall not be greater than 15 l/min.

d) The response time of the photometer, excluding the sampling system, shall not be greater than 500 ms.

e) It is necessary to reduce the response to other elements, particularly carbon, the concentration of which will vary during the breathing cycle. This will be achieved by ensuring that the band pass width of the interference filter is no greater than 3 nm and that all necessary side-band filters are included.

8.16.3.2.4 *Sample selector*

A system is required which will switch the sample to the photometer only during the inhalation phase of the respiratory cycle. During the exhalation phase clean air shall be fed to the photometer. The essential elements of such a system are:

a) an electrically operated valve with a response time of the order of 100 ms. The valve shall have the minimum possible dead space compatible with straight-through, unrestricted flow when open;

b) a pressure sensor which is capable of detecting a minimum pressure change of approximately 0,05 mbar and which can be connected to a probe inserted in the facepiece cavity. The sensor shall have an adjustable threshold and be capable of differential signalling when the threshold is crossed in either direction. The sensor shall work reliably when subjected to the accelerations produced by the head movements of the subject;

c) an interfacing system to actuate the valve in response to a signal from the pressure sensor;

d) a timing device to record the proportion of the total respiratory cycle during which sampling took place.

Figure 12 shows a schematic diagram of such a sampling system.

8.16.3.2.5 *Sample tubes and probe*

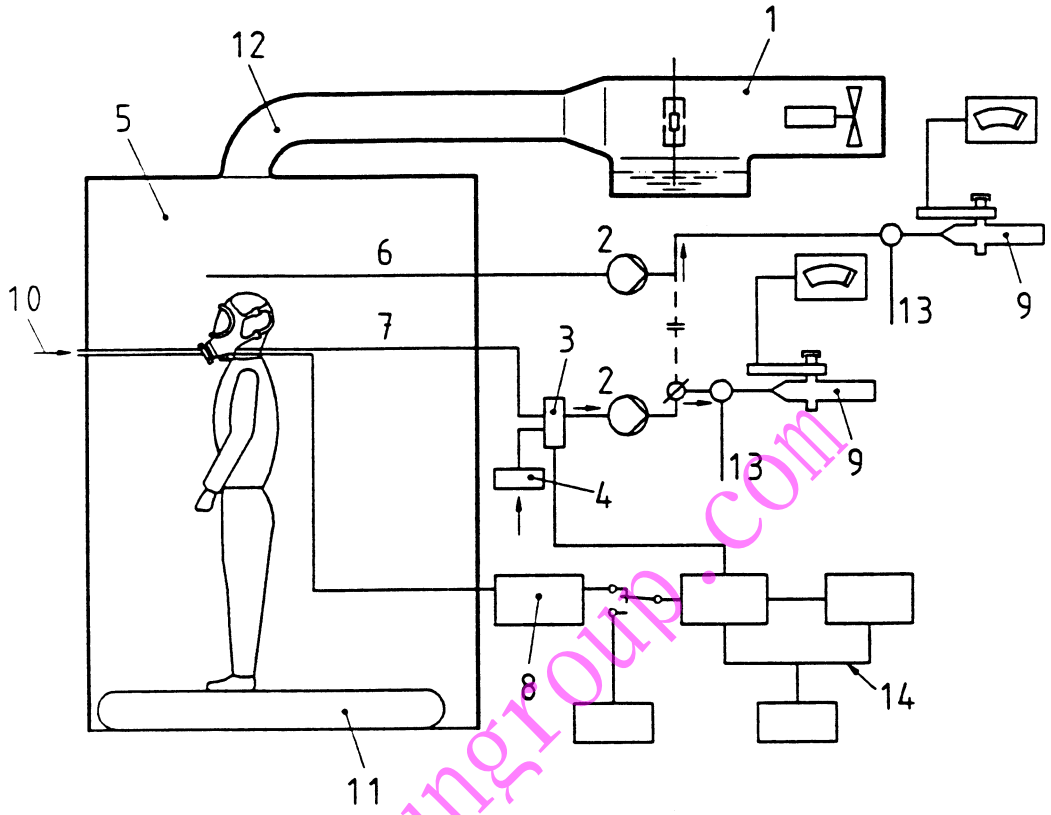
Sample tubes are of plastic tubing with a nominal inside diameter of 4 mm through which air is drawn.

