84-140

NEOTERIK

NEOTERIK HEALTH TECHNOLOGIES, INC.

INFORMAL HEARINGS ON PROPOSED RULEMAKING 42 CFR 84

We are offering these comments as a further contribution to the proposed rulemaking. We are a small business, located in Maryland. We design, manufacture and sell products, including respirators, which need NIOSH certification.

In December, we sent comments in wrting to the NIOSH docket office in Atlanta. The comments we are making today are in addition to those.

1. We are pleased that NIOSH is proposing to keep its role in a certification program for respirators. We strongly believe that a more effective NIOSH certification program wil provide increased protection for users of respirators. The contribution to worker safety made by NIOSH personnel like Nancy Bollinger, Chris Coffey and Sam Terry is substantial and must be recognized and must be allowed to continue.

2. The 42 CFR 84 proposal includes a requirement for so-called "workplace or simulated workplace test " (para. 84-32) to be performed before certification is assured.

These tests are therefore a crucial new requirement, a requirement which we oppose absolutely!

The reasons for our opposition are:

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(a) This requirement is devestatingly unfair to small business. One of our respriators can be as good or better than one produced by a large manufacturer and yet not be certified because we might be unable to organize a field test. Clearly, giants of the industry like 3M and MSA can wield enormous commercial influence and are far more likely to receive willing cooperation from user companies than we are. This is a built-in bias against small business.

(b) Certain large companies will be able to perform field tests within their own company or within their own conglomerate.

(c) Certain large companies will be able to perform field tests within the locations of their current major customers. There will be an opportunity to offer commercial benefits to these customers and so the results, including subjective comments, may be influenced to be favorable and to gain certification. This is a built-in bias against small companies.

(d) Certain large companies will perform their own sample analysis or use laboratories within their own organizations. This is a built-in bias against small companies.

(e) The field test protocols are not included for comment. How can a crucial, new test be considered by us if the test procedure itself is not available until the time of final rulemaking. We must oppose a requirement which is, in the words of the rulemakers, "the most significant of the new requirements", when we do not understand the procedures. These procedures will directly effect our ability to stay in business. As a small company, we must oppose this open-ended approach to certification. When the procedures are available, we will comment on them.

(f) The field test protocols are not known, and so their cost impacts cannot be determined. However, the new costs will be biased against small business. The incremental expenses will be more burdensome for us than for the big companies. The greater the expense, the more disproportionate the effect, and the greater the bias against small companies.

(g) The field tests will introduce large elements of variability, subjectivity and lack of control into the certification process. In other words, the lucky ones will get approved.

(h) We must emphasize the very broad significance of this workplace testing proposal. A small manufacturer will not be able to meet this requirement. The costs, the organization, the time, and the complexity will be too great. If you ever wanted a regulation biased overwhelmingly against small business, this is it. If you ever wanted a regulation certain to drive small business out of an industry, this is it. If you ever wanted a regulation to stifle innovation, this is it.

And for what? Why does NIOSH propose this, and I quote, "most significant of the new requirements?" Where is the list of failures attributed to the lack of this requirement in the present NIOSH program? What were the causes of these failures, if they exist? Is it really difficult to devise controlled laboratory tests to search for these causes? Why burden the industry, and single out and punish the small manufacturers, in order to introduce an approval technique which has no documented success, no documented procedures, no obvious role to play, and no track record proving it can distinguish good respirators from bad ones.
This requirement will result in much more expensive respirators, less competition among manufacturers, less innovation in design and less protection for wearers.

(i) We would like to introduce at this point a set of documents, marked "Neoterik Exhibit A." As I am sure you know, the major European nations have now completed a multi-national project to produce a single European standard for respirators. This new CEN standard has been prepared by the CEN/TC 79/SG3 working group. We are entering these documents into the record for your review.

List of European Countries in the Program wich produced the multi-national standard for respirators:

Austria
Belgium
Denmark
Finland
Greece
Holland
Ireland
Italy
Norway
Portugal
Spain
Sweden
United KIngdom
West Germany

Particularly, please consider how the CEN program deals with the question of practical performance tests. We refer, as an example only, to the document N-168, Respiratory Protective Devices, Full Face Masks; Section 4 is the requirements section and here is Section 4.5.

"4.5 Practical Performance Test.

"The complete apparatus shall undergo performance tests under realistic conditions. These general tests serve the purpose of checking the equipment for imperfectons that cannot be determined by the tests described in other parts of this standard."

This requirement, we submit, is essentially the same requirement as the one NIOSH is attempting to meet by introducing field testing as part of the approval program.

The European standard continues:

"Where a full face mask is to be used for filtering devices, testing has to be in accordance with 5.2."

Section 5 contains all the test procedures.
Section 5 states:

"5.2 Practical Performance Test

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

Then, the section lists and defines the following:

"Items to be assessed by wearer"
"Walking Test"
"Work simulation test"

Finally, "where in the opinion of the test station approval iss not granted because practical performance tests show the apparatus has imperfections related to wearer's acceptance the test station shall provide full details of those parts of the practical performance tests which revealed these imperfections."

Summarizing, the CEN standard has been able to include laboratory test procedures for practical performance testing, and a system for updating these procedures based on results. These procedures together with other tests achieve everything that NIOSH claims for its own field test requirement. At the same time, the CEN standard does not introduce the bias, costs, variability, and other undesirable consequences of the NIOSH proposal.

It goes without saying that the professionals who drafted 42 CFR 84 must be fully aware of what their counterparts in Western Europe are proposing. At least, we hope it goes without saying. It would be strange if in revising standards of such importance there was no seeking of input from the people in Europe who were doing the same thing. Therefore, NIOSH must have reasons for not adopting the CEN approach. What are these reasons?

We submit the CEN "Practical Performance Tests" as a replacement for the NIOSH "Workplace Testing" requirement. CEN tests do exist for all types of respirators, but of course test details may need to be altered. However, "Practical Performance Tests" are the best way to satisfy this particular need, and field testing complications and protocols must be ruled inapplicable to the product certification program.

3. We would like to oppose the procedure 84.229, for sequential analysis of performance test results using one-sided tolerance limits.

The consequence of this paragraph is to change every single specification in every test contained in the document. The consequence of this paragraph is to change every single specification because the pass/fail requirement in the specification will no longer apply.

Procedure 84.229 in this context is a flawed technique which will result in higher costs because of a misapplication of statistical theory to quality assurance.

Procedure 84.229 is a statistical quality control technique, and has a limited application in estimating the extremities of an uncontrolled production process. It attempts to predict future events based upon certain mathematical assumptions, and to attach probabilities to these events.

The basic assumptions of 84.229 are that the test results obtained can be fitted into a pre-determined mathematical pattern, and that all future results from future tests on future products will fit the same pre-determined pattern.

The testing and evaluation done under 42 CFR 84 does not satisfy these assumptions. Under 42 CFR 84, a manufacturer submits pre-tested and verified products for repeat testing. These products have been produced, inspected and tested before being submitted. This inspection and testing program is explicitly required by NIOSH. So, by definition, the products do not fit a pre-determined mathematical pattern. They do not follow a normal curve, a binomial curve, or any other mathematical pattern. The products are, simply, products which have passed a final test specification, and any attempt to manipulate the test results according to statistical theories of distribution is spurious.

42 CFR 84 contains a procedure for obtaining Type Approval. The document contains a specification and it contains test procedures. A submitted product is subjected to two basic questions. The first is, does it meet the specification? This question is answered by performing tests against the specifications. If the answer is yes, then the second basic question is asked: Can this performance be maintained in production? This question is answered by the review of the quality control and quality assurance program, including the final test requirements. It cannot be answered by manipulating the type approval test results.

Mathematically the situation is that a small sample of products is submitted to a re-testing program. There is no information concerning the population submitted to the original testing program. In other words, the survival rate is not known. Further, the module, assembly, component and piecepart survival rates are not known. What is known is that there have been inspection and test activities, and it is certain that as a result any mathematical distributions which may be present have been truncated and distorted as a result of these inspections and tests. So, the products submitted to NIOSH are a small sample of an indeterminate, truncated mathematical distribution, the yield of an unknown survival rate, built from an unknown number of sub-parts, each of which is also a small sample of an indeterminate, truncated mathematical distribution, the yield of an unknown survival rate. This situation certainly does not satisfy the assumptions for the application of the procedure 84.229. This procedure simply cannot be used in this way.

Consider, for example, the noise level requirements. The specification in 84.228 is a maximum of 80 dBA. Suppose three respirators are tessted by NIOSH, and the results are 72, 73 and 74 dBA. How do we interpret these results? Procedure 84.229 says that NIOSH can use this data to guess what percentage of future product shipped to users by the manufacturer will fail in the field. We say that any such guess is erroneous and spurious. We say that these results show that the product did in fact survive its repeat testing, that the testing programs have some correlation and that the product is capable of meeting the specifiction. How many defectives may or may not be shipped to users is a function of the manufacturer's quality control program and is not a function of the re-test program contained in 42 CFR 84.

It could be argued that, in our example above, the test results were too close to the limit. What does this mean exactly? If it means that the limit as proposed is too high, then NIOSH should derive at a lower one and write it into the proposal.

We urge you to delete 84.229. It is invalid, will not improve protection, and will significantly increase costs. Please note, this kind of test interpretation does not appear in the European procedures.

For and on behalf of
Neoterik Health Technologies, Inc.

Kenneth V. Vaughan
President

Exhibit A

NEOTERIK

NEOTERIK HEALTH TECHNOLOGIES, INC.

The New Multi-National European Standards for Respiratory Protective Equipment

Contents:

List of European Countries in the Program which produced the multi-national standard for respirators:

Austria
Belgium
Denmark
Finland
Greece
Holland
Ireland
Italy
Norway
Portugal
Spain
Sweden
United Kingdom
West Germany

DD 97 : Part 1 : 1984

UDC 614.894

Draft for Development

Respiratory protective equipment

Part 1. Glossary of terms

Projet à développer
Appareils de protection respiratoire
Partie 1. Glossaire

Entwurf zur weiteren Ausarbeitung
Atemschutzgeräte
Teil 1. Begriffe

British Standards Institution

Foreword

This Draft for Development has been prepared under the direction of the Personal Safety Equipment Standards Committee and its technical content is identical with that agreed at the meeting of CEN/TC 79, Respiratory protection, held in June 1993.

This Draft for Development is one of a series dealing with respiratory protective devices based on CEN draft documents and is being published in this way to enable experience to be gained in its use within the UK.

Other Parts published or in course of preparation in this series are as follows:

Part 2	Classification
Part 3	Nomenclature of piece parts
Part 4	Schedule of equivalent terms
Part 5*	Specification for full face masks
Part 6*	Specification for half and quarter masks
Part 7*	Specification for mouthpieces
Part 8*	Specification for particle filters
Part 9*	Specification for gas and combined filters
Part 10*	Specification for fresh air hose breathing apparatus
Part 11*	Specification for compressed air line breathing apparatus
Part 12*	Specification for self contained open circuit breathing apparatus
Part 13*	Specification for power assisted particle filtering devices incorporating helmets and hoods
Part 14*	Specification for power assisted particle filtering devices incorporating full face masks and quarter masks

*In course of preparation.

Contents

This publication is not to be regarded as a British Standard

It is being issued in the Draft for Development series of publications and is of a provisional nature because the draft European Standard that it is closely based on, prEN 132 'Respiratory protective equipment — Definitions' is under further review to improve certain of its contents and add other terms. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

A review of this Draft for Development will be carried out not later than two years after its publication. Notification of the start of the review period, with a request for the submission of comments from users of this Draft for Development will be made in an announcement in the appropriate issue of *BSI News*. Observations which it is felt should receive attention before the official call for comments will be welcomed.

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This Draft for Development will be withdrawn and a British Standard published once a European Standard or Harmonization Document on this subject acceptable to the UK has been published.

Glossary

1 Object and field of application

This Draft for Development defines terms used for respiratory protective equipment with the objective of ensuring the correct use of these terms.

The natural composition of air and the requirements for the purity of breathable air are given in annexes A and B.

This Draft for Development refers to terms in the field of respiratory protection.

2 Definitions

NOTE. The terms are listed in alphabetical order.

2.1 aerosol. A suspension of solid, liquid, or solid and liquid particles in a gaseous medium, having a negligible falling velocity (generally considered to be less than 0.25 m/s).

2.2 air supply hose. A hose delivering air at atmospheric pressure or at a pressure slightly above or below atmospheric.

2.3 assisted. Of a filtering device or a fresh air hose breathing apparatus, having air delivered to the facepiece independently of the lungs.

2.4 blouse. A garment which covers the head and upper part of the body to the waist and wrists and to which air is supplied.

2.5 body harness. A means of supporting the apparatus at the waist and/or on the shoulders.

2.6 breakthrough concentration. The concentration of test gas in effluent air at which the filter under test is deemed to be exhausted.

2.7 breathable air. Air suitable to breathe.

NOTE. See annexes A and B.

2.8 breathing apparatus. Apparatus which enables the wearer to breathe independently of the ambient atmosphere.

2.9 breathing hose. A flexible, for instance corrugated, hose connected to the facepiece through which air or oxygen enters at atmospheric pressure or at a pressure slightly above or below atmospheric.

2.10 breathing resistance. The resistance of a respiratory protective device to the flow of air into (inhalation resistance) or out of (exhalation resistance) the facepiece.

2.11 clogging. Accumulation of particles on a filter with a consequent increase in resistance to flow.

2.12 combined filter. A filter which removes dispersed solid and/or liquid particles, and specified gases and vapours.

2.13 compressed air line breathing apparatus. Apparatus which is not self contained and in which the wearer is supplied with air from a source of compressed air.

2.14 connecting tube. A tube connecting the demand valve or the continuous flow valve to the supply system.

2.15 contaminant. Undesirable solid, liquid or gaseous matter in air.

2.16 continuous flow valve. A valve which allows the wearer of a breathing apparatus to regulate a continuous flow of air within prescribed limits.

2.17 demand valve. A part of a breathing apparatus by means of which the wearer receives air or oxygen from an air or oxygen supply on demand.

2.18 dust. A general term denoting solid particles (see also fume).

2.19 escape-type respiratory protective equipment. Respiratory protective equipment to be used only during escape from hazardous atmospheres.

2.20 exhalation valve. A non-return valve which allows the escape of exhaled air from the facepiece.

2.21 exhaled air. The atmosphere breached out by the wearer.

2.22 facepiece. Types of facepiece are: full face mask, half mask, quarter mask, mouthpiece assembly, filtering facepiece. Exceptionally it may include helmet, hood, blouse or suit.

2.23 face seal leakage. Inward leakage of ambient atmosphere, during inhalation, between the face and the facepiece. Normally expressed as a percentage of total inhaled air.

2.24 filter. A device which removes specific contaminants from the medium passing through it.

2.25 filter housing. The component which is attached to the facepiece and into which the filter, encapsulated or unencapsulated, is inserted.

2.26 filtering device. A device in which air passes through a filter before being inhaled. The device may be unassisted or powered.

2.27 filtering facepiece. A facepiece entirely or substantially constructed of filter material.

2.28 fresh air hose breathing apparatus. Apparatus in which air is drawn from an ambient air source with or without the assistance of a manual or powered device.

2.29 full face mask. A facepiece covering the mouth, nose, eyes and chin.

2.30 fume. A fine solid aerosol which is chemically generated or is of metallic origin.

2.31 gas filter. A filter which removes specific gases and vapours.

2.32 half mask. A facepiece covering mouth, nose and chin.

2.33 head harness. A means of holding a facepiece in place on the head.

2.34 helmet. A facepiece additionally designed to protect the upper part of a wearer's head against blows.

2.35 high pressure. The pressure between the source of compressed gas and pressure reducer (normally over 100 bar*).

2.36 hood. A facepiece which completely covers the head, neck and sometimes the shoulders.

2.37 inhalation valve. A valve which allows air or oxygen to enter the facepiece and prevents exhaled air from leaking through the intake opening.

2.38 inhaled air. The atmosphere breathed in by the wearer.

2.39 minute volume. The volume of air inhaled in 1 min.

2.40 mist. A general term denoting a liquid aerosol.

2.41 mouthpiece assembly. A device, held by the teeth, sealing against the lips, and through which air is inhaled and exhaled, while the nose is blocked up by a clip.

2.42 nominal protection factor. The ratio of the concentration of contaminant present in the ambient atmosphere to its concentration in the air inhaled by the wearer of a respiratory protective device, calculated as maximum permitted inward leakage in prescribed tests.

2.43 oxygen deficient air. Air containing oxygen below 17 % by volume.

2.44 particle. Solid or liquid matter in the finely divided state.

2.45 particle filter. A filter which removes airborne particles.

2.46 pendulum-type respiratory protective device. A respiratory protective device in which the wearer both inhales and exhales by the same route.

2.47 permissible exposure level. The value of concentration for an airborne contaminant which is used as a guide in the control of health hazards.

2.48 powered filtering device. A filtering device in which air is delivered to the facepiece by means of a powered blower normally worn by the wearer of a respiratory protective device. The filter may be connected by means of a short length of flexible hose.

2.49 prefilter. A filter in front of the main filter which removes coarse particles.

2.50 pressure gauge. A pressure indicator giving the pressure in a part of an apparatus.

2.51 pressure reducer. A device which reduces pressure to a lower pressure.

2.52 protection factor. The ratio of the concentration of contaminant present in the ambient atmosphere to its concentration in the air inhaled by the wearer of a respiratory protective device.

2.53 quarter mask. A facepiece covering mouth and nose.

2.54 self-contained breathing apparatus. Breathing apparatus where the breathing gas supply is carried on the wearer of the breathing apparatus.

2.55 self-contained closed-circuit oxygen breathing apparatus. Self-contained breathing apparatus which removes carbon dioxide from, and adds oxygen to, the exhaled air for breathing by the wearer and is independent of the ambient atmosphere.

2.56 self-contained open-circuit compressed air breathing apparatus. Self-contained breathing apparatus which has a portable supply of compressed air and is independent of the ambient atmosphere. The exhaled air passes without recirculation to the ambient atmosphere.

2.57 smoke. A general term denoting an aerosol generated by incomplete combustion of organic compounds.

2.58 suit. A garment which covers the whole body to wrists and ankles.

2.59 vapour. The gaseous phase of a substance which is liquid or solid at 20 °C and 1 bar (absolute).

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*1 bar = 10^5 N/m^2 = 10^5 Pa.

Annexes

Annex A. Definition of breathable air

For the purposes of this Draft for Development breathable air has the following standards of purity:

(a) Impurities are kept to a minimum but in no event do not exceed the permissible exposure level.

(b) The mineral oil content is such that the air is without odour of oil.

NOTE. The odour threshold is in the region of 0.3 mg/m³.

(c) In self-contained open-circuit compressed air breathing apparatus the water content of the air is not greater than 30 mg/m at 300 bar or 50 mg/m³ at 200 bar air pressure.

(d) In compressed air line breathing apparatus the air has a dew point sufficiently low to prevent ice formation freezing.

(e) Relevant national regulations are satisfied.

Annex B. Explanation of breathable air

Air for respiratory protective devices may be natural or synthetic. A typical composition of natural air is given in table 1.

Table 1. Composition of natural air

Components	Mass (dry air)	Volume (dry air)
	%	%
Oxygen (O_2)	23.01	20.93
Nitrogen (N_2)	75.51	78.10
Argon (A)	1.286	0.9325
Carbon dioxide (CO_2)	0.04	0.03
Hydrogen (H_2)	0.001	0.01
Neon (Ne)	0.012	0.0018
Helium (He)	0.00007	0.0005
Krypton (Kr)	0.0003	0.00001
Xenon (Xe)	0.00004	0.000009

There may be a fire risk when the oxygen content is above the level shown in the table.

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Committees responsible for this Draft for Development

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British Agrochemicals Association
British Pest Control Association
Chemical Industries Association
Chief and Assistant Chief Fire Officers' Association
Department of Transport (Marine Directorate)
Electricity Supply Industry in England and Wales
Engineering Equipment and Materials Users' Association
Health and Safety Executive
Home Office
Industrial Safety (Protective Equipment) Manufacturers' Association
Institute of Occupational Medicine
Institution of Mechanical Engineers
Ministry of Defence
National Coal Board
National Radiological Protection Board
Safety Equipment Distributors' Association
Trades Union Congress

Amendments issued since publication

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Draft for Development

Respiratory protective equipment

Part 2. Classification

Projet à développer
Appareils de protection respiratoire
Partie 2. Classification

Entwurf zur weiteren Ausarbeitung
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Teil 2. Einteilung

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Part 14*	Specification for power assisted particle filtering devices incorporating full face masks and quarter masks.

*In course of preparation.