The probe shall be fitted securely in an airtight manner to the facepiece as near as possible to the centre line of the facepiece and extending through the inner mask if fitted. A probe that has been found suitable is shown in Figure 11. The probe is adjusted so it just touches the wearer's lips.

8.16.3.2.6 *Sample pump*

If no pump is incorporated into the photometer an adjustable flow pump is used to withdraw an air sample. Some types of reciprocating diaphragm pumps have proved to be suitable. The pump shall be such that aerosol losses are minimized within the pump and changes in flow rate caused by changing pressure within the sampling zone are also minimized.

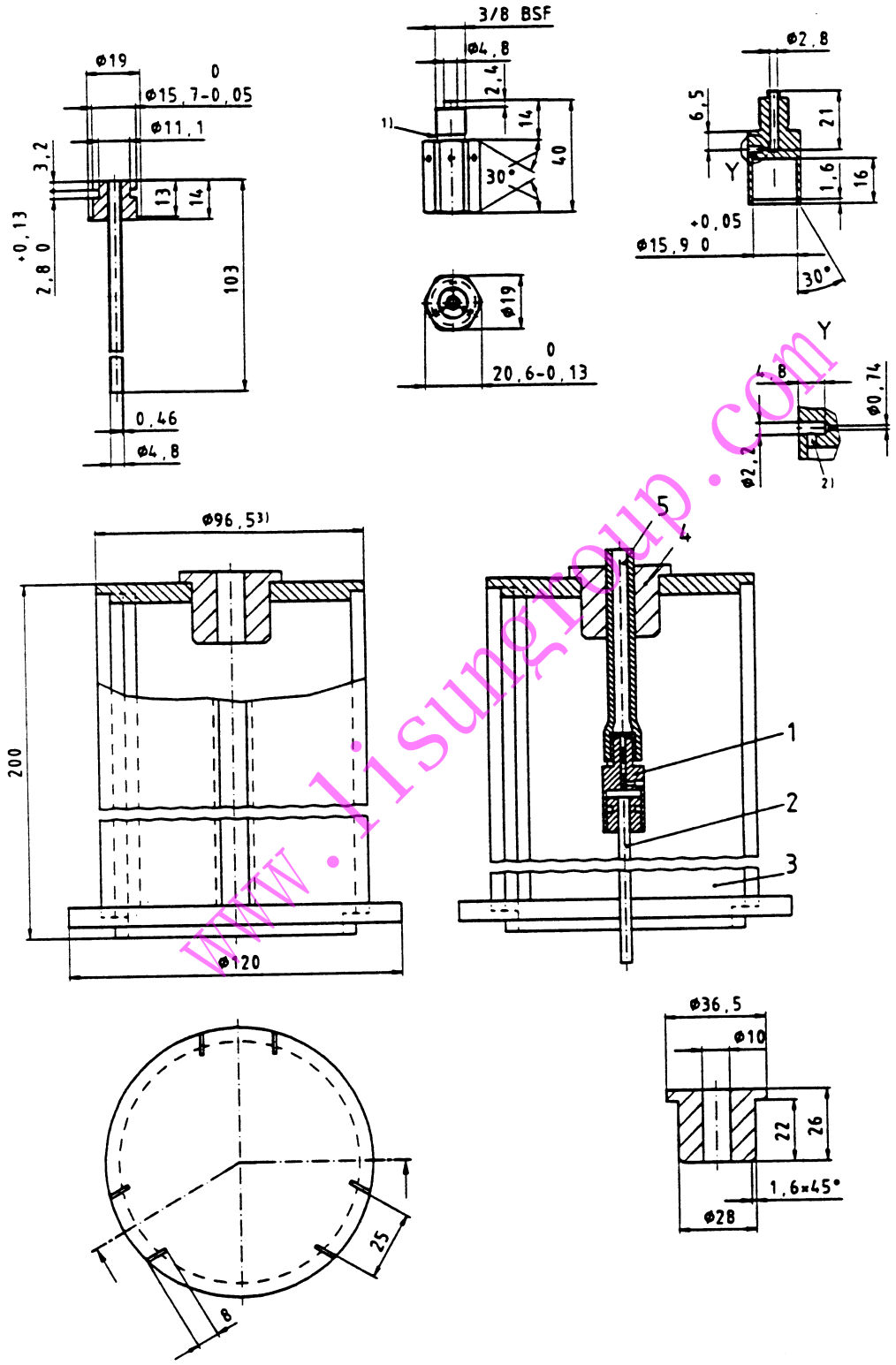
The pump is so adjusted as to withdraw a constant flow of 1 l/min from the sample probe. With some types of photometer it may be necessary to dilute the sample with clean air.



1	Atomiser	8	Manometer
2	Pump	9	Photometer
3	Change-over valve	10	Reference simulator fresh air
4	Filter	11	Treadmill
5	Hood/chamber	12	Ducting and baffle
6	Hood/chamber sampler	13	Additional air
7	Facepiece sampler	14	Pulsed sampling interface

Figure 12 — Arrangement for testing inward leakage using sodium chloride

Dimensions in millimetres



1 Nozzle
2 Feed tube (salt solution)
3 Sleeve
4 Bush
5 Air tube (10,0 O/Dia)

Figure 13 — Assembly of atomizer

8.16.3.2.7 *Sampling of hood/chamber concentration*

The hood/chamber aerosol concentration is monitored during the tests using a separate sampling system, to avoid contamination of the facepiece sampling lines. It is preferable to use a separate flame photometer for this purpose.

If a second photometer is not available, sampling of the hood/chamber concentration using the separate sampling system and the same photometer may be made. However, time will then be required to allow the photometer to return to a clean background.

8.16.3.2.8 *Pressure detection probe*

A second probe is fitted near to the sampling probe extending into the inner mask and is connected to the pressure sensor.

8.16.3.3 *Calculation of leakage*

The leakage P shall be calculated from measurements made over the last 100 s of each of the exercise periods to avoid carry over of results from one exercise to the other.

$$P\,(\%) = \frac{C_2}{C_1} \times \left(\frac{t_{IN} + t_{EX}}{t_{IN}}\right) \times 100$$

C_1 challenge concentration;

C_2 measured mean concentration;

t_{IN} total duration of inhalation;

t_{EX} total duration of exhalation.

Measurement of C_2 is preferably made using an integrating recorder. The sample concentration taken inside the facepiece equals the measured concentration minus the background level.

8.17 Field of vision

One sample shall be tested in the state as received.

The facepiece shall be fitted to the dummy head (see Figure 14) by first placing the chin in the "cup" of the facepiece and then the facepiece shall be placed to seal against the face of the dummy head. The straps shall be passed over the dummy head and adjusted to maximize the field of vision. The head straps shall be tightened in a manner that maintains the symmetry of the facepiece on the dummy head with talc to minimize friction between dummy head and strap. The straps shall be tightened to a tension level of 50 N.

Measurements of both total field of vision and overlapping field of vision shall be made for three separate fittings of the facepiece to the dummy head.