Classification

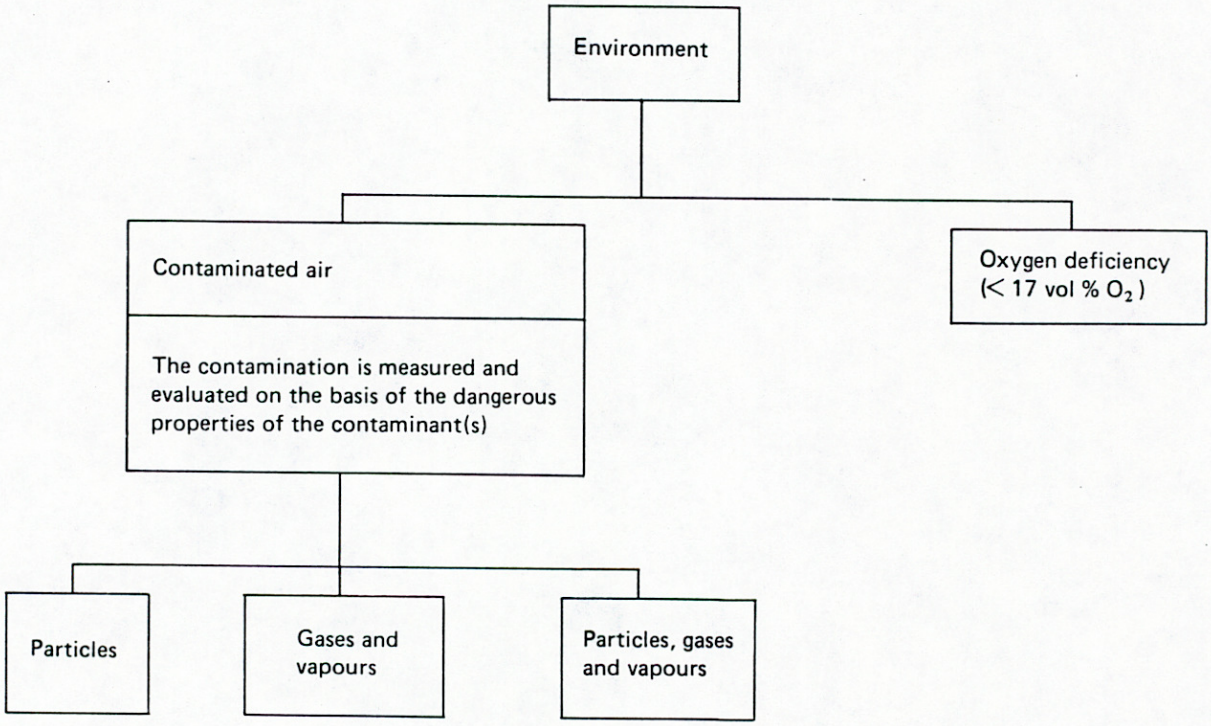
1 Object and field of application

This Draft for Development classifies respiratory protective equipment according to design and indicates in general terms the kinds of contaminated environments where protection may be required.

2 Classification

2.1 Classification of the environment

The environment may be contaminated by particles and/or by gases and vapours. Oxygen deficiency may also occur.



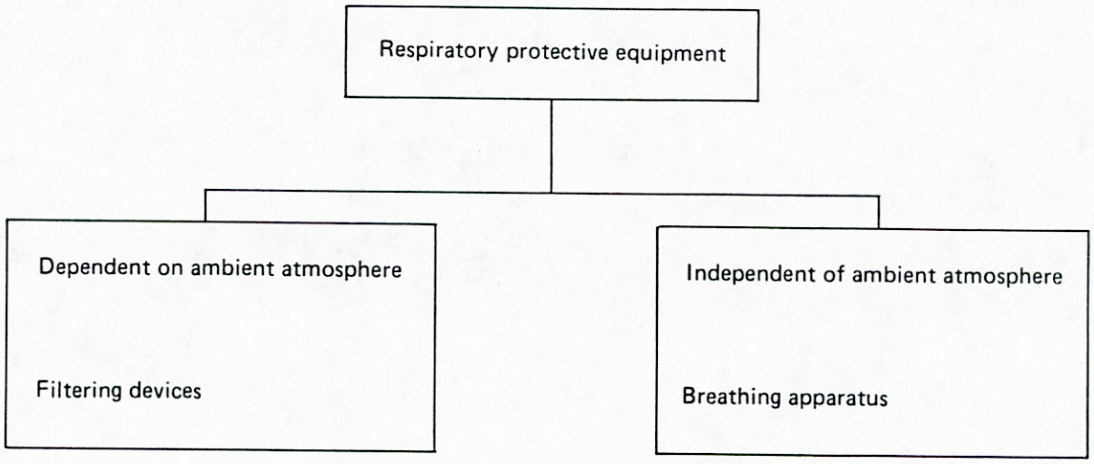
Temperature and humidity is also to be taken into consideration.

2.2 Classification of respiratory protective equipment

2.2.1 *General.* There are two distinct methods of providing personal respiratory protection against contaminated atmospheres:

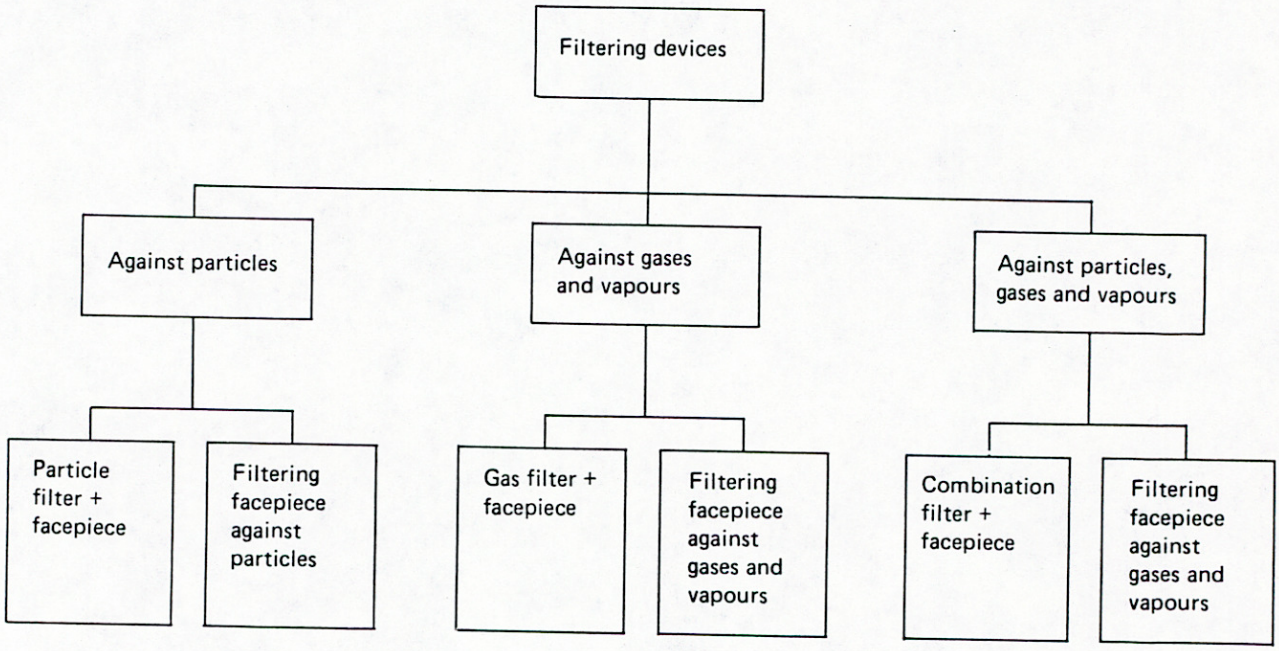
(a) by purifying the air (filtering device);

(b) by supplying air or oxygen from an uncontaminated source (breathing apparatus).



Respiratory protective equipment may also be designed specifically for escape purposes only.

2.2.2 *Filtering devices.* The inhaled air passes through a filter to remove contaminants.



The filtering devices can be unassisted or power assisted.

Particle filters are divided into the following classes:

low efficiency filters

medium efficiency filters

high efficiency filters

Medium and high efficiency filters are graded according to their ability to remove solid and liquid or solid particles only.

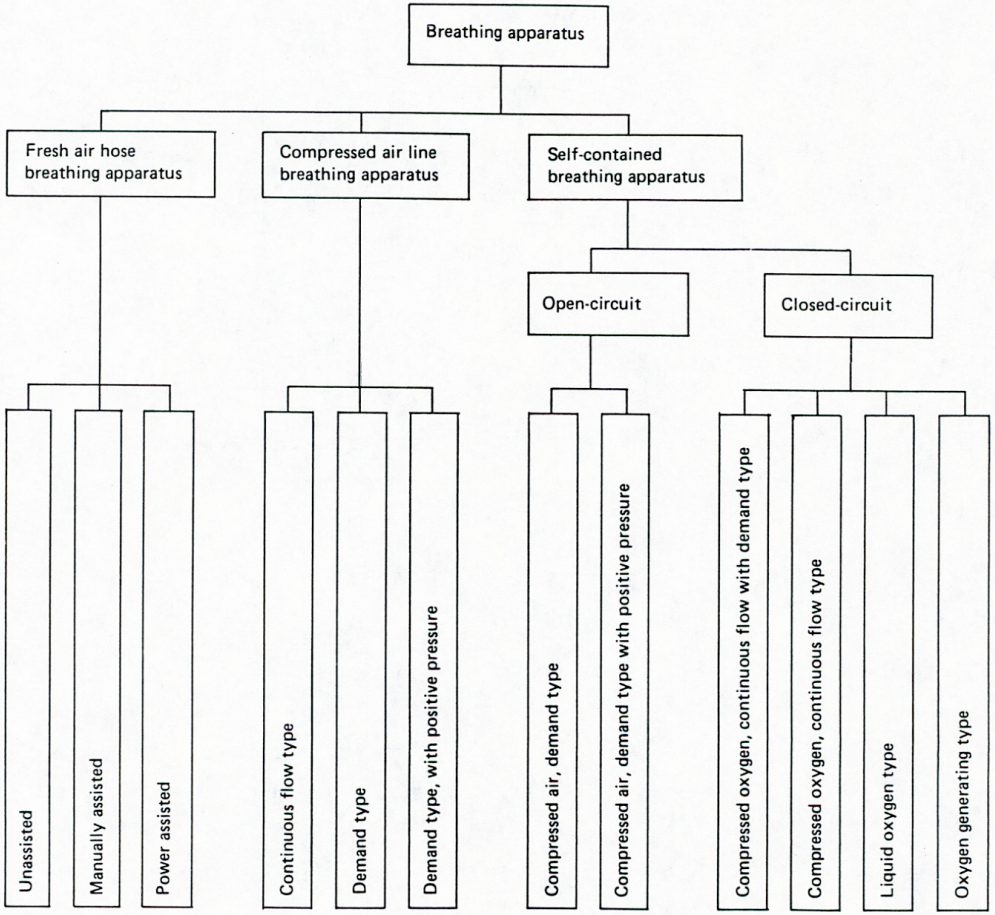
Gas filters are divided into the following classes:

low capacity filters

medium capacity filters

high capacity filters

2.2.3 *Breathing apparatus.* The main types of breathing apparatus are represented below.



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Health and Safety Executive
Home Office
Industrial Safety (Protective Equipment) Manufacturers' Association
Institute of Occupational Medicine
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Draft for Development

Respiratory protective equipment

Part 3. Nomenclature of piece parts

Projet à développer
Appareils de protection respiratoire
Partie 3. Nomenclature des pièces

Entwurf zur weiteren Ausarbeitung
Atemschutzgeräte
Teil 3. Benennungen von Einzelteilen

British Standards Institution

Contents

This publication is not to be regarded as a British Standard

It is being issued in the Draft for Development series of publications and is of a provisional nature because the draft European Standard that it is closely based on, prEN 134 'Respiratory protective equipment — Terminology of piece parts' is under further review to improve certain of its contents. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

A review of this Draft for Development will be carried out not later than two years after its publication. Notification of the start of the review period, with a request for the submission of comments from users of this Draft for Development will be made in an announcement in the appropriate issue of *BSI News*. Observations which it is felt should receive attention before the official call for comments will be welcomed.

According to the replies received, the responsible BSI Committee will judge whether the Draft for Development can be converted into a British Standard or what other action should be taken.

This Draft for Development will be withdrawn and a British Standard published once a European Standard or Harmonization Document on this subject acceptable to the UK has been published.

Foreword

This Draft for Development has been prepared under the direction of the Personal Safety Equipment Standards Committee and its technical content is identical with that agreed at the meeting of CEN/TC 79, Respiratory protection, held in June 1983.

This Draft for Development is one of a series dealing with respiratory protective devices based on CEN draft documents and is being published in this way to enable experience to be gained in its use within the UK.

Other Parts published or in course of preparation in this series are as follows:

Part 1	Glossary of terms
Part 2	Classification
Part 4	Schedule of equivalent terms
Part 5*	Specification for full face masks
Part 6*	Specification for half and quarter masks
Part 7*	Specification for mouthpieces
Part 8*	Specification for particle filters
Part 9*	Specification for gas and combined filters
Part 10*	Specification for fresh air hose breathing apparatus
Part 11*	Specification for compressed air line breathing apparatus
Part 12*	Specification for self-contained open circuit breathing apparatus
Part 13*	Specification for power assisted particle filtering devices incorporating helmets and hoods
Part 14*	Specification for power assisted particle filtering devices incorporating full face masks and quarter masks.

*In course of preparation.

Nomenclature

1 Object and field of application

This Draft for Development establishes nomenclature for the typical piece parts of respiratory protective equipment with the objective of ensuring the correct use of terminology in the field of respiratory protection.

This Draft for Development gives the nomenclature of typical piece parts only; it does not specify what or how many components are to be used for the design of a respiratory protective device. The terms are given trilingually. The illustrations are given only as examples for identification of the different parts of the apparatus.

ENGLISH

2 Nomenclature

2.1 Facepieces

2.1.1 *Full face mask*

FRENCH

Nomenclature

Pièces faciales

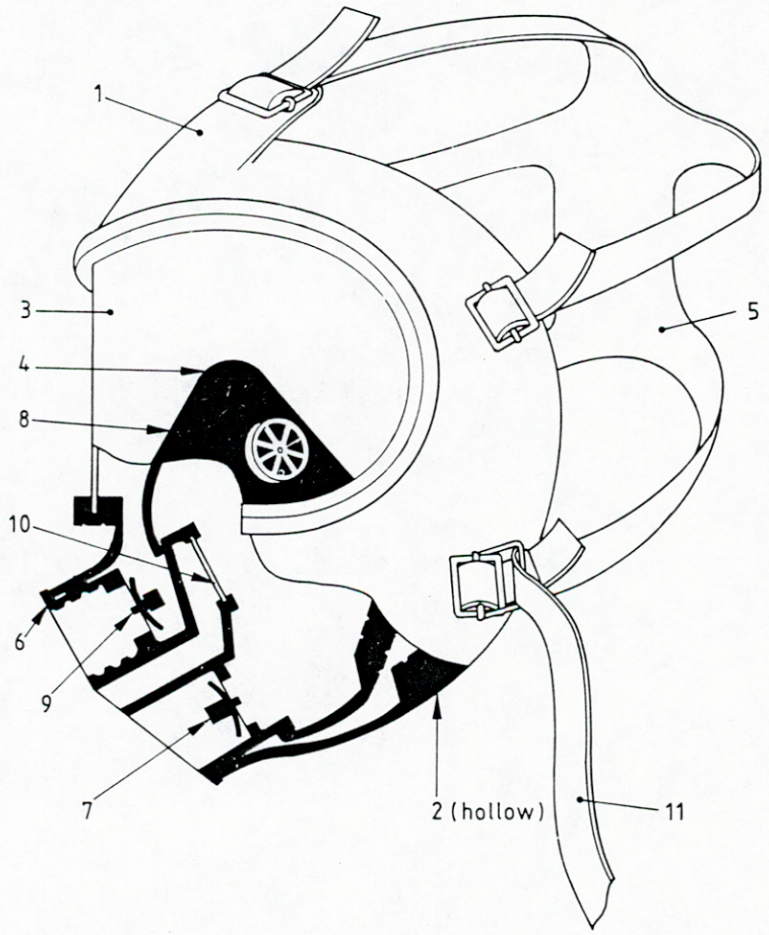
Masque complet

GERMAN

Nomenklatur

Atemanschlüsse

Vollmaske



1. Faceblank
2. Facepiece seal
3. Visor
4. Inner mask
5. Head harness
6. Connector
7. Exhalation valve
8. Check valve
9. Inhalation valve
10. Speech diaphragm
11. Neck strap

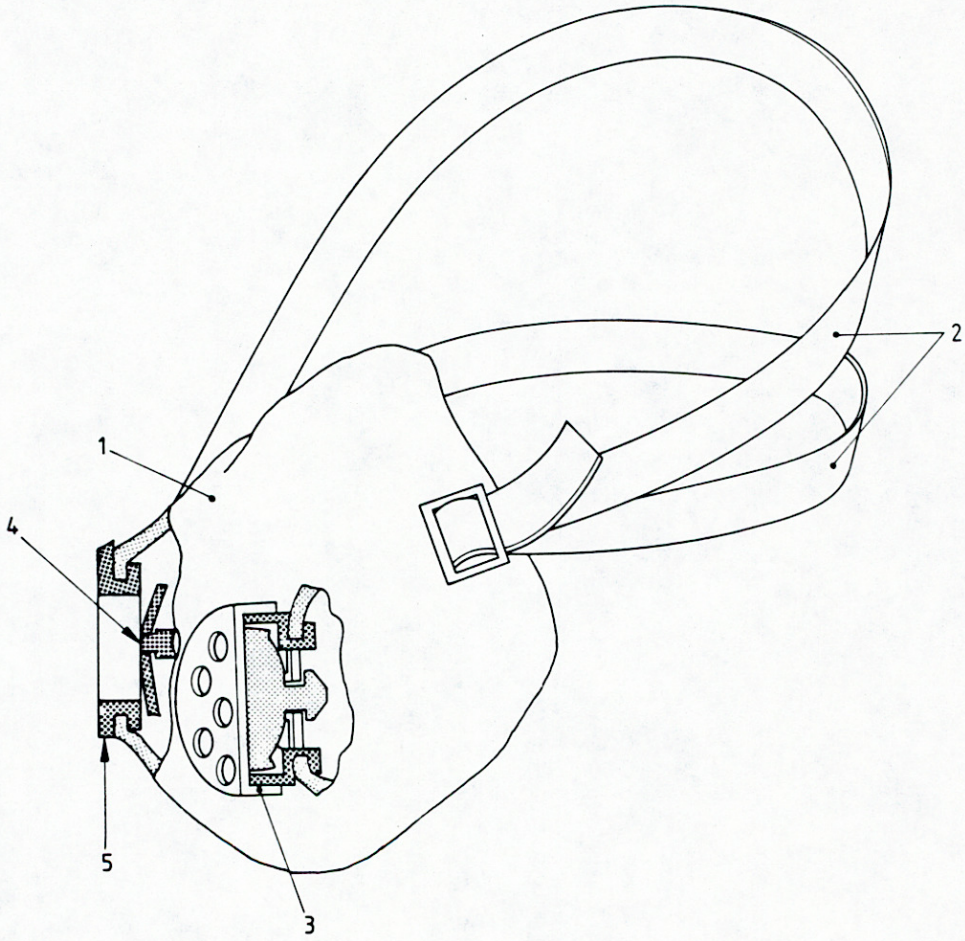
1. Jupe de masque
2. Bordure d'étanchéité
3. Oculaire
4. Masque intérieur
5. Jeu de brides
6. Raccord
7. Soupape expiratoire
8. Soupape inspiratoire du demi-masque intérieur
9. Soupape inspiratoire
10. Membrane phonique
11. Bride serre-nuque

1. Maskenkörper
2. Maskendichtrahmen
3. Sichtscheibe
4. Innenmaske
5. Kopfbänderung
6. Anschlusstück
7. Ausatemventil
8. Steuerventil
9. Einatemventil
10. Sprechmembran
11. Nackenband