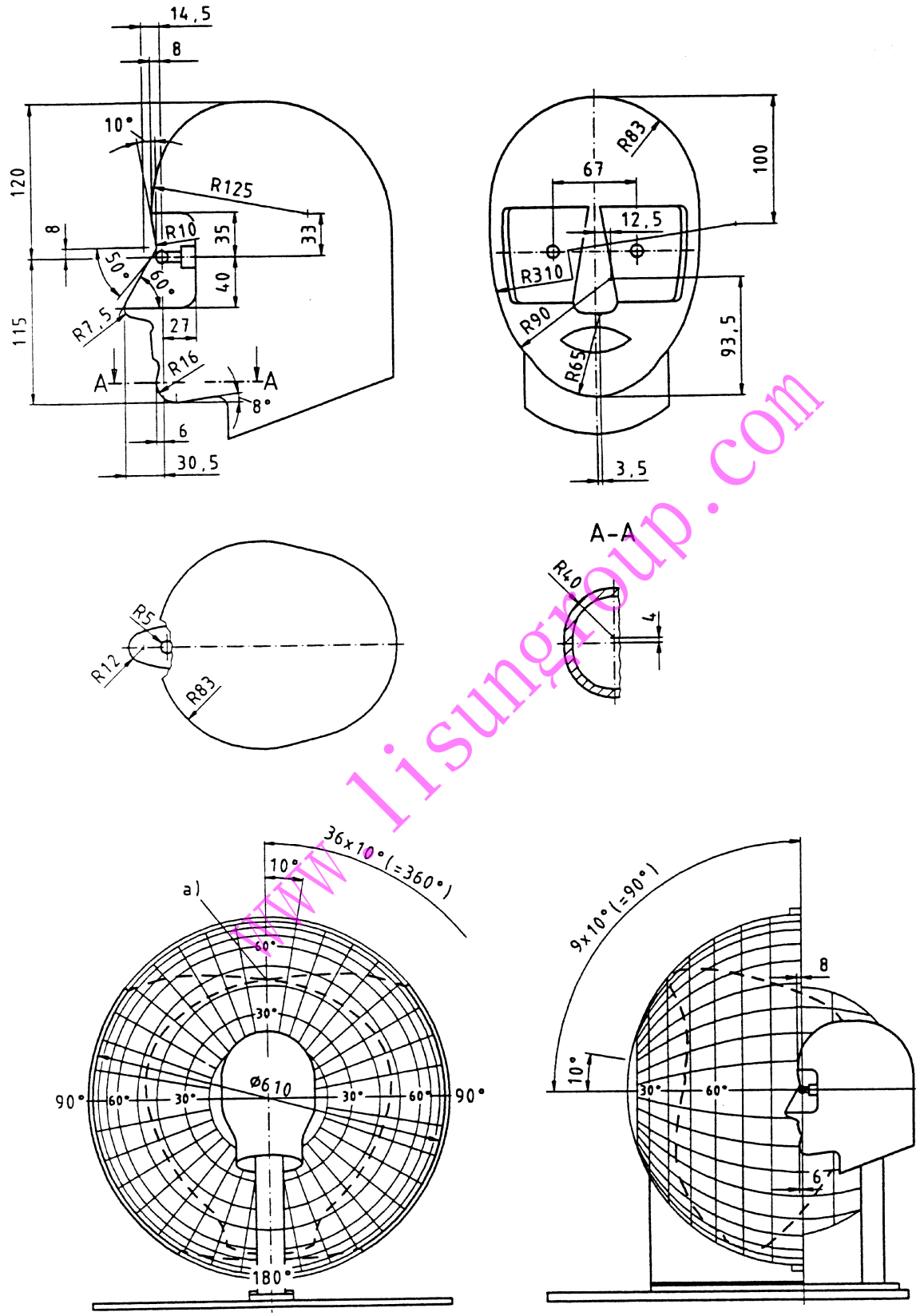
A diagram (see Figure 15) shall be used for evaluation.

To produce the results, either a planimeter method or a weighing method can be used.

The average of the three results shall be reported as the total field of vision and overlapping field of vision.

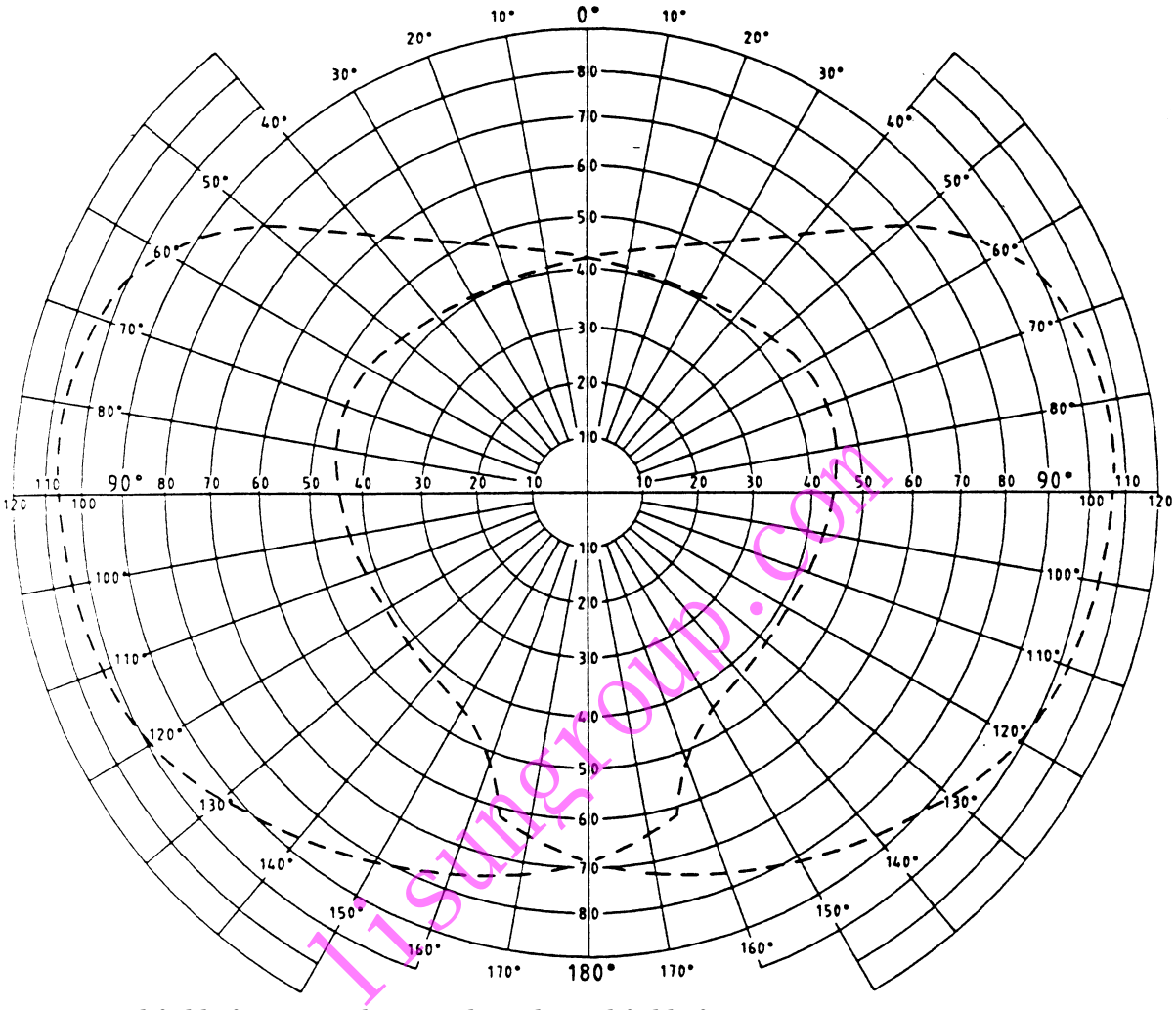
NOTE It should be noted that the rim of the apertometer bowl should be accurately lined up with the position of the filaments of the electric bulbs in the dummy head. Two critical dimensions have been marked in Figure 14 with (*).

Dimensions in millimetres



a) Transfer the natural field of vision with the natural overlapped field of vision to the diagram

Figure 14 — Apertometer



..... natural field of vision with natural overlapped field of vision

The areas enclosed by circular lines of the diagram are proportional to the corresponding areas marked on the spherical shell of the apertometer.

Semi-circular surface represented inside pf the 90° circle ..... = 126,9 cm^2

Natural field of vision inside of the 90° circle (78,8 %) ..... = 100,0 cm^2

Natural field of vision outside of the 90° circle ..... = 12,0 cm^2

Natural field of vision total ..... = 112,0 cm^2 = 100 %

Natural overlapped field of vision ..... = 39,0 cm^2 = 100 %

Shape of lenses (dimensions) _____ _____

Facepiece model _____ _____

Where measurements of the field of vision are taken, the effective field of vision as observed by the apertometer shall be transferred to the diagram. Only the effective field of vision within the natural field of vision respectively the effective overlapped field of vision shall be plainmetered and noted in cm^2.

Planimetered area of effective field of vision (total) ..... cm^2

Planimetered area of effective overlapped field of vision ..... cm^2

Effective field of vision (total) ..... %

Effective overlapped field of vision ..... %

Figure 15 — Diagram of apertometer

8.18 Practical performance

8.18.1 *General*

Two samples shall be tested: both after conditioning in accordance with **8.2**.

All tests shall be carried out by two test subjects at ambient temperature. The test temperature and humidity shall be recorded.