ENGLISH
2.1.2 *Half mask*

FRENCH
Demi-masque

GERMAN
Halbmaske

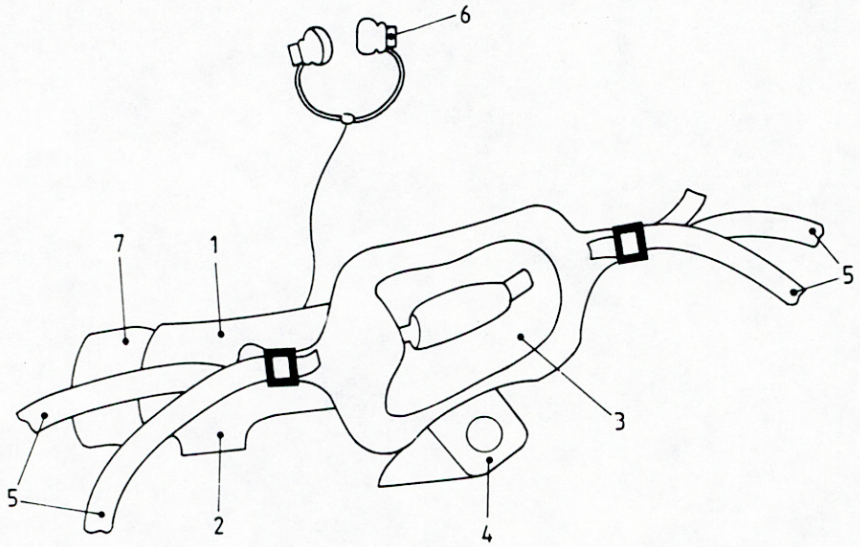


1. Faceblank
2. Head harness
3. Exhalation valve
4. Inhalation valve
5. Connector

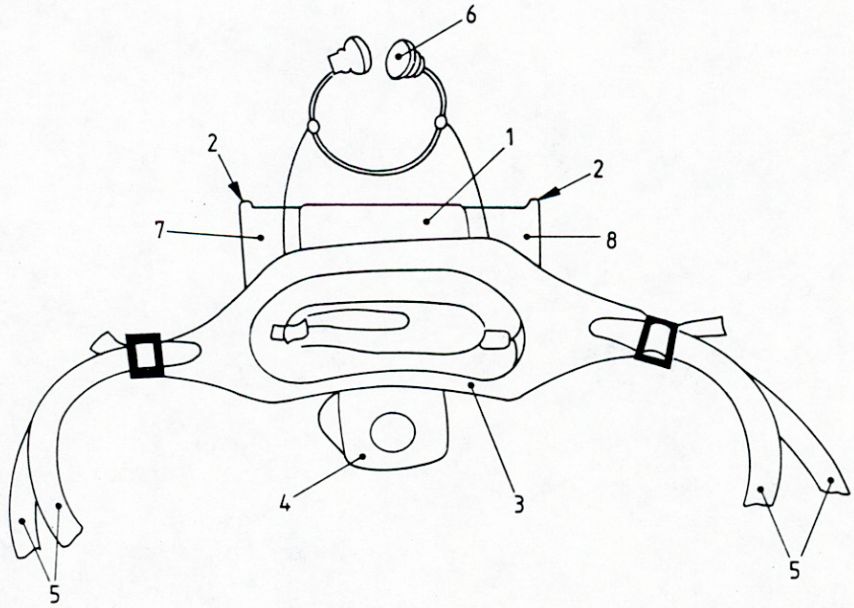
1. Jupe de masque
2. Jeu de brides
3. Soupape expiratoire
4. Soupape inspiratoire
5. Raccord

1. Maskenkörper
2. Kopfbänderung
3. Ausatemventil
4. Einatemventil
5. Anschlusstück

ENGLISH	FRENCH	GERMAN
2.1.2 *Mouthpiece assembly*	*Ensemble embout buccal*	*Mundstückgarnitur*



ien circuit type | Type circuit ouvert | Offener kreislauf



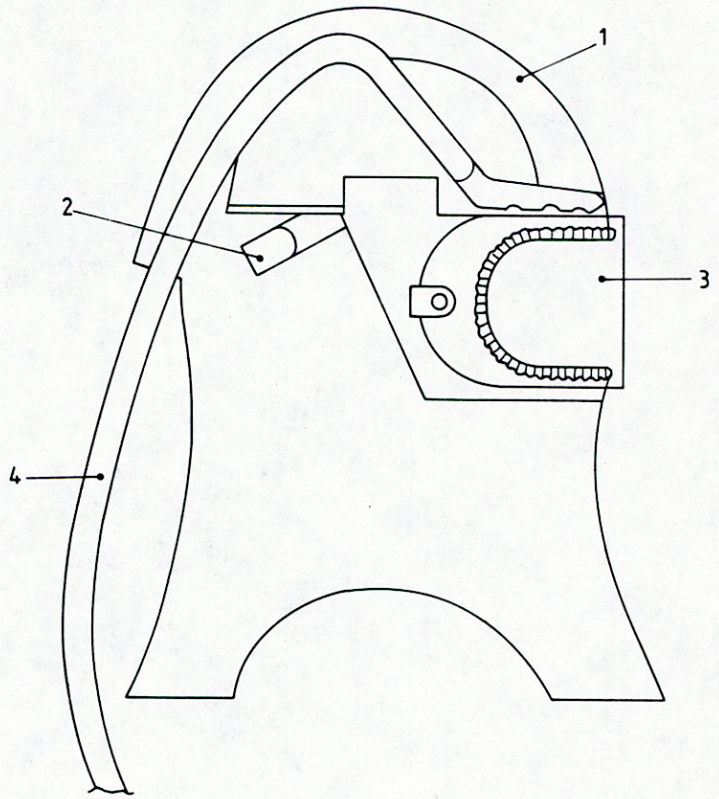
Closed circuit type | type circuit fermé d'embout | geschlossener kreislauf

1. Mouthpiece body	1. Corps d'embout buccal	1. Mundstückkörper
2. Connector	2. Raccord	2. Anschlusstück
3. Mouthpiece	3. Embout buccal	3. Mundstück
4. Chin support	4. Mentonnière	4. Kinnstütze
5. Head harness	5. Jeu de brides	5. Kopfbänderung
6. Nose clip	6. Pince narines	6. Nasenklemme
7. Exhalation valve	7. Soupape expiratoire	7. Ausatemventil
8. Inhalation valve	8. Soupape inspiratoire	8. Einatemventil

ENGLISH
2.1.4 *Hood*

FRENCH
Cagoule

GERMAN
Haube

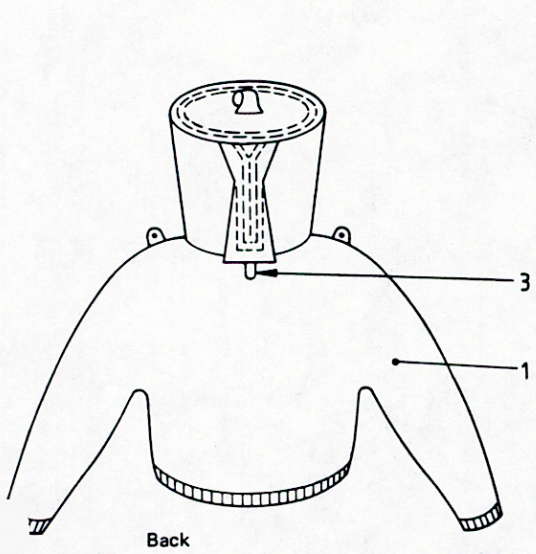


1. Hood
2. Head harness
3. Visor
4. Air supply hose

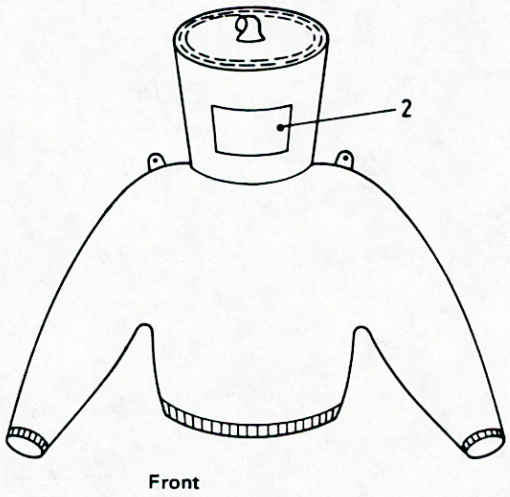
1. Cagoule
2. Jeu de brides
3. Oculaire
4. Tuyau d'alimentation en air

1. Haube
2. Kopfbänderung
3. Sichtscheibe
4. Luftversorgungsschlauch

ENGLISH	FRENCH	GERMAN
1.5 *Blouse*	*Gilet*	*Bluse*



Back



Front

1. Blouse
2. Visor
3. Connector

1. Gilet
2. Oculaire
3. Raccord

1. Bluse
2. Sichtscheibe
3. Anschlusstück

ENGLISH

2.2 Filtering devices

Filtering devices consist either of a facepiece and filter(s) or of a filtering facepiece.

2.2.1 *Facepiece and filter*

FRENCH

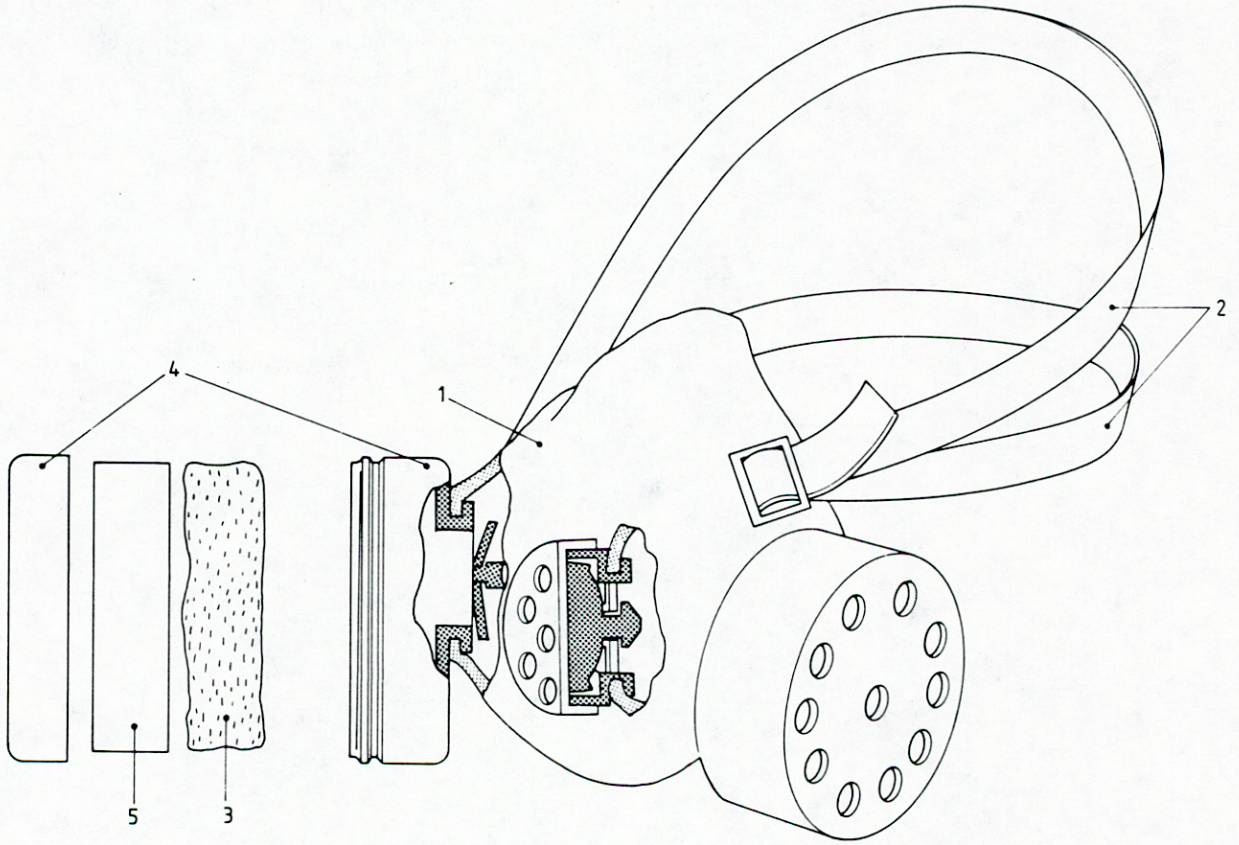
Appareils filtrants

Piece faciale avec filtre

GERMAN

Filtergeräte

Atemanschluss mit filter



1. Facepiece
2. Head harness
3. Filter
4. Filter housing
5. Prefilter

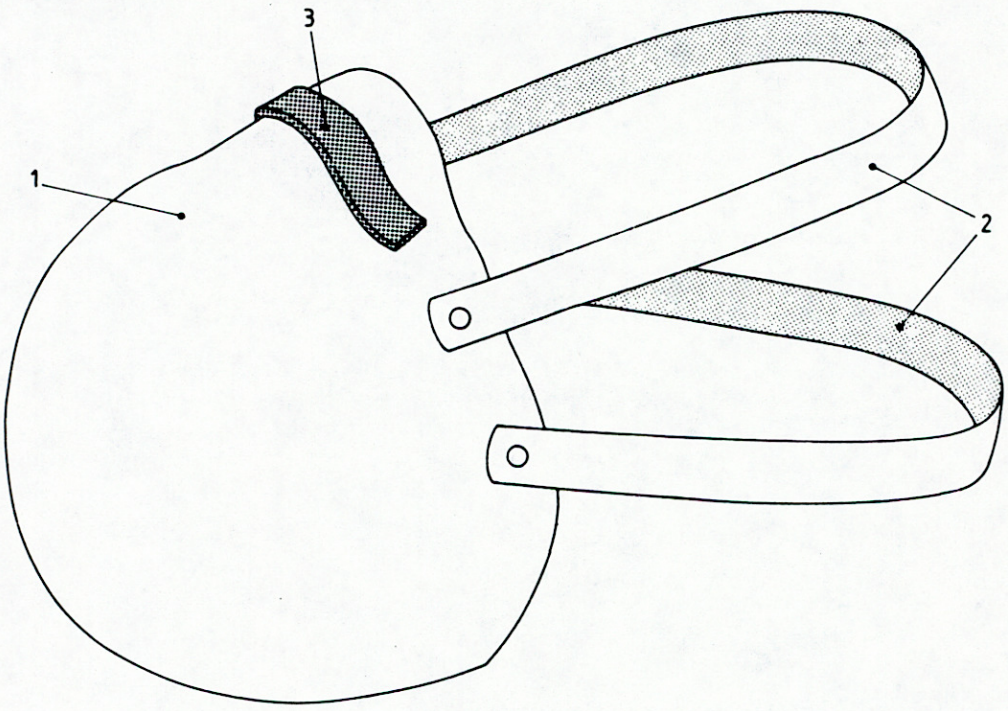
1. Pièce faciale
2. Jeu de brides
3. Filtre
4. Boitier de filtre
5. Préfiltre

1. Maskenkörper
2. Kopfbänderung
3. Filter
4. Filteraufnahme
5. Vorfilter

ENGLISH
2.2.2 *Filtering facepiece*

FRENCH
Pièce faciale filtrante

GERMAN
Filtriender Atemanschluss



1. Facepiece
2. Head harness
3. Nosepiece

1. Pièce faciale
2. Jeu de brides
3. Pince nez

1. Maskenkörper
2. Kopfbänderung
3. Nasenbügel

ENGLISH

2.3 Breathing apparatus

2.3.1 *Unassisted fresh air hose breathing apparatus*

FRENCH

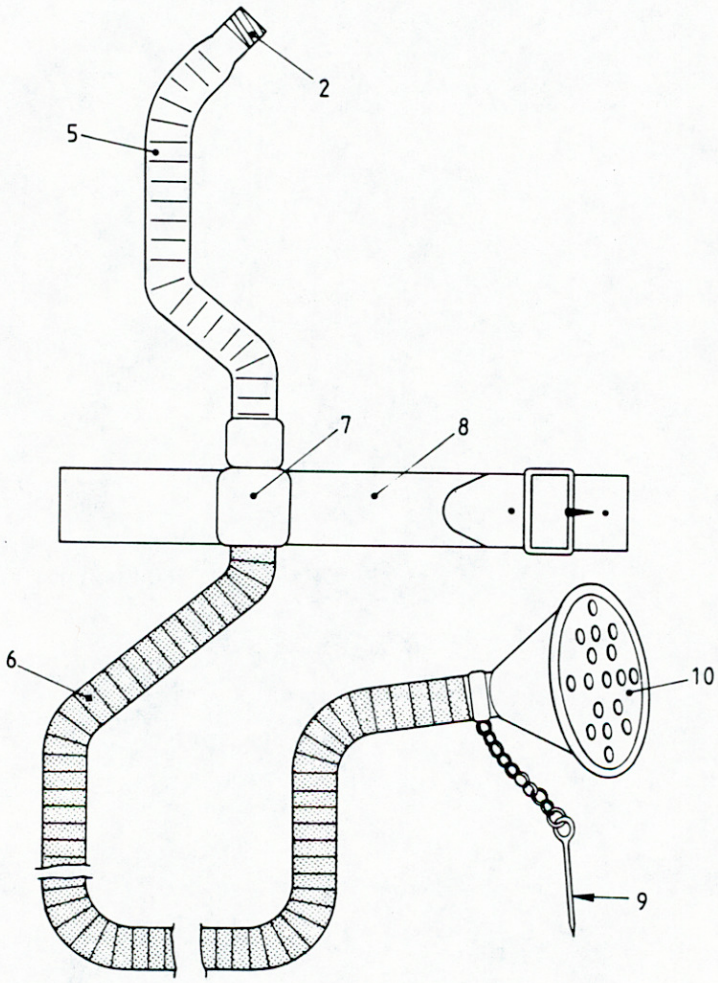
Appareils de protection respiratoire isolants

Appareil de protection respiratoire à air libre nonassisté

GERMAN

Unabhangiges Atemschutz Geräte

Frischluft-Saugschlauchgerät



1. Facepiece
2. Connector
3. Exhalation valve
4. Inhalation valve
5. Breathing hose
6. Air supply hose
7. Coupling
8. Belt or harness
9. Anchorage
10. Strainer

1. Pièce faciale
2. Raccord
3. Soupape expiratoire
4. Soupape inspiratoire
5. Tuyau respiratoire
6. Tuyau d'alimentation en air
7. Accouplement
8. Ceinture ou harnais
9. Ancrage
10. Crépine

1. Atemanschutz
2. Geräteanschlussstück
3. Ausatemventil
4. Einatemventil
5. Atemschlauch
6. Luftzuführungsschlauch
7. Verbindungsstück
8. Leibgurt oder Tragervorrichtung
9. Anker
10. Filter

ENGLISH

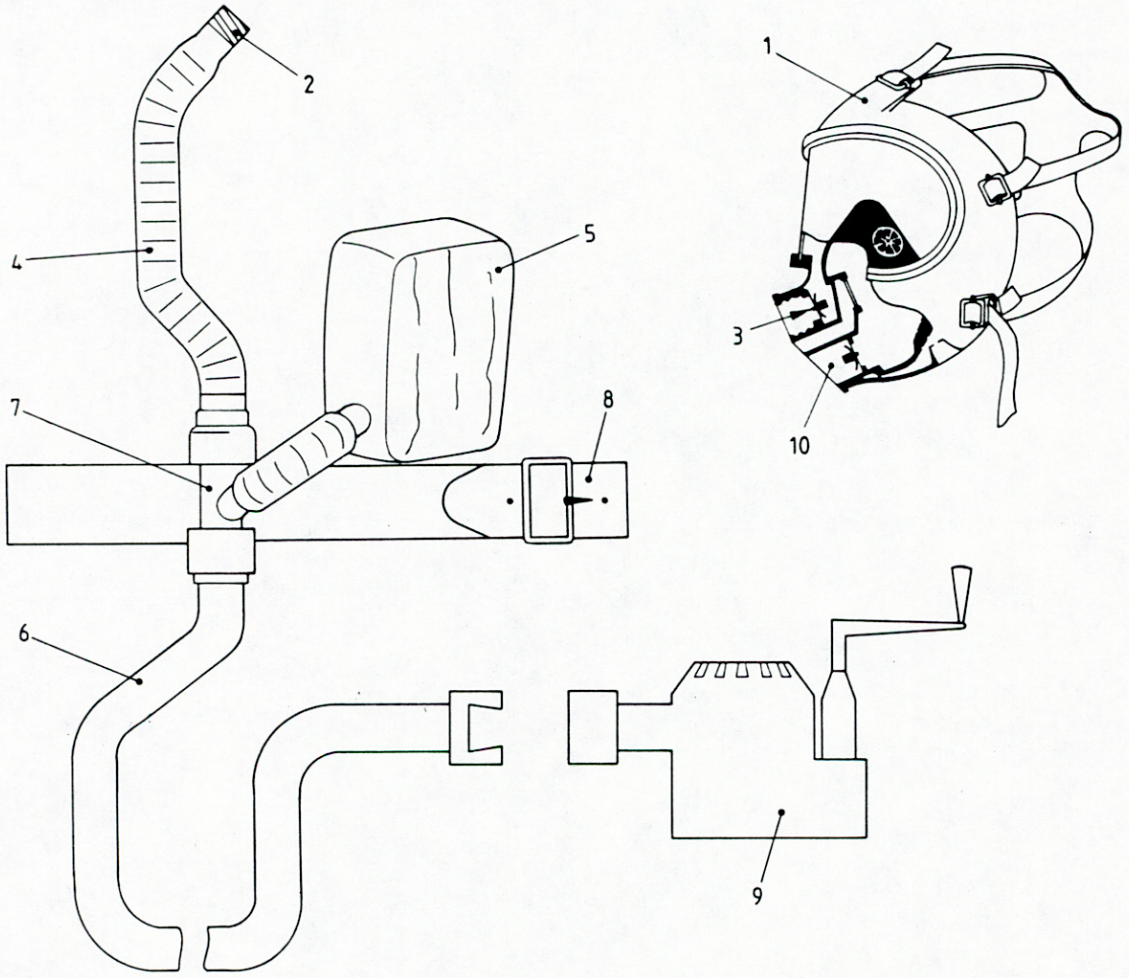
2.3.2 *Assisted fresh air hose breathing apparatus: manually assisted type*

FRENCH

Appareil de protection respiratoire à air libre assisté: type à assistance manuelle

GERMAN

Frischluft-Druck-Schlauchgerät: mit Handgebläse



1. Facepiece
2. Connector
3. Inhalation valve
4. Breathing hose
5. Breathing bag
6. Air supply hose
7. Coupling
8. Belt or body harness
9. Blower (hand operated)
10. Exhalation valve

1. Pièce faciale
2. Raccord
3. Soupape inspiratoire
4. Tuyau respiratoire
5. Sac respiratoire
6. Tuyau d'alimentation en air
7. Accouplement
8. Ceinture ou harnais
9. Ventilateur (manuel)
10. Soupape expiratoire