During the test a filter simulator (Figure 9) shall be fitted to the facepiece with an EN 148-1 connector. For other facepieces a filter or other equipment, normally used with the facepiece shall be fitted.

For the test, persons shall be selected who are familiar with using such or similar equipment.

During the test the apparatus shall be subjectively assessed by the wearer and after the test, comments on the following shall be recorded:

a) harness, i.e. donning and removal, adjustability, security and comfort;

b) security of fastenings and couplings;

c) accessibility of controls (if fitted);

d) vision, i.e. distortion, misting;

e) speech transmission;

f) any other comment reported by the wearer on request.

8.18.2 *Walking test*

The subjects wearing normal working clothes and wearing the facepiece shall walk at a regular rate of 6 km/h on a level course. The test shall be continuous, without removal of the apparatus, for a period of 10 min.

8.18.3 *Work simulation test*

During this test the following activities shall be carried out in simulation of the practical use. The test shall be completed within a total working time of 20 min.

The sequence of activities is at the discretion of the test house. The individual activities shall be arranged so that sufficient time is left for the comments prescribed:

a) walking on the level with headroom of (1,3 ± 0,2) m for 5 min;

b) crawling on the level with headroom of (0,70 ± 0,05) m for 5 min;

c) filling a small basket (see Figure 16, approximate volume = 8 l) with suitable chippings or other suitable material from a hopper which stands 1,5 m high and has an opening at the bottom to allow the contents to be shovelled out and a further opening at the top where the basket full of chippings shall be returned.

The subject shall stoop or kneel as he wishes and fill the basket with chippings. He shall then lift the basket and empty the contents back into the hopper. This shall be repeated 19 times in 10 min.

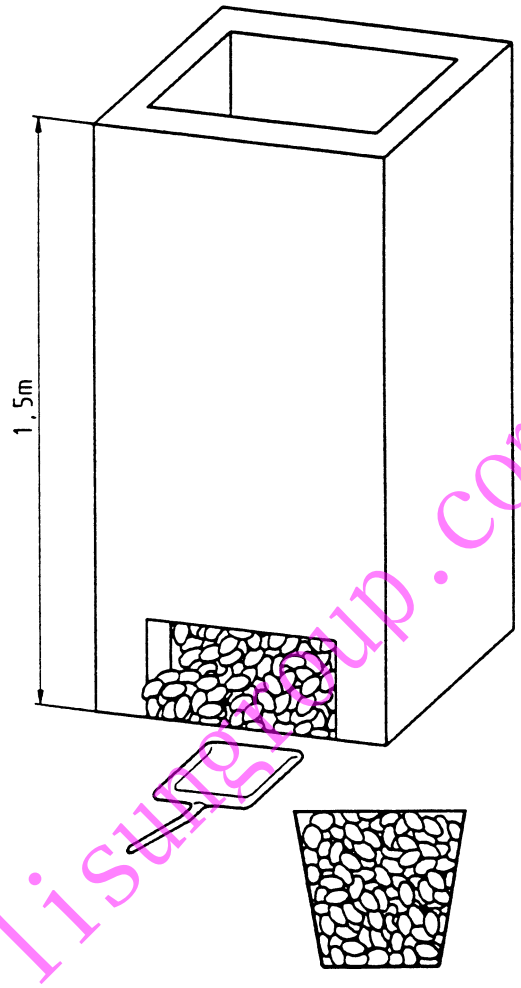


Figure 16 — Basket and hopper, chippings

9 Marking

9.1 The manufacturer shall be identified by name, trade mark or other means of identification.

9.2 All units of the same model shall be provided with a type identifying marking.

9.3 The number and the year of this European Standard shall be marked.

9.4 The respective class number following the letters “CL” immediately following the number of the standard e.g. EN 136:1996 CL 3 shall be marked.

9.5 Where the reliable performance of components may be affected by ageing, means of identifying the date (at least the year) of manufacture shall be given.

For parts, which cannot be marked the relevant information shall be included in the information supplied by the manufacturer.

9.6 Components or parts which are designed to be replaced by the authorized user and sub-assemblies with considerable bearing on safety shall be readily identifiable.

For parts which cannot reasonably be marked the relevant information shall be included in the information supplied by the manufacturer.

9.7 The marking shall be clearly visible and durable.

10 Information supplied by the manufacturer

10.1 On delivery, information supplied by the manufacturer shall accompany every full face mask.

10.2 The information shall be in the official language(s) of the country of destination.

10.3 The information shall contain all information necessary for trained and qualified persons on:

— application/limitation;
— facepiece classification;
— checks prior to use;
— donning, fitting;
— use;
— cleaning/disinfection;
— storage;
— maintenance (preferably separately printed information).

10.4 The information shall be precise and comprehensible. If helpful, illustrations and part numbers should be added. Additional markings indicating limitations or extra requirements shall be explained.

10.5 Warning shall be given against problems likely to be encountered, for example:

— fit of facepiece (check prior to use);
— it is unlikely that the requirements for leakage will be achieved if facial hair or spectacle side arms pass under the face seal;
— hazards of oxygen and oxygen-enriched air;
— air quality;
— use of equipment in explosive atmosphere;
— class 1 full face mask shall not be used with self-contained breathing apparatus;
— if other protection than just respiratory protection, i.e.:

protection during exposure of a speech diaphragm to the puncturing action of certain transuranium contaminants of high specific activity, protection against high speed particles by the visor, protection against chemicals,

is claimed, then the requirements of the relevant European Standard(s) shall be met;

— use in combination with any other personal protective equipment.

Table — Summary of requirements and tests

Title	Class	Requirement clause	Number of samples[1)]	Conditioning	Test clause
Visual inspection	1, 2, 3	**7.3**	all	as required	**8.3**
Materials	2, 3	**7.4**	all	a.r.	**8.3**
Resistance to temperature	1, 2, 3	**7.5**	2	t.c.	**8.3**, **8.4**, **8.13**, **8.16**
Flammability	1	**7.6.1**, **7.6.2**	3	1 a.r., 2 t.c.	**8.3**, **8.5.1**, **8.13**
	1	**7.6.1**, **7.6.2**	3	1 a.r., 2 t.c.	**8.3**, **8.5.1**, **8.13**
Resistance to thermal radiation	3	**7.7**	5	a.r.	**8.6**, **8.13**
Cleaning and disinfecting	1, 2, 3	**7.8**	2 (in the course of inward leakage test)	—	**8.7**
Finish of parts	1, 2, 3	**7.9**	all	a.r.	**8.3**, **8.18**
Replaceable components	3	**7.10**	all	a.r.	**8.3**
Head harness	1, 2, 3	**7.11.1**	2	t.c.	**8.3**, **8.18**
	1, 2, 3	**7.11.2**	2	t.c.	**8.3**, **8.18**
	1	**7.11.3.1**	3	a.r.	**8.3**, **8.8.1**
	2, 3	**7.11.3.2**	3	a.r.	**8.3**, **8.8.1**
	1, 2, 3	**7.11.4**	3	a.r.	**8.3**, **8.8.2**
	3	**7.11.5**	2	t.c.	**8.3**, **8.18**
Connector	1, 2, 3	**7.12.1**	2	a.r.	**8.3**, **8.16**, **8.18**
	1	**7.12.2**	2	a.r.	**8.3**
	2, 3	**7.12.3**	2	a.r.	**8.3**
	1	**7.12.4.2**	3	a.r.	**8.9**, **8.13**
	2, 3	**7.12.4.3**	3	a.r.	**8.9**, **8.13**
Speech diaphragm	1, 2, 3	**7.13.1**	3	a.r.	**8.3**, **8.10.1**
	1, 2, 3	**7.13.2**	3	a.r.	**8.3**, **8.10.2**
	3	**7.13.3**	3	a.r.	**8.3**, **8.6**, **8.10.3**
Eyepieces/visor	1, 2, 3	**7.14.1**	2	a.r.	**8.3**
	1, 2, 3	**7.14.2**	2	t.c.	**8.18**
	1, 2, 3	**7.14.3**	2	t.c.	**8.3**, **8.18**
	1, 2, 3	**7.14.4**	5	a.r.	**8.3**, **8.11**, **8.13**
Inhalation valves and exhalation valves	1, 2, 3	**7.15.1**	3	a.r.	**8.3**
	1, 2, 3	**7.15.2**	3	a.r.	**8.3**
	1, 2, 3	**7.15.3**	3	a.r.	**8.3**, **8.12.1**, **8.15.1**, **8.16**
	1	**7.15.4.1**	3	a.r.	**8.3**, **8.12.2**, **8.13**
	2, 3	**7.15.4.2**	3	a.r.	**8.3**, **8.12.2**, **8.13**
Leaktightness	1, 2, 3	**7.16**	all	as required	**8.13**
Compatibility with skin	1, 2, 3	**7.17**	2	t.c.	**8.3**, **8.18**