1. Atemanschluss
2. Geräteanschlussstück
3. Einatemventil
4. Atemschlauch
5. Atembeutel
6. Luftzuführungsschlauch
7. Verbindungsstück
8. Leibgurt oder Tragevorrichtung
9. Handgebläse
10. Ausatemventil

ENGLISH

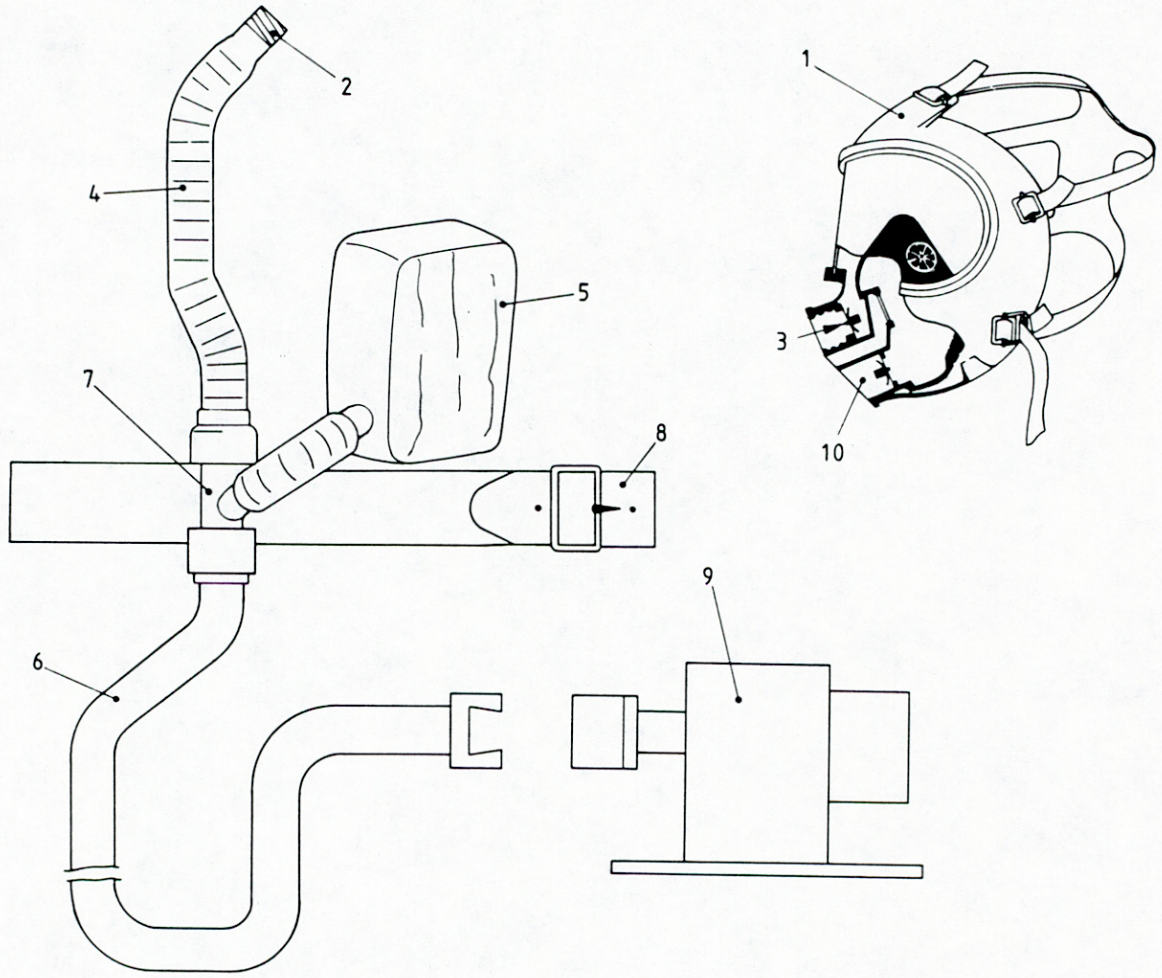
2.3.3 *Assisted fresh air hose breathing apparatus: power assisted type*

FRENCH

Appareil de protection respiratoire à air libre assisté: type à assistance motorisée

GERMAN

Frischluft-Druck-schlauchgerät: mit Motorgebläse



1. Face piece
2. Connector
3. Inhalation valve
4. Breathing hose
5. Breathing bag
6. Air supply hose
7. Coupling
8. Belt or body harness
9. Blower (motor-driven or compressed air
10. Exhalation valve

1. Pièce faciale
2. Raccord
3. Soupape inspiratoire
4. Tuyau respiratoire
5. Sac respiratoire
6. Tuyau d'alimentation en air
7. Accouplement
8. Ceinture ou harnais
9. Ventilateur (motorisé) ou injecteur à air comprimé
10. Soupape expiratoire

1. Atemanschluss
2. Gerätenaschlussstück
3. Einatemventil
4. Atemschlauch
5. Atembeutel
6. Luftzuführungsschlauch
7. Verbindungsstück
8. Leibgurt oder Tragevorrichtung
9. Motorgebläse oder Druckluft-Injektor
10. Ausatemventil

ENGLISH

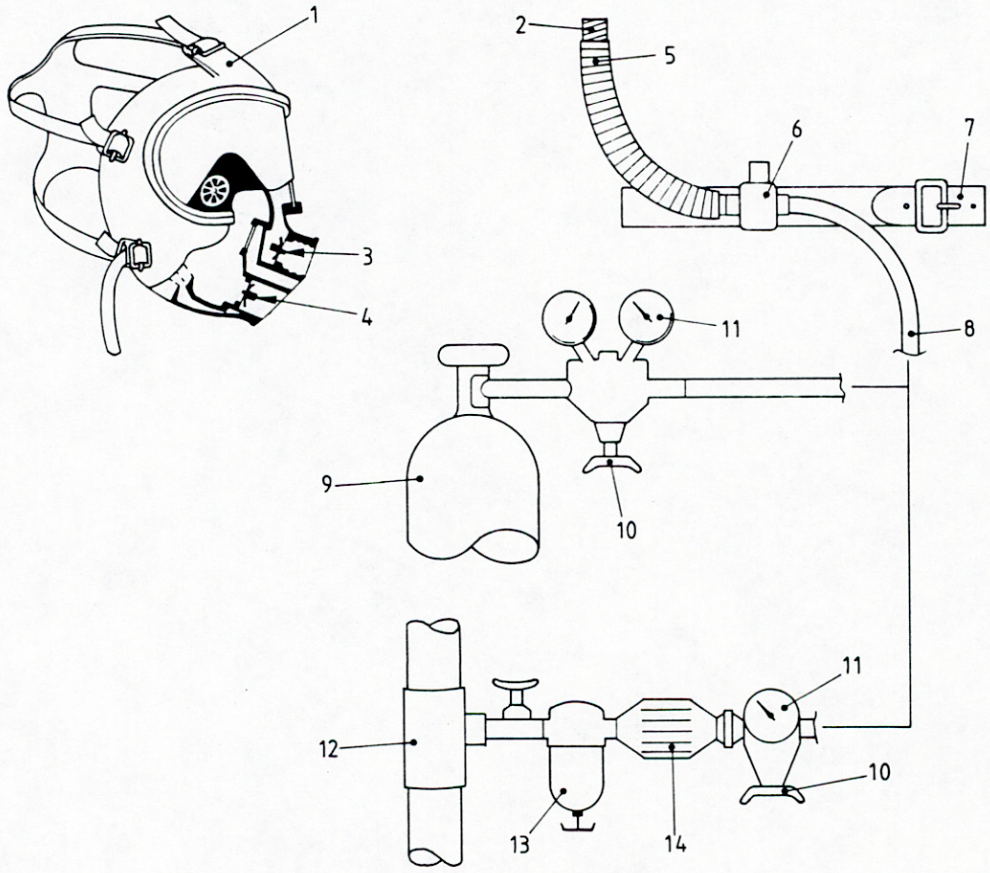
2.3.4 *Compressed air line breathing apparatus: continuous flow type*

FRENCH

Appareil de protection respiratoire à adduction d'air comprimé: type à débit continu

GERMAN

Druckluft-Schlauchgerät: mit Regelventil



1. Facepiece
2. Connector
3. Inhalation valve
4. Exhalation valve
5. Breathing hose
6. Coupling and continuous flow valve
7. Belt or body harness
8. Compressed air supply tube
9. Compressed air cylinder
10. Pressure reducer
11. Pressure gauge
12. Compressed air line
13. Separator
14. Filter

1. Pièce faciale
2. Raccord
3. Soupape inspiratoire
4. Soupape expiratoire
5. Tuyau respiratoire
6. Accouplement et robinet de réglage
7. Ceinture ou harnais
8. Tube d'alimentation en air comprimé
9. Bouteille d'air
10. Détendeur
11. Manomètre
12. Canalisation d'air comprimé
13. Séparateur
14. Filtre

1. Atemanschluss
2. Anschlussstück
3. Einatemventil
4. Ausatemventil
5. Atemschlauch
6. Verbindungsstück mit Regelventil
7. Leibgurt oder Tragevorrichtung
8. Druckluftzuführungsschlauch
9. Druckluftflasche
10. Druckminderer
11. Manometer
12. Druckluftleitung
13. Abscheider
14. Filter

ENGLISH

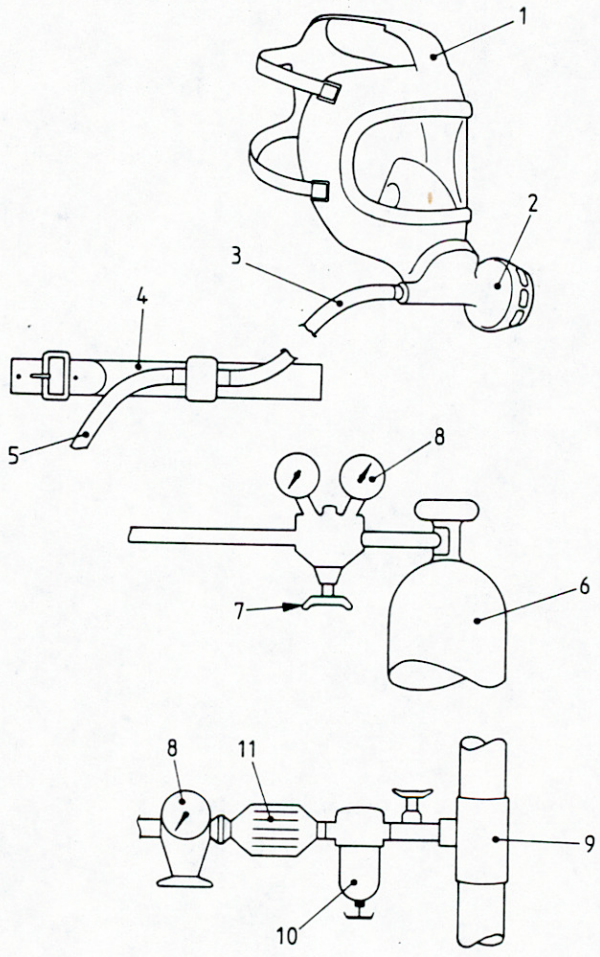
2.3.5 *Compressed air line breathing apparatus: demand type*

FRENCH

Appareil de protection respiratoire à adduction d'air comprimé: type à la demande

GERMAN

Druckluft-Schlauchgerät: mit Lungenautomat



1. Facepiece
2. Demand valve (lung-governed)
3. Breathing tube
4. Belt or body harness
5. Compressed air supply tube
6. Compressed air cylinder
7. Pressure reducer
8. Pressure gauge
9. Compressed air line
10. Separator
11. Filter

1. Pièce faciale
2. Soupape à la demande
3. Tuyau d'alimentation en air
4. Ceinture ou harnais
5. Tuyau d'alimentation en air comprimé
6. Bouteille d'air comprimé
7. Détendeur
8. Manomètre
9. Canalisation d'air
10. Séparateur
11. Filtre

1. Atemanschluss
2. Lungenautomat
3. Lungenautomatenschlauch
4. Leibgurt oder Tragevorrichtung
5. Druckluft-Zuführungsschlauch
6. Druckluftflasche
7. Druckminderer
8. Manometer
9. Druckluftleitung
10. Abscheider
11. Filter

ENGLISH

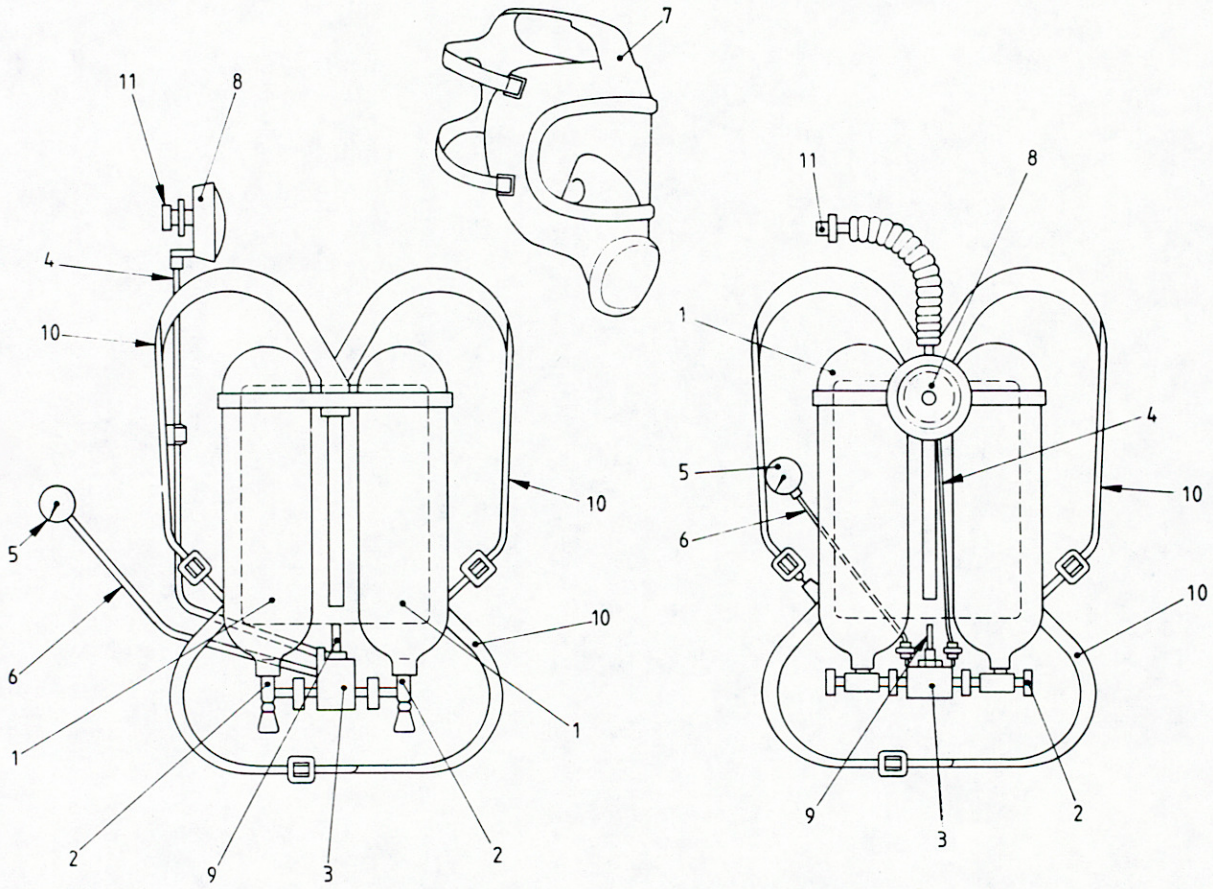
2.3.6 *Self-contained open-circuit compressed air breathing apparatus: demand type*

FRENCH

Appareil de protection respiratoire autonome à circuit ouvert, à air comprimé: type à la demande

GERMAN

Behaltengerät mit Druckluft, Pressluftatmer: mit Lungenautomat



Single-stage reduction

Two-stage reduction

1. Compressed air cylinder
2. Cylinder valve
3. Pressure reducer
4. Compressed air supply tube
5. Pressure gauge
6. Pressure gauge tube
7. Facepiece
8. Demand valve (lung-governed)
9. Warning device
10. Body harness
11. Connector

1. Bouteille d'air comprimé
2. Robinet de bouteille
3. Détendeur
4. Tuyau d'alimentation en air comprimé
5. Manomètre
6. Tube de manomètre
7. Pièce faciale
8. Soupape à la demande
9. Avertisseur
10. Harnais
11. Raccord

1. Druckluftflasche
2. Flaschenventil
3. Druckminderer
4. Lungenautomatenschlauch
5. Manometer
6. Manometerleitung
7. Atemanschluss
8. Lungenautomat
9. Warneinrichtung
10. Tragevorrichtung
11. Anschlussstück

ENGLISH

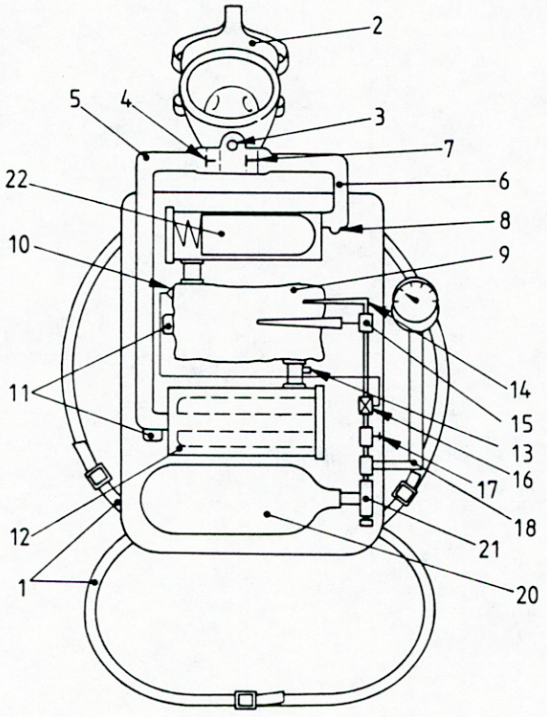
2.3.7 *Self-contained closed-circuit oxygen breathing apparatus: compressed oxygen type*

FRENCH

Appareil de protection respiratoire autonome à circuit fermé à oxygène: type à oxygène comprimé

GERMAN

Regenerationsgerät mit Drucksauerstoff: Sauerstoffschutzgerät



1. Body harness
2. Facepiece
3. Facepiece connector
4. Exhalation valve
5. Exhalation hose
6. Inhalation hose
7. Inhalation valve
8. Saliva trap
9. Breathing bag
10. Warning device
11. Relief valve
12. Regeneration cartridge
13. Flushing device
14. Oxygen supply tube
15. Demand valve (lung-governed)
16. Pressure reducer
17. Supplementary valve
18. Pressure gauge tube
19. Pressure gauge
20. Oxygen cylinder
21. Cylinder valve
22. Cooler

1. Harnais
2. Fièce faciale
3. Raccord du masque
4. Soupape expiratoire
5. Tuyau expiratoire
6. Tuyau inspiratoire
7. Soupape inspiratoire
8. Boîte à salive
9. Sac respiratoire
10. Avertisseur
11. Soupape de surpression
12. Cartouche de régénération
13. Dispositif de purge
14. Tube d'alimentation en oxygène
15. Soupape à la demande
16. Détendeur
17. Robinet d'oxygène additionel
18. Tube de manomètre
19. Manomètre
20. Bouteille d'oxygène
21. Robinet de bouteille
22. Refrigérant

1. Tragevorrichtung
2. Atemanschluss
3. Maskenanschlussstück
4. Ausatemventil
5. Ausatemschlauch
6. Einatemschlauch
7. Einatemventil
8. Speichelfänger
9. Atembeutel
10. Warneinrichtung
11. Überdruckventil
12. Regenerationspatrone
13. Spüleinrichtung
14. Sauerstoff-zuführungsleitung
15. Lungenautomat
16. Druckminderer
17. Sauerstoffzusatzventil
18. Manometerleitung
19. Manometer
20. Sauerstoffflasche
21. Flaschenventil
22. Kühler

ENGLISH

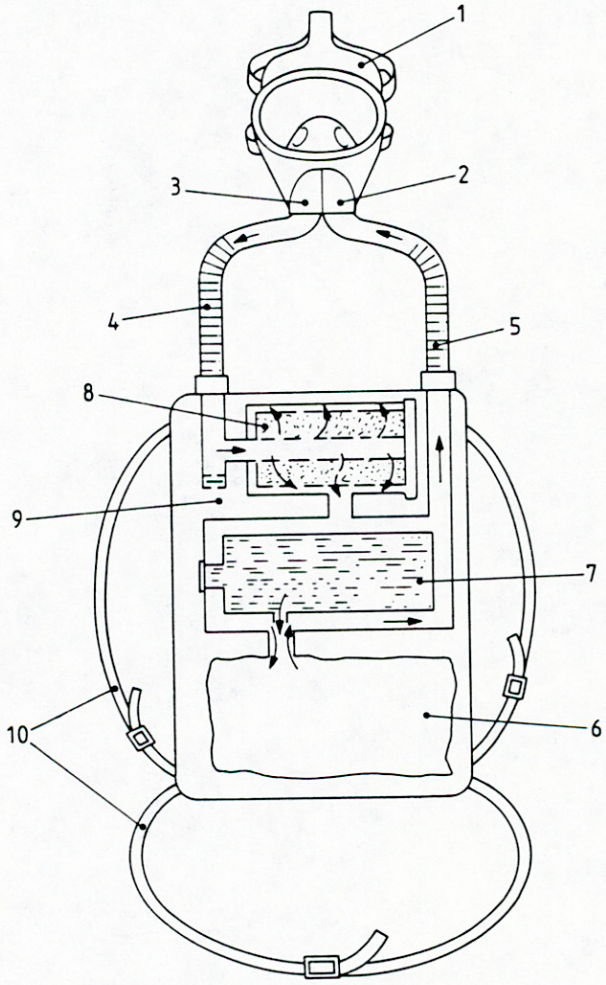
2.3.8 *Self-contained closed-circuit oxygen breathing apparatus: liquid oxygen type*

FRENCH

Appareil de protection respiratoire autonome à circuit fermé à oxygène: type à oxygène liquide

GERMAN

Regenerationsgerät mit Flüssigsauerstoff: flussigern Sauerstoff



1. Facepiece
2. Inhalation valve
3. Exhalation valve
4. Exhalation hose
5. Inhalation hose
6. Breathing bag
7. Evaporator
8. Regeneration cartridge
9. Relief valve
10. Body harness

1. Pièce faciale
2. Soupape inspiratoire
3. Soupape expiratoire
4. Tuyau expiratoire
5. Tuyau inspiratoire
6. Sac respiratoire
7. Evaporateur
8. Cartouche de régénération
9. Soupape de surpression
10. Harnais

1. Atemanschluss
2. Einatemventil
3. Ausatemventil
4. Ausatemschlauch
5. Einatemschlauch
6. Atembeutel
7. Verdampfer
8. Regenerationspatrone
9. Überdruckventil
10. Tragevorrichtung

ENGLISH

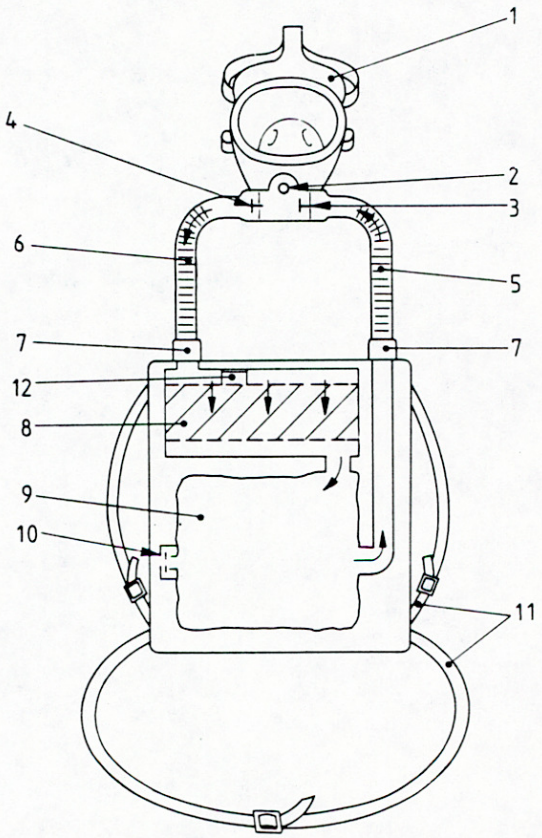
2.3.9 *Self-contained closed-circuit oxygen breathing apparatus: oxygen generating type*

FRENCH

Appareil de protection respiratoire autonome à circuit fermé à oxygène: type à génération d'oxygène

GERMAN

Regenerationsgerät: mit chemisch gebundenem Sauerstoff



1. Facepiece
2. Facepiece connector
3. Inhalation valve
4. Exhalation valve
5. Inhalation hose
6. Exhalation hose
7. Breathing hose connector
8. Cartridge (Oxygen-generating and CO_2 absorbing)
9. Breathing bag
10. Relief valve
11. Body harness
12. Starter

1. Pièce faciale
2. Raccord
3. Soupape inspiratoire
4. Soupape expiratoire
5. Tuyau inspiratoire
6. Tuyau expiratoire
7. Raccord du tuyau respiratoire
8. Cartouche (fournissant l'oxygène et absorbant le CO_2)
9. Sac respiratoire
10. Soupape de surpression
11. Harnais
12. Dispositif dé demarrage

1. Atemanschluss
2. Maskenanschlussstück
3. Einatemventil
4. Ausatemventil
5. Einatemschlauch
6. Ausatemschlauch
7. Atemschlauchanschlussstück
8. Chemikalpatrone (zur Sauerstoffentwicklung und CO_2-Aufnahme)
9. Atembeutel
10. Überdruckventil
11. Tragevorrichtung
12. Starter

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Committees responsible for this Draft for Development

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Chemical Industries Association
Chief and Assistant Chief Fire Officers' Association
Department of Transport (Marine Directorate)
Electricity Supply Industry in England and Wales
Engineering Equipment and Materials Users' Association
Health and Safety Executive
Home Office
Industrial Safety (Protective Equipment) Manufacturers' Association
Institute of Occupational Medicine
Institution of Mechanical Engineers
Ministry of Defence
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National Radiological Protection Board
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Draft for Development

Respiratory protective equipment

Part 4. Schedule of equivalent terms

Projet à développer
Appareils de protection respiratoire
Partie 4. Liste des termes équivalents

Entwurf zur weiteren Ausarbeitung
Atemschutzgeräte
Teil 4. Übersicht über Benennungen

British Standards Institution

Contents

This publication is not to be regarded as a British Standard

It is being issued in the Draft for Development series of publications and is of a provisional nature because the draft European Standard that it is closely based on, prEN 135 'Respiratory protective equipment – List of equivalent terms' is under further review to improve certain of its contents and add other terms. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

A review of this Draft for Development will be carried out not later than two years after its publication. Notification of the start of the review period, with a request for the submission of comments from users of this Draft for Development will be made in an announcement in the appropriate issue of *BSI News*. Observations which it is felt should receive attention before the official call for comments will be welcomed.

According to the replies received, the responsible BSI Committee will judge whether the Draft for Development can be converted into a British Standard or what other action should be taken.

This Draft for Development will be withdrawn and a British Standard published once a European Standard or Harmonization Document on this subject acceptable to the UK has been published.

Foreword

This Draft for Development has been prepared under the direction of the Personal Safety Equipment Standards Committee and its technical content is identical with that agreed at the meeting of CEN/TC 79, Respiratory protection, held in June 1983.

This Draft for Development is one of a series dealing with respiratory protective devices based on CEN draft documents and is being published in this way to enable experience to be gained in its use within the UK.

Other Parts published or in course of preparation in this series are as follows:

Part 1	Glossary of terms
Part 2	Classification
Part 3	Nomenclature of piece parts
Part 5*	Specification for full face masks
Part 6*	Specification for half and quarter masks
Part 7*	Specification for mouthpieces
Part 8*	Specification for particle filters
Part 9*	Specification for gas and combined filters
Part 10*	Specification for fresh air hose breathing apparatus
Part 11*	Specification for compressed air line breathing apparatus
Part 12*	Specification for self-contained open circuit breathing apparatus
Part 13*	Specification for power assisted particle filtering devices incorporating helmets and hoods
Part 14*	Specification for power assisted particle filtering devices incorporating full face masks and quarter masks.

*In course of preparation.

Schedule

1 Object and field of application

This Draft for Development establishes a schedule for terms used in the field of respiratory protective equipment and in addition lists the equivalent terms in French and German. The objective of this Draft for Development is to harmonize these terms and to support their use in these three languages.

2 Schedule of equivalent terms

Term number	ENGLISH	FRENCH	GERMAN
001	absorbant	absorbant	Absorptionsmittel
002	absorber	absorbeur	Absorber
003	actual pressure	pression disponible	Vorratsdruck
004	adjustable	ajustable	einstellbar
005	adjustment	ajustement (réglage)	Einstellung
006	adsorbent	adsorbant	Adsorptionsmittel
007	aerosol	aérosol	Aerosol
008	ageing	vieillissement	Alterung
009	air flow indicator	débimètre à air	Luftströmungsanzeiger
010	air purifier	purificateur d'air	Luftreiniger
011	air supply	alimentation en air	Luftversorgung
012	air supply hose (low pressure)	tuyau d'alimentation en air (basse pression)	Luftversorgungsschlauch (Niederdruck)
013	air volume, air capacity	réserve d'air (capacité d'air)	Luftvorrat
014	airways	voies respiratoires	Atemwege
015	alkali cartridge	cartouche alcaline	Alkalipatrone
016	ambient atmosphere	atmosphère ambiante	Umgebungsatmosphäre
017	ambient temperature	température ambiante	Umgebungstemperatur
	anchorage	ancrage	Anker
[illegible]	anti-fogging compound	produit anti-buée	Antibeschlagmittel
020	anti-mist disc	disque anti-buée	Klarscheibe
021	apertometer (for measuring the field of vision)	apertomètre (campimètre) (pour la mesure du champ visuel)	Apertometer (zur Gesichtsfeldmessung)
022	apparatus	appareil	Gerät
023	approval	approbation	Zulassung
024	approval number	numéro d'approbation	Zulassungsnummer (s. auch Prüfnummer)
025	as received	en l'état	im Anlieferungszustand
026	assisted	assisté	mit Luftversorgung
027	assisted fresh air hose breathing apparatus	appareil de protection respiratoire à air libre assisté	Frischluft-Druck-schlauchgerät
028	audible warning device	dispositif d'alarme sonore	akustische Warnein-richtung
029	automatic	automatique	selbsttätig
030	back plate	support dorsal	Rückenauflage
031	bellows	soufflet	Blasebalg
032	belt	ceinture	Leibgurt
033	blouse	gilet (veste)	Bluse
034	blower	ventilateur	Gebläse
035	blow out release	soupape de sécurité	Sicherheitsventil
036	body harness	harnais	Tragevorrichtung
037	breakthrough concentration	concentration de claquage	Durchbruchskonzentration
0[illegible]	breakthrough time	durée de claquage	Durchbruchszeit
0[illegible]	breathable	respirable	atembar
040	breathable air	air respirable	Atemluft
041	breathing air supply	alimentation en air	Atemluftversorgung (Atemluftabgabe)

Term number	ENGLISH	FRENCH	GERMAN
042	breathable gas	gaz respiratoire	Atemgas
043	breathing apparatus	appareil de protection respiratoire isolant	unabhängiges Atemschutzger
044	breathing apparatus for high altitudes	appareil de protection pour haute altitude	Höhenatemgerät
045	breathing bag	sac respiratoire	Atembeutel
046	breathing circuit	circuit respiratoire	Atemkreislauf
047	breathing hood	cagoule de protection respiratoire	Atemschutzhaube
048	breathing hose (low pressure)	tuyau respiratoire (basse pression)	Atemschlauch (Niederdruck)
049	breathing machine	machine respiratoire	künstliche Lunge
050	breathing minute volume	volume respiratoire minute	Atemminutenvolumen
051	breathing resistance	résistance respiratoire	Atemwiderstand
052	breathing simulator	simulateur de respiration	Atmungssimulator
053	breathing tube (medium pressure)	tuyau d'alimentation en air comprime (moyenne pression)	Lungenautomatenschlauch (Mitteldruck)
054	breathing valve	soupape respiratoire	Atemventil
055	buckle	boucle	Gurtschloss, Schnalle
056	by-pass valve	robinet de bipasse (robinet de dérivation)	Bypass-Ventil
057	capacity (of the breathing bag)	capacité (du sac respiratoire)	Fassungsvermögen (des Atembeutels)
058	carbon dioxide content	teneur en dioxyde de carbon	Kohlendioxidgehalt
059	carrying frame	chassis de transport	Tragegestell
060	carrying strap	sangle de transport	Trageband
061	cartridge connector	raccord de cartouche	Patronenanschlussstück
062	casing	boîtier (carter)	Gerätegehäuse
063	cavity of a mask	cavité interne du masque	Maskeninnenraum
064	ceiling value	valeur plafond	Höchstwert
065	centre thread	filetage central	Zentralgewinde
066	centre thread connection	raccord à filetage central	Zentralgewindeanschluss
067	chanelling (in a purifier)	cheminée (dans une cartouche épuratrice)	Kurzschluss (in einer Filterpatrone)
068	charging connector	raccord de remplissage	Füllanschluss
069	charging device	dispositif de remplissage	Fülleinrichtung
070	check valve	soupape inspiratoire du demi-masque intérieur	Steuerventil
071	chin support	mentonnière	Kinnstütze
072	circuit valve assembly	boîtier de soupape	Ventilkasten
073	cleaning	nettoyage	Reinigung
074	cleaning agents	agents de nettoyage	Reinigungsmittel
075	clogging	colmater	Verstopfen
076	clogging test	essai de colmatage	Einspeichertest
077	closed-circuit	circuit fermé	geschlossener Kreislauf
078	closed-circuit breathing	respiration en circuit fermé	Kreislaufatmung

Term number	ENGLISH	FRENCH	GERMAN
079	closed-circuit breathing apparatus	appareil respiratoire à circuit fermé	Regenerationsgerät
080	cold chamber	chambre froide	Kältekammer
081	combined filter	filtre combiné	Kombinationsfilter
082	compatibility to skin	compatibilité avec la peau	Hautverträglichkeit
083	component part	accessoire	Zubehörteil
084	compressed air	air comprimé	Druckluft
085	compressed air cylinder (air cylinder)	bouteille d'air comprimé	Druckluftflasche
086	compressed air cylinder assembly with pressure reducer	bouteille d'air comprimé avec détendeur	Druckluftflasche mit Druckminderer
087	compressed air filter	filtre pour air comprimé	Druckluftfilter
088	compressed air injector	injecteur à air comprimé	Druckluft-Injektor
089	compressed air line	canalisation d'air comprimé	Druckluft-Leitung
090	compressed air line breathing apparatus	appareil de protection respiratoire à adduction d'air comprimé	Druckluft-Schlauchgerät
091	compressed air supply	alimentation en air comprimé	Druckluft-Vorrat
	compressed air supply tube (medium pressure)	tube d'alimentation en air comprimé (moyenne pression)	Druckluft-Zuführungsschlauch (Mitteldruck)
093	compressed air supply tube (medium pressure) with coupling	tube d'alimentation en air comprimé (moyenne pression) avec accouplement	Druckluft-Zuführungsschlauch mit Kupplung (Mitteldruck)
094	compressed oxygen	oxygène comprimé	Drucksauerstoff
095	connecting piece	raccord	Verbindungsstück
096	connecting tube for warning signal	tube (tubulure) de signal avertisseur	Warnsignalleitung
097	connection	raccordement	Verbindung
098	connector	raccord	Anschlussstück
099	constant flow device	appareil à débit continu	Einrichtung für konstante Dosierung
100	contaminant	impureté	Verunreinigung
101	continuous air flow	débit continu	kontinuerliche Luftstrom
102	continuous flow valve (control valve for continuous air flow in compressed air line breathing apparatus)	robinet de réglage (de débit continu)	Regelventil (für kontinuerlichen Luftstrom bei Druckluft-Schlauchgeräten)
103	control device	dispositif de réglage	Regeleinrichtung
104	control valve	robinet de réglage	Regulierventil
105	cooler	réfrigérant (refroidisseur)	Kühler
106	cooling system	réfrigérant (refroidisseur)	Kühleinrichtung
107	corrugated hose	tuyau annelé	Faltenschlauch
108	coupling	accouplement	Kupplung, Verbindungsstück
	coupling and continuous flow valve	accouplement et robinet de réglage de débit continu	Verbindungsstück mit Regelventil
110	cover locking device	fermeture du couvercle	Deckelverschluss
111	cylinder pressure	pression de bouteille	Flaschendruck

Term number	ENGLISH	FRENCH	GERMAN
112	cylinder valve (valve of a compressed gas container)	robinet de bouteille	Flaschenventil (Ventil eines Druckgasbehälters)
113	cylinder valve connection	raccord du robinet de bouteille	Flaschenventilanschluss
114	date of manufacture	date de fabrication	Herstelldatum
115	dead space	espace mort	Totraum
116	demand valve	soupape à la demande	atemgesteurte Dosiereinrichtung (Lungenautomat)
117	disinfecting agent	agent de désinfection	Desinfektionsmittel
118	disinfecting solution	désinfectant	Desinfektionslösung
119	disinfection	désinfection	Desinfektion
120	distortion of vision	distorsion de la vision	Sicht verzerrung
121	diving apparatus	appareil de plongée	Tauchgerät
122	dummy body	mannequin	Körperattrappe
123	dummy head	tête factice	Prüfkopf
124	dust	poussière	Staub
125	effective air volume	volume d'air effectif	effektives Luftvolumen
126	effective duration	durée d'utilisation (autonomie)	effektive Gebrauchszeit
127	effective field of vision	champ visuel effectif	effektives Gesichtsfeld
128	effective volume	volume efficace	nutzbarer Inhalt
129	efficiency	efficacité	Wirkungsgrad
130	effluent side	côté aval	Mundseite
131	encapsulated particle filter	filtre à particules (type emboîté)	gekapseltes Partikelfilter
132	equilibrated filter (with respect to humidity)	filtre équilibré (en humidité relative)	feuchtigkeitsangeglichenes Filter
133	equipment connector	raccord à la pièce faciale	Geräteanschlussstück
134	escape apparatus	appareil d'évacuation	Fluchtgerät
135	escape-type respiratory protective equipment	appareil de protection respiratoire, type évacuation	Atemschutzgeräte für Selbstrettung
136	evaporator	évaporateur	Verdampfer
137	examination	examen	Untersuchung
138	excess air	excès d'air	Überschüssige Luft
139	excess breathing gas	gaz respiratoire en excès	Überschüssiges Atemgas
140	exhalation air	air expiré	Ausatemluft
141	exhalation hose	tuyau expiratoire	Ausatemschlauch
142	exhalation resistance	résistance expiratoire	Ausatemwiderstand
143	exhalation valve	soupape expiratoire	Ausatemventil
144	exhalation valve housing	boîtier de soupape expiratoire	Ausatemventilgehäuse
145	exhalation valve leakage	fuite de soupape expiratoire	Ausatemventilschlupf
146	exhaled air	air expiré	ausgeatmete Luft
147	external atmosphere	atmosphère extérieure	Aussenatmosphäre
148	eyepiece	oculaire	Sichtscheibe
149	face blank	jupe de masque	Maskenkörper
150	facepiece	pièce faciale	Atemanschluss
151	facepiece connector	raccord du masque	Maskenanschlussstück
152	facepiece seal	bordure d'étanchéité	Maskendichtrahmen

Term number	ENGLISH	FRENCH	GERMAN
153	face seal	surface d'étanchéité	Auflagenfläche auf der Dichtlinie einer Maske
154	facepiece seal leakage	fuite faciale	Maskenundichtheit am Gesicht
155	face seal, sealing	étanchéité	Abdichtung (an Masken oder Mundstück)
156	field of application	domaine d'application	Anwendungsbereich
157	field of vision	champ visuel	Gesichtsfeld
158	filling pressure	pression de remplissage	Fülldruck
159	filter	filtre	Filter
160	filter canister	cartouche filtrante	Filterbüchse
161	filter capacity	capacité de filtre	Aufnahmevermögen eines Filters
162	filter class	classe de filtre	Filterklasse
163	filter holder	support de filtre (monture)	Filterfassung
164	filter housing	boîtier de filtre	Filteraufnahme
165	filter housing for insert filter	boîtier pour filtre	Steckfilterfassung
166	filter housing with cover for filter	boîtier pour filtre emboité avec couvercle	Steckfilterfassung mit Deckel
167	filtering device	appareil filtrant	Filtergerät
168	filtering device with canister	appareil protection respiratoire à cartouche filtrante	Filtergerät mit Filterbüchse
169	filtering device with filter cartridge	appareil de protection respiratoire à filtre emboîté (galette filtrante)	Filtergerät mit Steckfilter
170	filtering device with screw filter	appareil de protection respiratoire à filtre vissé	Filtergerät mit Schraubfilter
171	filtering facepiece	pièce faciale filtrante	filtriender Atemanschluss
172	filter self-rescuer	appareil de protection respiratoire filtrant pour évacuation (autosauveteur filtre)	Fluchtfiltergerät (Filterselbstretter)
173	filter type	type de filtre	Filtertyp
174	filtration efficiency	pouvoir d'arrêt	Abscheidegrad
175	fit (of a mask)	ajustage (d'un masque)	Sitz (einer Maske)
176	flame arrester	pare-flamme	Flammensparre
177	flammability	inflammabilité	Entflammbarkeit
178	flammable gas mixture	mélange de gaz inflammable	zündfähiges Gasgemisch
179	flash back check valve	soupape anti-retour	Rückschlagventil
180	flexibility	élasticité (souplesse)	Dehnbarkeit
181	flexible bladder	vessie	elastische Blase
182	flow	courant	Strömung
183	flowmeter	débitmètre	Durchflussmesser
184	flow rate (volume flow rate)	débit volumique	Volumenstrom
185	flushing device	dispositif de purge	Spüleinrichtung
186	frame	chassis, (bâti)	Rahmen
187	frequency range	gamme de fréquence	Frequenzbereich
188	fresh air hose breathing apparatus	appareil (de protection respiratoire à air libre)	Frischluft-Schlauchgerät