[a] Most samples are used for more than one test.
Abbreviations:
a.r. as received (shall be taken as "not conditioned in accordance with **8.2**" but other (non-destructive) tests may be performed on these samples).
t.c. conditioned in accordance with **8.2**.

Table — Summary of requirements and tests (*continued*)

Title	Class	Requirement clause	Number of samples[1)]	Conditioning	Test clause
Carbon dioxide content of the inhalation air	1, 2, 3	**7.18**	1	a.r.	**8.14**
Breathing resistance	1, 2, 3	**7.19.2**	3	a.r.	**8.15.1**
	2, 3	**7.19.3**	3	a.r.	**8.15.1**
	2, 3	**7.19.4**	3	a.r .	**8.15.2**
Inward leakage	1, 2, 3	**7.20**	2	1 a.r., 1 t.c.	**8.16**
Field of vision	1, 2, 3	**7.21**	1	a.r.	**8.17**
Practical performance	1, 2, 3	**7.22**	2	t.c.	**8.18**
Marking	1, 2, 3	**9**	all	a.r.	**8.3**
Information supplied by the manufacturer	1, 2, 3	**10**	1	—	**8.3**

[a] Most samples are used for more than one test.
Abbreviations:
a.r. as received (shall be taken as "not conditioned in accordance with **8.2**" but other (non-destructive) tests may be performed on these samples).
t.c. conditioned in accordance with **8.2**.

Annex A (informative)
Marking

It is recommended to consider for marking the following components and sub-assemblies to be identifiable:

Table A.1

Components/Sub-assemblies	Part-marking	Date of manufacture	Remarks
Inhalation valve disc	–	–	1
Exhalation valve disc	–	+	1
Connector (if fitted)	+	–	–
Faceblank	+	+	–
Head harness	+	+	1
Visor	+	–	1
Visor frame	+	–	1
Inner mask	+	+	–
Check valve unit	–	–	1
Speech diaphragm unit	+	+	1

+: The marking is necessary.

–: The marking is not necessary.

1: For parts which cannot reasonably be marked the relevant information shall be included in the information to be supplied by the manufacturer.

The components of a sub-assembly have not to be marked when the sub-assembly is identifiable. Those components not offered as spare parts by the manufacturer have not to be marked but the relevant information has to be given in the information to be supplied by the manufacturer.

Annex ZA (informative)
Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive 89/686/EEC.

WARNING: Other requirements and other EU Directives *may* be applicable to the products falling within the scope of this standard.

The clauses of this standard are likely to support requirements of Directive 89/686/EEC, Annex II:

EU Directive 89/686/EEC, Annex II:	Clauses of this standard:
1.1.1	**7.20**, **7.22**
1.1.2.1	**5**, **7.6**, **7.7**, **7.20**, **7.22**
1.1.2.2	**5**, **7.6**, **7.7**
1.2.1	**7.4**, **7.5**, **7.6**, **7.7**
1.2.1.1	**7.4**, **7.17**
1.2.1.2	**7.9**
1.2.1.3	**7.14**, **7.21**
1.3.1	**7.11**, **7.22**
1.3.2	**7.22**
1.4	**7.3**, **10**
2.1	**7.11**
2.3	**7.14**, **7.21**, **7.22**
2.4	**7.3**, **9**, **10**
2.6	**7.4**
2.8	**7.3**, **10**
2.9	**7.10**, **7.11**
2.12	**7.3**, **9**, **10**
3.10.1	**7.4**, **7.8**, **7.16**, **7.18**, **7.19**, **7.20**, **7.22**, **9**, **10**

Compliance with this Standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

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