Term number	ENGLISH	FRENCH	GERMAN
189	fresh air hose breathing apparatus and compressed air line breathing apparatus	appareil (de protection respiratoire à air non autonome)	Schlauchgerät
190	frictional spark	étincelle de friction	Reibungsfunke
191	front strap	bride frontale	Stirnband
192	full face mask	masque complet	Vollmask
193	fume	fumée	Rauch
194	gas	gaz	Gas
195	gas filter	filtre anti-gaz	Gasfilter
196	gasket	joint	Dichtung, Dichtring
197	gas mixture	mélange de gaz	Gasgemisch
198	gas tight	étanche aux gaz	gasdicht
199	gauge window	verre de manomètre	Manometer-Sichtscheibe
200	half mask	demi-masque	Halbmaske
201	harmful effect	effet néfaste	schädigender Einfluss, schädingende Wirkung
202	harness	harnais	Begurtung, Bänderung
203	head harness	jeu de brides	Kopfbänderung
204	head plate	calotte	Kopfplatte
205	head strap	bride	Kopfband
206	heat exchanger	échangeur de chaleur	Wärmeaustauscher
207	heavy duty man test	essai sur l'homme dans des conditions sévères	Geräteprüfung unter schwere Bedingungen (Maximalübung)
208	helmet	casque	Helm
209	high pressure	haute pression	Hochdruck
210	high pressure parts	pièces supportant la haute pression	hochdruckführende Teile
211	high pressure tubing (high pressure tube)	tubulure (tube) haute pression	Hochdruckleitung
212	hood	cagoule	Haube
213	hose	tuyau (tube)	Schlauch
214	humidity	humidité	Feuchte, Feuchtigkeit
215	hygiene standard	norme d'hygiène	Hygiene-Richtlinie
216	inadvertently	par inadvertance	unbeabsichtigt
217	ingress (or inward leakage)	fuite	Eindringen (Undichtheit)
218	inhalation air	air inhalé	Einatemluft
219	inhalation hose	tuyau inspiratoire	Einatemschlauch
220	inhalation resistance	résistance inspiratoire	Einatemwiderstand
221	inhalation valve	soupape inspiratoire	Einatemventil
222	inhaled air	air inhalé	eingeatmete Luft
223	initial length	longueur initiale	ursprüngliche Länge
224	injector	injecteur	Injektor
225	inlet valve	soupape inspiratoire	Einlassventil
226	inner mask	masque intérieur	Innenmaske
227	insert filter (e.g. cartridge)	filtre emboîté	Steckfilter
228	inspection	inspection	Überprüfung

Term number	ENGLISH	FRENCH	GERMAN
229	inspiratory air stream	courant d'air inhalé	Einatemluftstrom
230	instruction for use	mode d'emploi	Gebrauchsanleitung
231	inward leakage	fuite (de pièces faciales)	Leacage, Schlupf
232	laboratory test	essai de laboratoire	Laborprüfung
233	leak tightness	étanchiété	Dichtheit
234	leakage	fuite	Undichtheit
235	lens, visor	oculaire	Augenscheibe (Sichtscheibe von Masken)
236	lens wiper	essuie-glace	Scheibenwischer
237	level course	plan horizontal	horizontale Ebene
238	limitation for use	limitation d'emploi	Einsatzgrenze
239	liquid oxygen	oxygène liquide	flüssig Sauerstoff
240	low pressure	basse pression	Niederdruck
241	low pressure compressor	compresseur d'air, basse pression	Niederdruckluftverdichter
242	low pressure hose	tuyau basse pression	Niederdruckleitung
243	low pressure stage	étage basse pression	Niederdruckstufe
244	lung-governed demand valve (demand valve)	soupape à la demande	atemgesteuerte Dosierungseinrichtung (Lungenautomat)
	lung-governed oxygen supply	alimentation en oxygène par soupape à la demande	atemgesteuerte Sauerstoffdosierung
246	lung-governed supply	alimentation par pulmocommande	atemgesteuerte Dosierung
247	maintenance	entretien	Wartung
248	main valve of gas container	robinet de bouteille de gaz comprimé	Drucksgasbehälterventil
249	man test	essai sur l'homme	Geräteprüfung mit Personen
250	man test with donned apparatus	essais de l'appareil porté sur l'homme	Leistungsübung mit angelegtem Gerät
251	manual breathable air supply device	dispositif manuel d'alimentation en air respirable	manuelle Atemluftversorgungseinrichtung
252	manufacturer	fabricant	Hersteller
253	marking	marquage	Kennzeichnung
254	mask	masque	Maske
255	maximum admissable filling pressure	pression de remplissage maximale autorisée	maximal zulässiger Fülldruck
256	mechanical strength	résistance mécanique	mechanische Widerstandsfähigkeit
257	medical grade oxygen	oxygène medical	medizinischer Sauerstoff
258	medium pressure	moyenne pression	Mitteldruck
259	medium pressure connecting tube	tube d'alimentation en air comprimé, moyenne pression	Mitteldruckleitung
260	minimum requirement	spécification minimale	Mindestanforderung
	minute volume	volume minute	Minutenvolumen
262	mist	brouillard	Nebel
263	mixed oxygen supply	alimentation mixte en oxygène	kombinierte Sauerstoffdosierung
264	mouthpiece	embout buccal	Mundstück

Term number	ENGLISH	FRENCH	GERMAN
265	mouthpiece assembly	ensemble embout buccal	Mundstückgarnitur
266	mouthpiece body	corps d'embout buccal	Mundstückkörper
267	national specification	prescriptions nationales	nationale Vorschrift
268	natural field of vision	champ visuel naturel	natürliches Gesichtsfeld
269	neck strap	bride serre-nuque	Nackenband
270	negative pressure	dépression (pression négative)	Unterdruck
271	nominal protection factor	facteur de protection nominale	Nennschutzfaktor
272	nominal working duration	durée de fonctionnement nominale	Nenngebrauchszeit
273	non-kinking	résistant au tortillement	knickfest
274	non-splintering	de sécurité (dans le cas du verre)	splittersicher
275	nose clip	pince narines	Nasenklemme
276	nose pad	bourrelet de pince narines	Nasen (klemmen) polster
277	nosepiece	pince nez	Nasenbügel
278	opening pressure	pression d'ouverture	Öffnungsdruck, Ansprechdruck
279	opening resistance	résistance à l'ouverture	Öffnungswiderstand
280	operating condition	modalité de mise en oeuvre	Betriebsbedingung
281	operating pressure	pression de fonctionnement	Anspringdruck
282	overlapped field of vision	champ de vision binoculaire	überdecktes Gesichtsfeld
283	oxygen content	teneur en oxygène	Sauerstoffgehalt
284	oxygen cylinder	bouteille d'oxygène	Sauerstoffflasche
285	oxygen deficiency	défaut (manque) d'oxygène	Sauerstoffmangel
286	oxygen feed	alimentation en oxygène	Sauerstoffzufuhr
287	oxygen supply container	bouteille d'oxygène	Sauerstoffvorratsbehälter
288	oxygen supply device	dispositif d'alimentation en oxygène	Sauerstoffverteiler
289	oxygen supply tube	tuyau (tube) d'alimentation en oxygène	Sauerstoffzuführungsleitung
290	particle	particule	Partikel
291	particle filter	filtre à particules	Partikelfilter
292	particulate matter	particules	Partikeln, Fremdkörper
293	pendulum breathing	respiration pendulaire	Pendelatmung
294	pendulum type respiratory protective device	appareil de protection respiratoire type pendulaire	Atemschutzgerät mit Pendelatmung
295	penetration	pénétration	Eindringen
296	permanent linear deformation	déformation linéaire permanente	bleibende Längenänderung
297	permanently installed compressed air line system	réseau d'air comprimé	Druckluftnetz
298	permeability	perméance	Durchlässigkeit, Durchlassgrad
299	physical stress	contrainte physique	körperliche Belastung
300	physiological requirements	exigences physiologiques	physiologische Anforderungen
301	piece part	composant	Einzelteil
302	pipe lines	tuyauteries	Rohrleitungen
303	plug-in connection	raccord à emboîtement	Steckverbindung
304	positive pressure	surpression (pression positive)	Überdruck

Term number	ENGLISH	FRENCH	GERMAN
305	power assisted breathable air supply device	dispositif motorisé d'alimentation en air respirable	Motorbetriebene Atemluft-versorgungseinrichtung
306	powered filtering device	appareil filtrant à ventilation assistée	motorbetriebene Filtergerät, Gebläsefiltergerät
307	practical performance test	essai practique de performance	praktische Leistungsübung
308	pre-flushing	prérincage	Vorspülung
309	pre-flushing system	dispositif de prérincage	Vorspüleinrichtung
310	precision gauge	manomètre de précision	Präzisionsmanometer
311	prefilter	préfiltre	Vorfilter
312	pressure drop	perte de charge	Druckabfall
313	pressure gauge	manomètre	Manometer
314	pressure gauge shut-off valve	robinet d'arrêt du manomètre	Manometer-Absperrventil
315	pressure gauge tube	tube de manomètre	Manometerleitung
316	pressure indicator	indicateur de pression	Druckanzeiger
317	pressure line	canalisation (conduite) pression	Druckleitung
318	pressure range	plage de pression	Druckbereich
319	pressure reducer	détendeur	Druckminderer
320	pressure reducer safety valve	soupape de sureté	Sicherheitsventil des Druckminderers
1	pressure regulator	clapet de détendeur	Druckregler
322	propane burner	brûleur à propane	Propan-Brenner
323	propane cylinder	bouteille de propane	Propanflasche
324	protection class	classe de protection	Schutzklasse
325	protection factor	facteur de protection	Schutzfaktor
326	protective clothing	vêtement de protection	Schutzanzug
327	protective cover	couvercle de protection	Schutzdeckel
328	protective hood	cagoule de protection	Schutzhaube
329	prototype	échantillon d'essai	Versuchsmuster
330	purifier, absorber	épurateur, absorbeur	Reiniger, Absorber
331	quarter mask	quart de masque	Viertelmaske
332	reactive value	valeur réactive	Blindwert
333	ready for use	prêt à l'emploi	gebrauchsfertig
334	recovery time	période de récupération	Entlastungszeit
335	regeneration cartridge	cartouche de régénération	Regenerationzpatrone
336	reliable	fiable	zuverlässig
337	relief valve	soupape de surpression	Überdruckventil
338	requirement	exigence	Anforderung
339	resistance	résistance	Widerstand
340	resistance to temperature	résistance à la température	Temperaturbeständigkeit
341	respiratory equipment	appareils respiratoires	Atemgeräte
342	respiratory protective device	appareil de protection respiratoire	Atemschutzgerät
,3	respiratory protective equipment	appareils de protection respiratoire	Atemschutzausrüstung
344	retreat warning signal	signal de retraite	Rückzugssignal

Term number	ENGLISH	FRENCH	GERMAN
345	revert seal (reverted edge seal)	lèvre d'étanchéité	Dichtlippe
346	rotary type blower	ventilateur (à turbine)	Rotationsgebläse
347	rough usage	usage sévère	rauher Betrieb, rauhe Behandlung
348	saliva trap	boîte à salive	Speichelfänger
349	saturator	saturateur	Sättiger
350	scavenging device (for apparatus with a continuous flow of < 1.5 L/min)	dispositif de purge automatique (pour appareil à débit continu inférieur à 1.5 L/min)	Spülventil (für Gerät mit konstanter Dosierung von < 1.5 L/min)
351	screw filter	filtre à visser	Schraubfilter
352	screw threaded connector	raccord fileté	Schraubverbindung
353	sealing	joint	Dichtung
354	self-sealing (by the pressure)	fermeture automatique (par la pression)	selbstschliessend (mit dem Druck)
355	self-contained	autonome	frei tragbar
356	self-contained breathing apparatus	appareil de protection respiratoire isolant autonome	frei tragbares Atemschutzgerät
357	self-contained closed-circuit oxygen breathing apparatus, compressed oxygen type	appareil de protection respiratoire autonome à circuit fermé, à oxygène comprimé	Regenerationsgerät mit Drucksauerstoff, Sauerstoffschutzgerät
358	self-contained closed-circuit oxygen breathing apparatus, liquid oxygen type	appareil de protection respiratoire autonome à circuit fermé, à oxygène liquide	Regenerationsgerät mit flüssigem Sauerstoff
359	self-contained closed-circuit oxygen breathing apparatus, oxygen generating type	appareil de protection respiratoire autonome à circuit fermé, à génération d'oxygène	Regenerationsgerät mit chemisch gebundenem Sauerstoff
360	self-contained open-circuit breathing apparatus	appareil de protection respiratoire autonome à circuit ouvert	Behältergerät
361	self-contained open-circuit compressed air breathing apparatus	appareil de protection respiratoire autonome à circuit ouvert, à air comprimé	Behältergerät mit Druckluft, Pressluftatmer
362	self-extinguishing	auto-extinguible	selbstverlöschend
363	separator	séparateur	Abscheider
364	serial number	numéro de fabrication	Fabrikationsnummer
365	shroud (of an exhalation valve)	préchambre (d'un soupape expiratoire)	Vorkammer (eines Ausatemventils)
366	shut-off valve for pressure gauge tube	robinet d'arrêt pour tube de manomètre	Absperrventil für Manometerleitung
367	sinusoidal breathing machine	machine respiratoire à à caractéristique sinusoidal	künstliche Lunge mit sinusförmiger Arbeitsweise
368	smoke	fumée	Rauch
369	socket	douille de raccord	Tülle
370	solvent	solvant	Lösemittel
371	sound pressure level	niveau de pression acoustique	Schall(druck)pegel
372	spare part	pièce de rechange	Ersatzteil

Term number	ENGLISH	FRENCH	GERMAN
373	spear valve	soupape à bec de canard	Lippenventil
374	speech diaphragm	membrane phonique	Sprechmembran
375	speech transmission	transmission de la parole	Sprechübertragung
376	standard	norme	Norm
377	standard thread connection	raccord à filetage normalisé	Standardschraubverbindung
378	standard thread connection, female	raccord à filetage normal femelle	Standardschraubverbindung-Aussenteil
379	standard thread connection, male	raccord à filetage normal male	Standardschraubverbindung-Innenteil
380	standard work simulation test	essai normalisé	Normübung
381	static pressure	pression statique	statischer Druck
382	steel cylinder	bouteille en acier	Stahlflasche
383	storage	stockage	Lagerung
384	strap	sangle	Gurt
385	strap, carrying	sangle de portage	Tragegurt
386	strap, shoulder	bretelle	Schultergurt
387	strokes (on work machine)	tractions	Schläge (am Schlaggerät)
388	sub-assembly	sous-ensemble	Baugruppe
389	suit	vêtement	Anzug
390	supplementary air supply valve	robinet d'air additionel	Zuschlussventil
391	teeth bites	tenon (têton)	Beisszapfen
392	temperature test	essai en température	Temperaturprüfung
393	temple strap	bride temporale	Schläfenband
394	tensile load	effort de traction	Zugbeanspruchung
395	test aerosol	aérosol d'essai	Prüfaerosol
396	test concentration	concentration d'essai	Prüfkonzentration
397	test for tightness (tightness test)	essai d'étanchéité	Dichtprüfung
398	test gas	gaz d'essai	Prüfgas
399	testing	essai	Prüfung
400	testing authority (testing house, testing station)	autorité d'essai	Prüfstelle
401	test mark	marque d'essai	Prüfzeichen
402	test number	numéro d'essai	Prüfnummer
403	test period	partie d'essai	Prüfschnitt
404	test pressure	pression d'essai	Prüfdruck
405	test rig	dispositif d'essai	Prüfapparatur
406	test specification	procédure d'essai	Prüfvorschrift
407	test subject (in man tests)	subject d'essai	Versuchsperson
408	total inward leakage	fuite totale vers l'intérieur	Gesamtschlupf
409	trade mark	marque commerciale	Warenzeichen
410	training gallery	parcours d'essai	Übungsstrecke
411	treadmill	tapis roulant	Laufband
412	trouble-free	sans incident	Störungsfrei
413	twin breathing hose	double tuyau respiratoire	Doppelatemschlauch

Term number	ENGLISH	FRENCH	GERMAN
414	twin filter	double filtres (séparés), (paire de filtres)	Filterpaar
415	two-way breathing	respiration à circuit ouvert	Zweiwegatmung
416	type identifying mark	marque d'identification du type	Typschild
417	type identifying marking	marquage du type	Typkennzeichnung, Bauartkennzeichnung
418	unassisted fresh air hose breathing apparatus	appareil de protection respiratoire à l'air libre non assisté	Frischluft-Saugschlauchgerät
419	unencapsulated particle filter	filtre à particule (type non emboîté)	ungekapselter Partikelfilter
420	valve disc	disque de soupape	Ventilscheibe
421	valve housing	boîtier de soupape	Ventilgehäuse
422	valve leakage	fuite de soupape	Ventilschlupf
423	valve seat	siège de soupape	Ventilsitz
424	valve spindle	vis de soupape	Ventilspindel
425	valve spring	ressort de soupape	Ventilfeder
426	vapour	vapeur	Dampf
427	vibration test	essai de vibrations	Rütteltest
428	visor (panoramic)	oculaire panoramique	Vollsichtfenster
429	visor	oculaire	Sichtscheibe
430	volume	volume	Volumen
431	waist belt (belt)	ceinture	Leibgurt
432	warning device	avertisseur	Warneinrichtung
433	warning signal	signal avertisseur	Warnsignal
434	weight apparatus	machine à tractions	Schlaggerät
435	weight distribution (mass distribution)	répartition des masses	Gewichtsverteilung (Massenverteilung)
436	working pressure	pression de service	Arbeitsdruck

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Committees responsible for this Draft for Development

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British Agrochemicals Association
British Pest Control Association
Chemical Industries Association
Chief and Assistant Chief Fire Officers' Association
Department of Transport (Marine Directorate)
Electricity Supply Industry in England and Wales
Engineering Equipment and Materials Users' Association
Health and Safety Executive
Home Office
Industrial Safety (Protective Equipment) Manufacturers' Association
Institute of Occupational Medicine
Institution of Mechanical Engineers
Ministry of Defence
National Coal Board
National Radiological Protection Board
Safety Equipment Distributors' Association
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CEN/TC 79/SG 3 **N 168**

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DRAFT
prEN 136
December 1986

English version

RESPIRATORY PROTECTIVE DEVICES
FULL FACE MASKS
REQUIREMENTS, TESTING, MARKING

Atemschutzgeräte;

Vollmasken;
Anforderungen, Prüfung, Kennzeichnung

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

This document N 150 REV (Oct. 1986) was discussed during the meeting of CEN/TC 79/SG 3 in Vienna on Oct. 28, 1986. The decisions were incorporated into this document.

Preamble:

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 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 and Field of Application

This European Standard refers to full face masks for respiratory protective devices, except escape apparatus and diving apparatus. It specifies minimum requirements for full face masks for use as part of respiratory protective devices.

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

2 References

EN 132	Respiratory Protective Devices; Definitions
EN 133	Respiratory Protective Devices; Classification
EN 134	Respiratory Protective Devices; Nomenclature of components
EN 135	Respiratory Protective Devices; List of equivalent terms
EN 138	Respiratory Protective Devices; Fresh air hose breathing apparatus; Requirements, testing, marking
EN 139	Respiratory Protective Devices; Compressed air line breathing apparatus; Requirements, testing, marking
EN 148 Part 1	Respiratory Protective Devices; Threads for facepieces; Standard thread connection
EN 148 Part 2	Respiratory Protective Devices; Threads for facepieces; Centre thread connection

3 Definition and Description

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, when the head is moved and when the wearer is speaking. Air enters the full face mask through the facepiece 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 facepiece 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.

4 Requirements

4.1 Material

Exposed parts of the apparatus i.e., other than cylinders shall not be made of aluminium, magnesium, titanium or other alloys containing such proportions of these metals, as will on impact, give rise to frictional sparks capable of igniting flammable gas mixtures.

Test according to 5.1.

Where the speech diaphragm is likely to be exposed to the puncturing action of certain transuranium contaminants of high specific activity this has to be considered and a suitable material selected.

4.2 Cleaning and disinfecting

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

Testing according to clause 5.1

4.3 Speech diaphragm assembly

T1

Testing according to 5.1.

4.3.1 Where the facepiece is designed with a speech diaphragm it shall be protected against mechanical damage and shall withstand a differential pressure of 80 mbar[1)] (static pressure) with the positive pressure on the outside (ambient atmosphere).

4.3.2 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 is repeated 10 times in 10 s intervals. T2

How is force fixed to assy

4.4 Replaceable components

Unless integral with the full face mask the following components shall be replaceable:

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

Testing according to 5.1.

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1) 1 bar = 10^5 N/m^2 = 100 kPa

4.5 Practical performance test (2 subjects)

T3

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 in other parts of this standard. In addition to the tests described in this standard details of practical performance tests for breathing apparatus are given in the relevant European Standard. Where a full face mask is to be used for filtering devices testing has to be in accordance with 5.2.

Where in the opinion of the test station approval is not granted because practical performance tests show the apparatus has imperfections related to wearer's acceptance the test station shall provide full details of those parts of the practical performance tests which revealed these imperfections. This will enable other test stations to duplicate the tests and asses the results thereof.

4.6 Resistance to temperature

T4

After storing in accordance with 5.3 and return to room temperature the facepiece shall show no appreciable deformation. After the resistance to temperature test the facepiece has to be tested for inward leakage and has to meet the requirements of 4.7.

4.7 Inward leakage of facepiece (ten subjects)

A full face mask shall fit against the contours of the face so that when tested in accordance with 5.4 the inward leakage of the test contaminant shall not exceed an average value of 0.05 % of the inhaled air for any of the recommended ten test subjects in any of the test exercises. The measured inward leakage includes the exhalation valve leakage. A recommended procedure for measuring the contribution from leakage through an exhalation valve is given in Annex A. It should not exceed 0.01 %.

4.8 Compatibility to skin

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

4.9 Flammability

When tested in accordance with 5.5 the facepiece, shall prove to be "self-extinguishing".

When tested both before and after the flammability test in accordance with 5.5 the leakage shall not exceed that indicated by a change of pressure of 1 mbar in 1 minute.

4.10 Carbon dioxide content of the inhalation air

When tested in accordance with 5.6 the carbon dioxide content of the inhalation air (dead space) shall not exceed an average of 1.0 percent (by volume).

4.11 Head harness

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

Testing according to 5.2.

4.11.2 The head harness shall be adjustable and shall hold the full face mask firmly and comfortably in position.

Testing according to 5.2.

4.11.3 Each strap of the head harness shall withstand a pull of 150 N in direction of pulling when the full face mask is donned (10 s).

4.11.4 Each strap shall extend to no more than 100 % at a pull of 50 N. There should be no permanent linear deformation of more than 5 % when tested (50 N, 10 s).

4.12 Facepiece connector

Testing according to 5.1.

The connections between the facepiece and the apparatus may be achieved by a permanent or special type of connection or by a standard thread connection. If a standard thread connection is used e. g. for a single filter mask then the relevant requirements of EN 148 should be satisfied.

A facepiece shall not have more than one standard thread connection.

If any other screw thread is used it shall not be possible to connect it to the standard thread.

4.12.1 Standard thread connection

The standard thread connection in accordance with EN 148 part 1 may be used as the full face mask connection for respiratory protective devices, except closed-circuit breathing apparatus and positive pressure respiratory protective devices.

4.12.2 Centre thread connection

The centre thread connection in accordance with EN 148 part 2 may be used as the full face mask connection for closed-circuit breathing apparatus.

4.12.3 The connection between the faceblank and the connector shall be sufficiently robust to withstand axially a tensile force of 500 N when tested in accordance with 5.7.

4.12.4 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.

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

4.13 Eyepiece(s) and visor(s)

4.13.1 Visors and anti-mist discs designed to serve as visors shal be attached in a reliable and gastight manner to the face-blank.
Testing according to 5.1.

4.13.2 Visors shall not distort vision as determined in man tests.
Testing according to 5.2.

4.13.3 The field of vision has to be tested in accordance with 5.8 and shall meet the following requirements:

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 th the effective field of vision shall be not less than 70 %, and the overlapped field of vision shall be not less than 20 %.

4.13.4 The manufacturer shall provide means to reduce misting of eyepiece(s) or visor(s) so that vision is not interfered w when the apparatus is tested in the practical performance tests including unfavourable climatic conditions.

Where anti-fogging compounds are used as intended or speci fied by the manufacturer, they shall be compatible to eyes skin and the components of the facepiece.

4.13.5 The impact resistance of the eyepiece(s) or visor shall be tested in accordance with 5.9*). At the end of the test the facepiece shall not be damaged in any way that may make it ineffective or cause injury to the wearer. The effectiveness is tested in accordance with 5.9 by comparing the tightness of the full face mask before and after the test. When tested for leak tightness, the facepiece shall not indicate increased leakage after the test for impact resistance of the eyepiece or visor.

4.14 Inhalation and exhalation valves

Valve assemblies shall be such that they can be readily maintained and correctly replaced.

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

Testing according to 5.1.

4.14.1 Inhalation valve(s)

4.14.1.1 A full face mask except one with a centre thread connection should preferably be provided with one or more inhalation valve(s). If a standard thread connection 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 integral inhalation valve, if there is no valve in the filter.

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*) National legislation may (and does in the UK) sometimes require higher impact resistance than that specified in clause 5.9

4.14.1.2 Inhalation valve(s) shall function properly in all orientations.

4.14.2 Exhalation valve(s)

4.14.2.1 Exhalation valve(s) shall function properly in all orientations.

4.14.2.2 A full face mask with a standard thread connection shall be designed to meet the following requirements:

It shall have at least one exhalation valve or other appropriate means to allow the escape of exhaled air and, where applicable, any excess air delivered by the air supply.

4.14.2.3 The exhalation valve(s) shall be protected against dirt and mechanical damage and shall be shrouded or shall include any other device that may be necessary to comply with 4.7.

4.14.2.4 The exhalation valve(s) shall continue to operate correctly after (a) a continuous exhalation flow of 300 l/min and (b) negative pressure (static) in the mask of 80 mbar (1 min; for both tests).

4.14.3 When the exhalation valve housing is attached to the face-blank it shall withstand axially a tensile force of 150 N applied for 10 s. The test is repeated 10 times in 10 s intervals.

4.15 Breathing resistance

4.15.1 When tested in accordance with 5.10 the breathing resistance of a full face mask (except for positive pressure respiratory protective devices):

4.15.1.1 All connections other than that in 4.15.1.2 shall not exceed 2.5 mbar for inhalation and 3.0 mbar for exhalation with breathing machine (25 x 2 l/min) or 160 l/min (continuous flow).

The inhalation resistance shall not exceed 0.5 mbar at 30 l/min continuous flow and 1.5 mbar at 95 l /min continuous flow.

4.15.1.2 All connections with centre thread and without valve(s) shall not exceed 0.6 mbar for inhalation or exhalation.

5 Testing

NO OF SAMPLES*	TEST(S) REQUIRED	PRE-CONDITIONING (YES/NO)	CLAUSES
1 all samples	VISUAL INSPECTION	NO	4.1/4.4/ 4.13.1/ 5.1
5	CLEANING AND DISINFECTION FOR TOTAL INWARD LEAKAGE TESTS	AS RECOMMENDED BY MANUFACTURER	4.2/5.4
3	SPEECH DIAPHRAGM (i) DIFFERENTIAL PRESSURE TEST (ii) AXIAL PULL TEST	NO	4.3.1/ 4.3.2
3	HEAD HARNESS TESTS (i) PULL TEST (ii) ELONGATION (iii) PERMANENT LINEAR DEFORMATION	NO	4.11.3/ 4.11.4
3	FACEPIECE CONNECTOR PULL TEST	NO	4.14.3
3	EXHALATION VALVE HOUSING PULL TEST	NO	4.14.3
5	FACEPIECES EXHALATION VALVES PERFORMANCE TESTS (i) CONTINUOUS FLOW (ii) NEG. PRESSURE OPTIONAL LEAKAGE TEST	NO 2 CONDITIONED 3 AS RECEIVED THEN USE FOR LEAKAGE TEST	4.14.2 4.14.2.4 4.7/ ANNEX A
5 FOR IMPACT TESTS	EYEPIECE/VISOR (i) FIELD OF VISION 1 sample (ii) IMPACT RESISTANCE 5 samples (iii) DISTORTION 2 samples	NO - EXCEPT TO CHECK FOR DISTORTION?**	4.13.3/ 5.8 4.13.5/ 5.9
3	FLAMMABILITY NOTE - CHECK LEAKAGE AFTER TEST	2 CONDITIONED** 1 AS RECEIVED	4.9/5.5
1	CARBON DIOXIDE CONTENT	NO	4.10/5.6
3	BREATHING RESISTANCE	NO	4.15/5.10
5	INWARD LEAKAGE	2 CONDITIONED** 3 AS RECEIVED	5.4
2	PRACTICAL PERFORMANCE TEST	NO	4.5/5.2

*Most samples are used for more than one test
**Conditioning/resistance to temperature - clauses 4.6/5.3

5.1 Visual inspection

The visual inspection is done where appropriate by the test station prior to laboratory or practical performance tests.

5.2 Practical performance test

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

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

a) harness comfort
b) security of fastenings and couplings
c) accessibility of controls (if fitted)
d) clarity of vision on the visor of the facepiece (if fitted)
e) speech transmission
f) any other comments reported by the wearer on request

* [illegible] trained and [illegible]

(OK)

see also 5.4.1.1 2nd paragraph

Walking test

The subjects wearing normal working clothes wearing the apparatus fitted with a filter simulator (figure 3) walk at a regular rate of 6 km/h on a level course. The test is continuous, without removal of the apparatus, for a period of 10 minutes.

Work simulation test

The apparatus fitted with a filter simulator (figure 3) is tested under conditions which can be expected during normal use. During this test the following activities shall be done in simulation of the practical use of the apparatus, the test shall be completed within a total working time of 20 minutes.

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

a) walking on the level with headroom of 1,1 to 1,5 m for 5 minutes.
b) crawling on the level with headroom of less than 0,75 m for 5 minutes.
c) filling a small basket (see figure 1 , approximate volume = 8 l) with "rubber chippings" 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 rubber chippings may be returned.

The subject stoops or kneels as he wishes and fills the basket with rubber chippings. He then lifts the basket and empties the contents back into the hopper. This is repeated 15 to 20 times in 10 minutes.

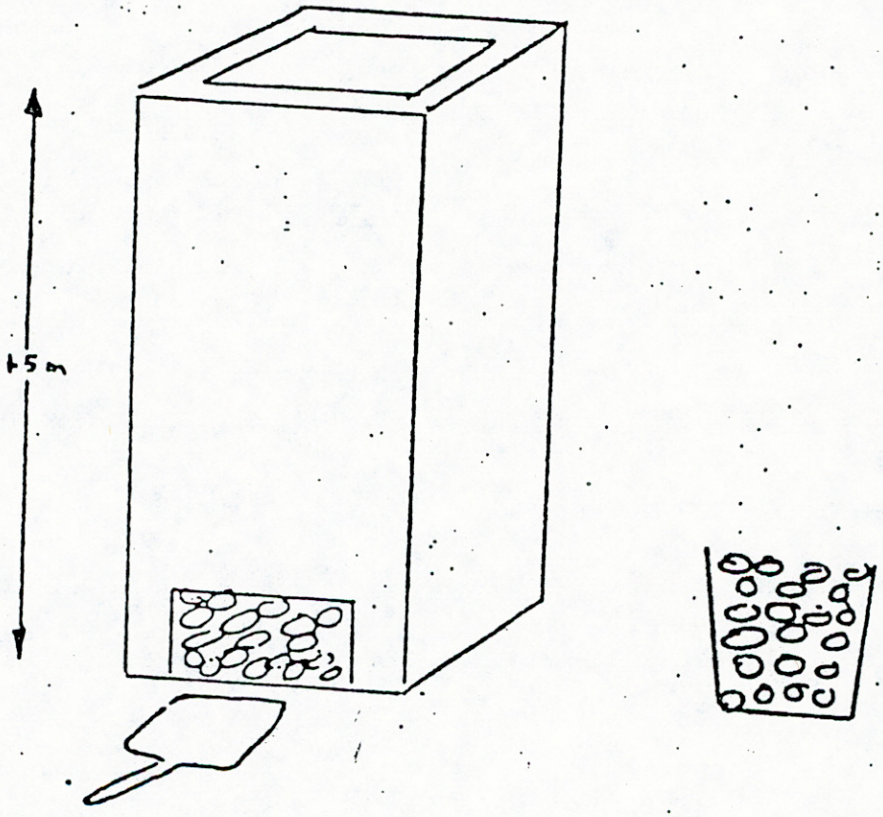


Figure 1: Basket for rubber chippings

5.3 Resistance to temperature

Two full face masks shall be exposed

a) for 72 hours to a dry atmosphere of 70 °C
b) for 72 hours to an atmosphere of 70 °C at 95 - 100 % relative humidity, and
c) for 24 hours to a temperature of -30 °C

5.4 Inward leakage of facepiece

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 NaCl and SF_6 methods are equally acceptable options.

The inward leakage is tested with 5 facepieces, two of them already tested for resistance to temperature in accordance with 5.3.

5.4.1 General test procedure

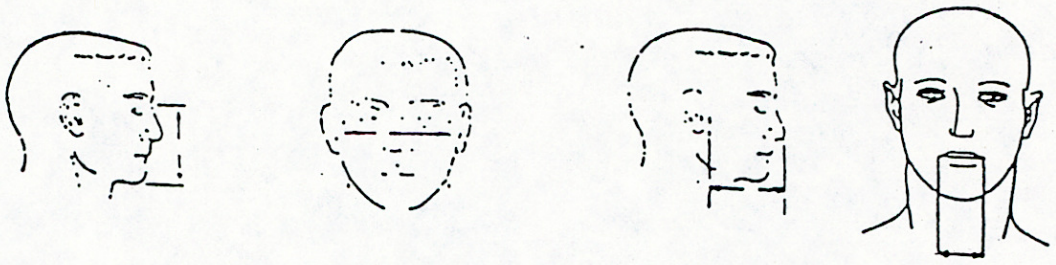
5.4.1.1 Inward leakage

Prior to the test there is 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.

Ten clean shaven persons (without beard or sideburns) are selected covering the spectrum of facial characteristics of the later on 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 are not to be used for testing facepieces.

In the test report the faces of the ten test subjects shall be described (for information only) by the four following facial dimensions (in mm):



length of face (nasion-menton) | width of face (bizygomatic diameter) | depth of face | width of mouth

Figure 2: Facial dimensions

If more than one size of facepiece is manufactured the test subjects are supplied with the appropriate size.

5.4.1.2 Test equipment

5.4.1.2.1 Test chamber

This should be made from transparent material and have a minimum cross-sectional dimension of 700 mm. It should be supported with adequate clearance above the head of the subject and extend down to the surface of the treadmill. The test atmosphere enters the top of the chamber through a flow distributor and is directed downwards over the head of the test subject at a flow rate of between 0.12 and 0.2 m/s. This flow rate should be measured close to the subject's head. In addition the flow rate should not fall below 0.1 m/s inside the effective working volume (0.1 m from the chamber wall and above a height of 0.75 m).

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

5.4.1.2.2 Treadmill

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

5.4.1.2.3 Canister simulator

If the facepiece is to be used with a filter canister having a standard thread, a device is required to simulate the maximum weight and resistance of canisters permitted for that type of facepiece, see fig. 3. This simulator must be connected to a clean air supply by an ultra-light weight flexible hose. If the facepiece uses a special connection the clean air supply must be attached to the filter or equipment normally used with the facepiece. It is important that the attachment of the clean air hose to the facepiece does not affect the fit of the facepiece and if necessary the hose must be supported.

5.4.1.3 Test procedure

The test subjects are asked to read the manufacturers fitting instructions and if necessary are shown how to fit the facepiece correctly by the test supervisor, in accordance with the fitting instructions.

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 will be repeated having allowed the system to re-settle.

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

After fitting the facepiece each test subject is asked "Does the mask fit?". If the answer is "Yes", continue the test. If the answer is "NO", take the test subject off the panel and report the fact.

Ensure the test atmosphere is OFF.

1. Place the test subject in the enclosure. Connect up the sampling probe. Have the test subject walk at 6 km/h for 2 minutes. Measure the test agent concentration inside the facepiece to establish the background level.

2. When a stable reading is obtained

3. Turn the test atmosphere ON

4. The subject continues to walk for a further 2 minutes or until the test atmosphere has stabilised.

5. Whilst still walking the subject performs the following exercises:

   a) walking without head movement or talking for 2 minutes

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

   c) moving the head up and down (approx. 15 times), as if inspecting the roof and floor for 2 minutes.

   d) reciting the alphabet or an agreed phrase) out loud as if communicating with a colleague for 2 minutes.

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

6. Record

   a) chamber concentration
   b) the leakage over each exercise period

7. Turn off the test atmosphere and when the test agent has cleared from the chamber remove the subject.

After each test the full face mask shall be cleaned, disinfected and dried and be used for the next inward leakage test.

5.4.2 Sulfur hexafluoride (SF_6)-method

5.4.2.1 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 SF_6.

The air inside the facepiece is sampled and analysed. The sample is extracted by punching a hole in the faceblank and inserting a probe through which the sample is drawn.

5.4.2.2 Test equipment (see Fig. 4, Fig. 5, Fig. 6)

5.4.2.2.1 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 % dependant on the test challenge atmosphere. It is recommended to use a test atmosphere between 0.1 and 1 % by vol.

5.4.2.2.2 Detection

The test atmosphere shall be analysed for SF_6 (continuously) by means of a suitable analyser (e.g., based on thermal conductivity or infrared spectroscopy). The probe for sampling the test atmosphere must not be positioned next to the exhalation valve. The SF_6 concentration inside the mask is 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 (approx. 5 mm, in the center of the facepiece), being a measure of the inward leakage.

The test is performed at ambient temperature and humidity.

5.4.2.2.3 Sampling

In order to prepare the full face mask for the test the faceblank or visor and the inner mask (if available) have to be perforated. A thin tube, as short as possible, leading into the inner mask is connected in a leak tight manner to the analysing instrument. The sampling rate should be constant and in the range between 0.3 and 1.5 l/min.

5.4.2.3 Calculation of the penetration

- - - - Fig 27 - - -

$$P\ (\%) = \frac{C2}{C1} \cdot 100$$

C1 ..... challenge concentration
C2 ..... measured mean concentration

Measurement C2 is taken via an integrating recorder.

5.4.3 Sodium chloride (NaCl)-method

5.4.3.1 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 sodium chloride aerosol. The air inside the facepiece is sampled and analysed during the inhalation phase of the respiratory cycle to determine the sodium chloride content. The sample is extracted by punching a hole in the faceblank and inner mask if fitted 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.

5.4.3.2 Test equipment

5.4.3.2.1 Aerosol generator

The sodium chloride aerosol is generated from a 2 % solution of reagent grade sodium chloride in distilled water. A single large Collison atomiser of the type described is used (see figure 7). This requires an air flow rate of 100 l/min at a pressure of 7 bar. The atomiser and its housing are 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.

5.4.3.2.2 Test agent

The mean sodium chloride concentration within the enclosure shall be (8 ± 4) mg/m³ and the variation throughout the effective working volume shall not be more than 10 %. The particle size distribution shall be 0.02 µm to 2 µm equivalent aerodynamic diamter with a mass median diameter of 0.6 µm.

5.4.3.2.3 Flame photometer

A flame photometer shall be used to measure the concentration of sodium chloride inside the facepiece. A suitable instrument for this purpose must have the following essential performance characteristics:

1. It should be a flame photometer specifically designed for the direct analysis of sodium chloride aerosol.

2. It should be capable of measuring concentrations of sodium chloride aerosol between 15 mg/m³ and 0.5 ng/m³.

3. The total aerosol sample required by the photometer should not be greater than 15 l/min.

4. The response time of the photometer, excluding the sampling system, should not be greater than 500 ms.

5. 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.

5.4.3.2.4 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 is fed to the photometer. The essential elements of such a system are:

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

2. A pressure sensor which is capable of detecting a minimum pressure change of approx. 0.05 mbar and which can be connected to a probe inserted in the mask cavity. The sensor must have an adjustable threshold and be capable of differential signalling when the threshold is crossed in either direction. The sensor must work reliably when subjected to the accelerations produced by the head movements of the subject.

3. An interfacing system to actuate the valve in response to a signal from the pressure sensor.

4. A timing device to record the proportion of the total respiratory cycle during which sampling took place.

Figure 8 shows a schematic diagram of such a sampling system.

5.4.3.2.5 Sampling probe

The probe consists of a length of 1 mm bore hypodermic tube fitted securely in an airtight manner to the facepiece as near as possible to the centre line of the mask and extending through the inner mask if fitted. A plastic ball of approximately 20 mm diameter with 8 holes each of 1.5 mm diameter and spaced equidistant around the circumference of the ball is fitted onto the hypodermic tube. The probe is adjusted so that the ball just touches the wearer's lips.

5.4.3.2.6 Sample pump

If no pump is incorporated into the photometer an adjustable flow pump is used to withdraw an air sample from the facepiece under test. This pump is so adjusted as to withdraw a constant flow of 1 l/min from the sample probe.

5.4.3.2.7 Sampling of chamber concentration

The 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 chamber concentration using a separate sampling system may be made at 5(e). However, time will then be required to allow the photometer to return to a clean background.

5.4.3.2.8 Pressure detection probe

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

5.4.3.3 Calculation of penetration

The leakage is measured over the last 100 s of each of the exercise periods to avoid carry over of result from one exercise to the other.

$$P\ (\%) = \frac{C2}{C1} \cdot \left[\frac{t_{IN} + t_{EX}}{t_{IN}}\right] \cdot 100$$

C1 ..... challenge concentration
C2 ..... measured mean concentration
t_{IN} ..... total duration of inhalation
t_{EX} ..... total duration of exhalation

Measurement C2 is taken via an integrating recorder.

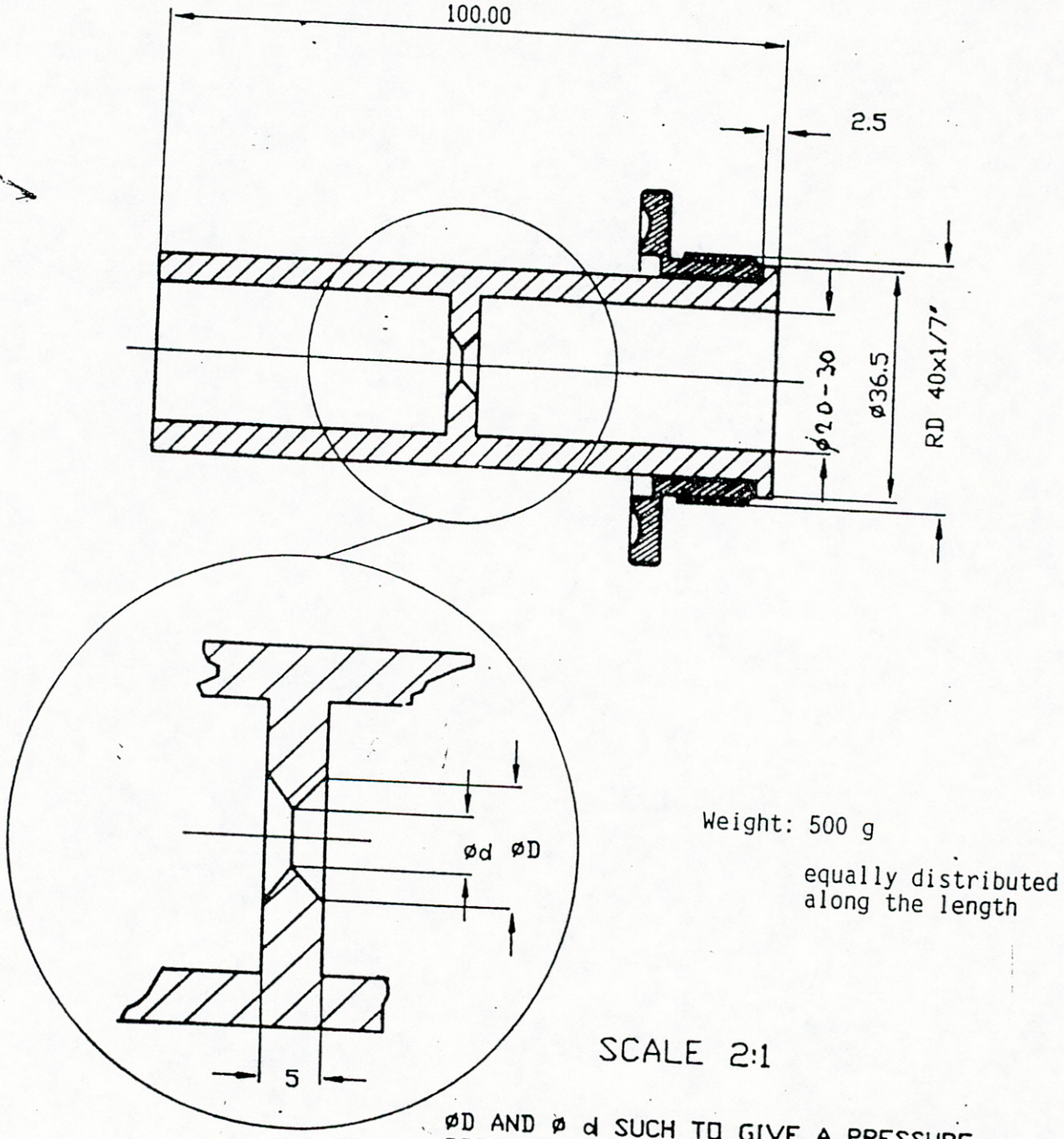


Figure 3 : Filter simulator for standard thread filters/facepieces

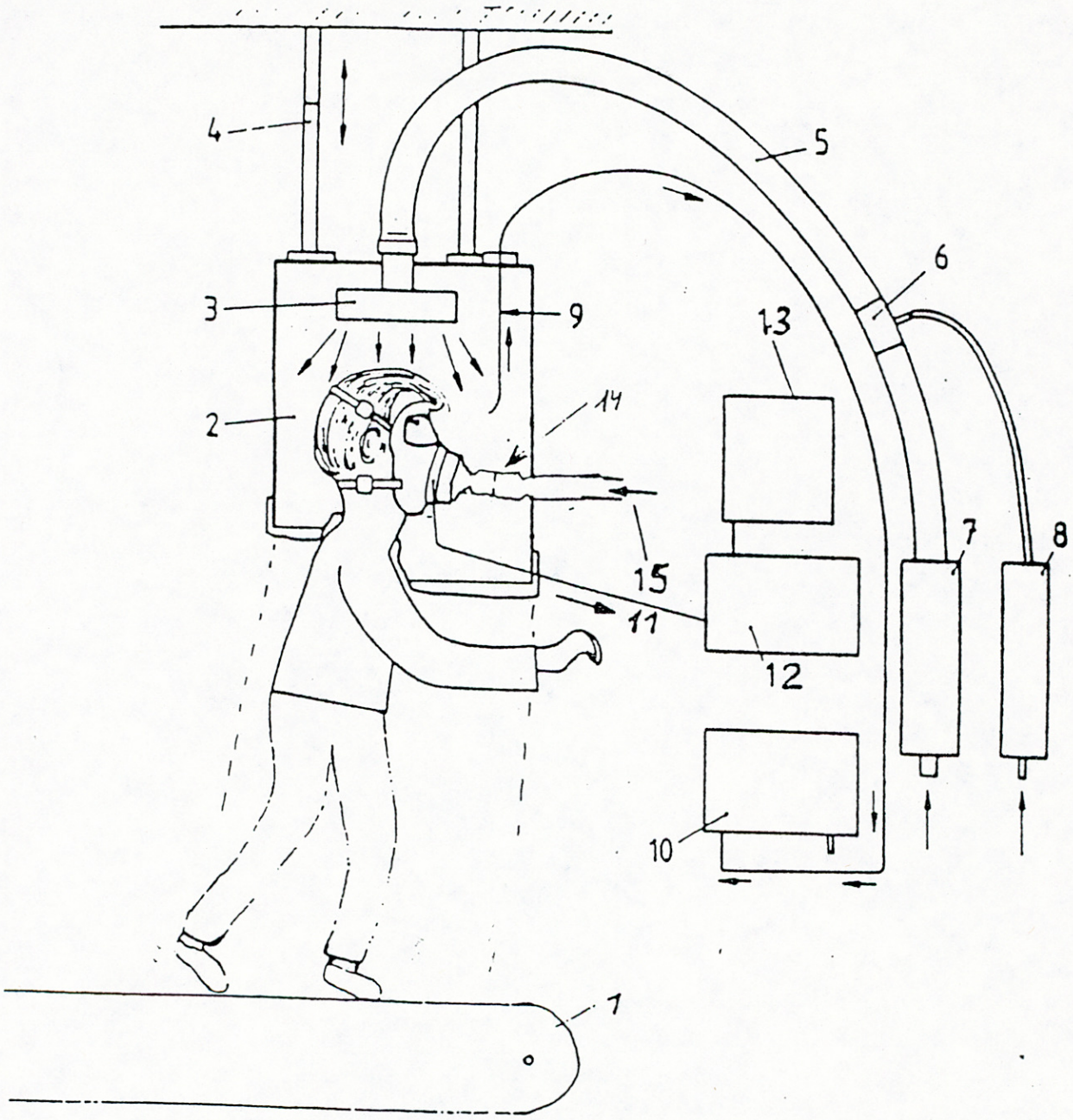


Figure 4: Scheme of the SF_6-test rig for inward leakage

1 treadmill
2 test hood/chamber
3 flow distributor
4 suspension
5 test agent supply hose
6 mixing point air/SF_6
7 flow meter for air with superposed control device
8 flow meter for SF_6 (100 % by volume) with superposed control valve
9 test atmosphere sampling probe
10 measuring instrument for test agent
11 sampling tube for the inhaled gas concentration
12 measuring instrument for inhaled gas concentration
13 recorder
14 canister simulator
15 breathable air

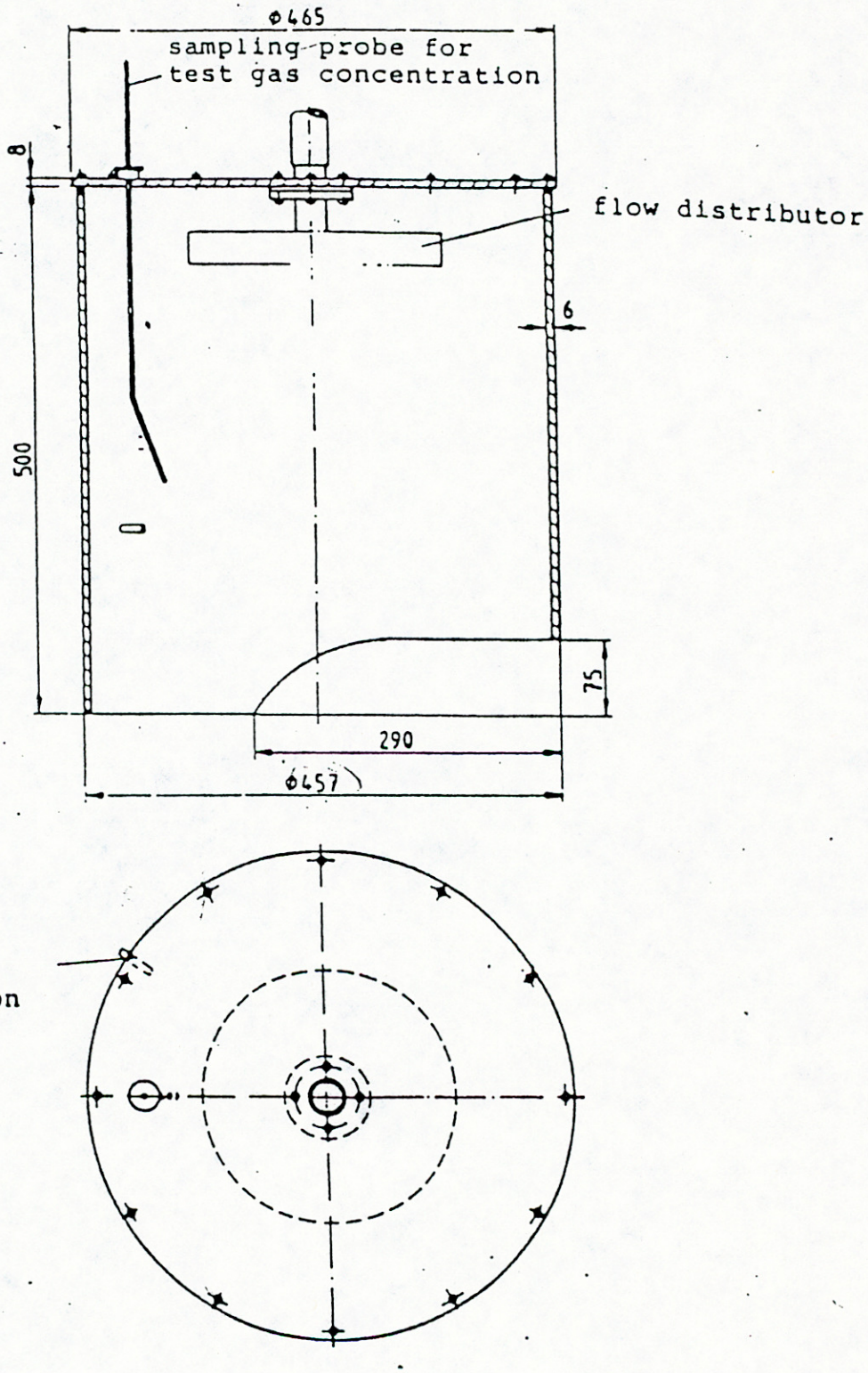
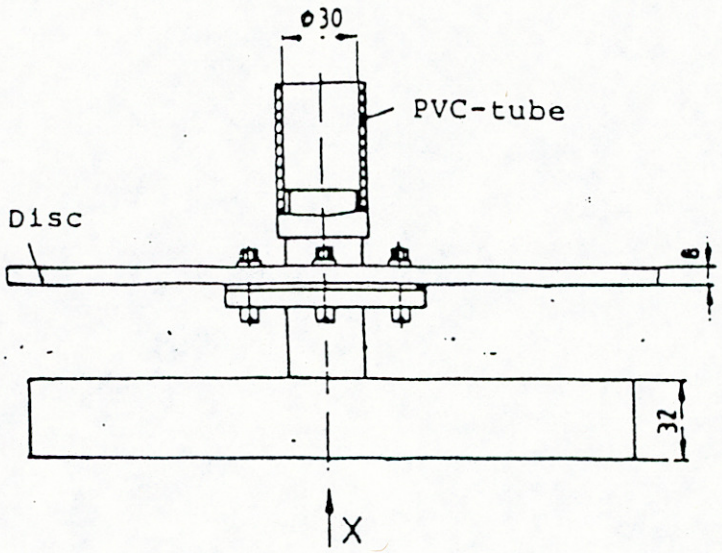
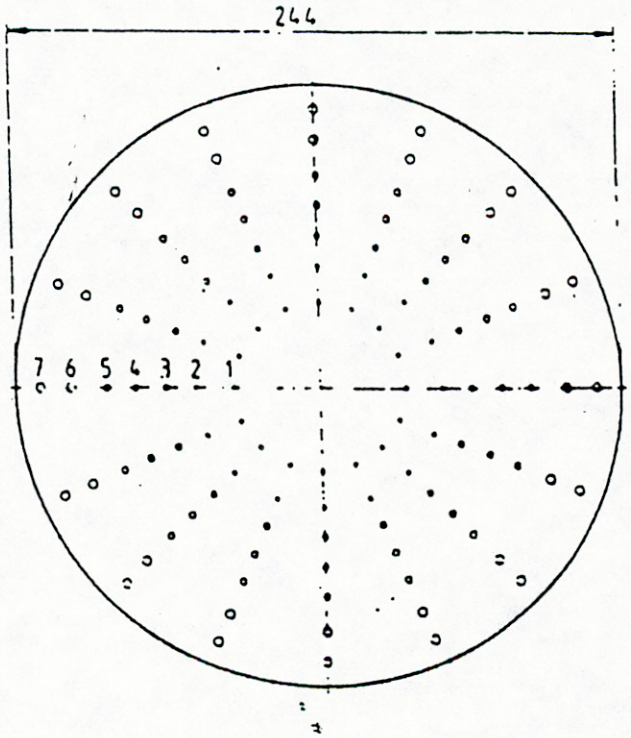


Figure 5: Typical SF_6-test hood

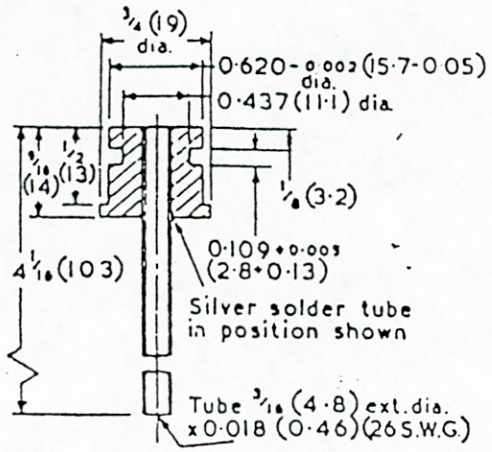


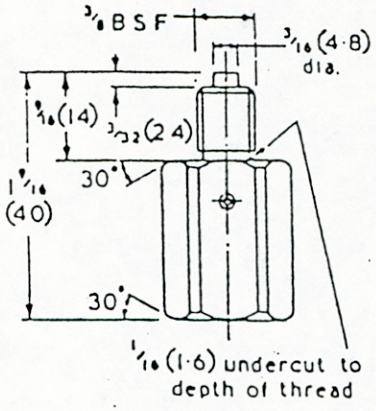
view X

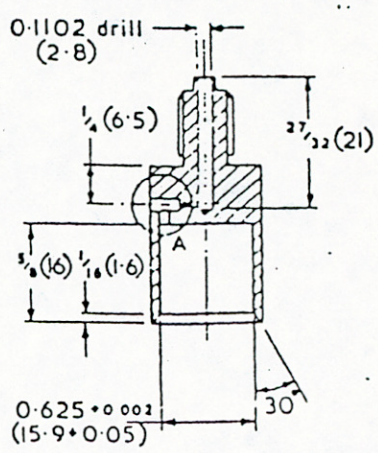


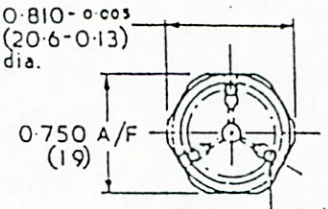
diameter of holes	
1	1,5 mm
2	1,5 mm
3	1,5 mm
4	2,0 mm
5	2,0 mm
6	2,5 mm
7	2,5 mm

Figure 6: Typical flow distributor







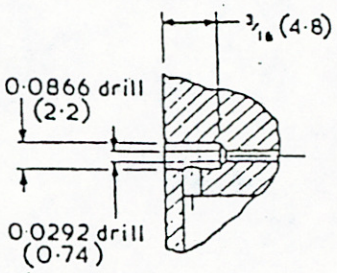


3 - holes 1/16 (1·6) dia. drill equally spaced on a 0·562 (14·27) P.C.D.

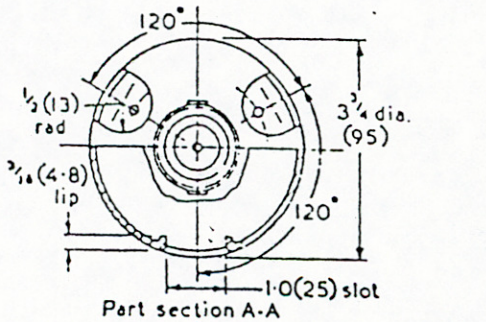
NOTE. All burrs and sharp edges to be removed

All dimensions are in inches (mm in brackets)

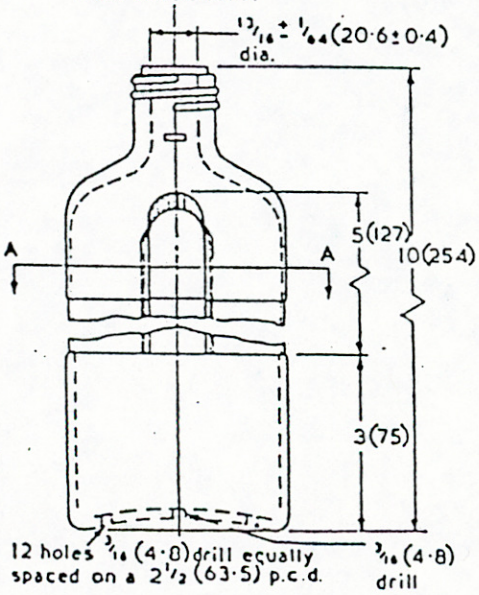
Material: stainless steel

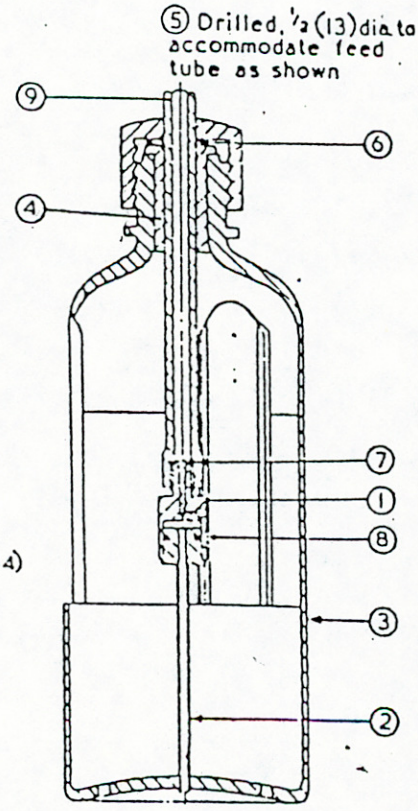


View encircled at A
Scale: 2:1

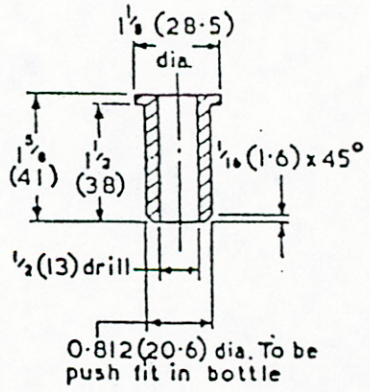


Part section A-A





Assembly of atomizer
All dimensions are in inches (mm in brackets)



ITEM LIST

Item	Name	No. off	Remarks
—	Assembly of atomizer	1	
1	Nozzle	1	
2	Feed tube, salt solution	1	
3	Bottle, polythene	1	Modified
4	Sleeve	1	
5	Screw cap for bottle	1	Modified
6	Washer 1 x 1/2 x 1/8 (25 x 13 x 3·2)	1	Hard rubber
7	Washer 3/8 x 3/16 x 3/32 (9·5 x 4·8 x 2·4)	1	Hard rubber
8	'O' seal O.S.9	1	To BS 1806
9	Air tube 1/2 (13) o.d., 1/4 (6·5) i.d.	As read.	Stainless steel

Figure 7: Assembly of atomiser

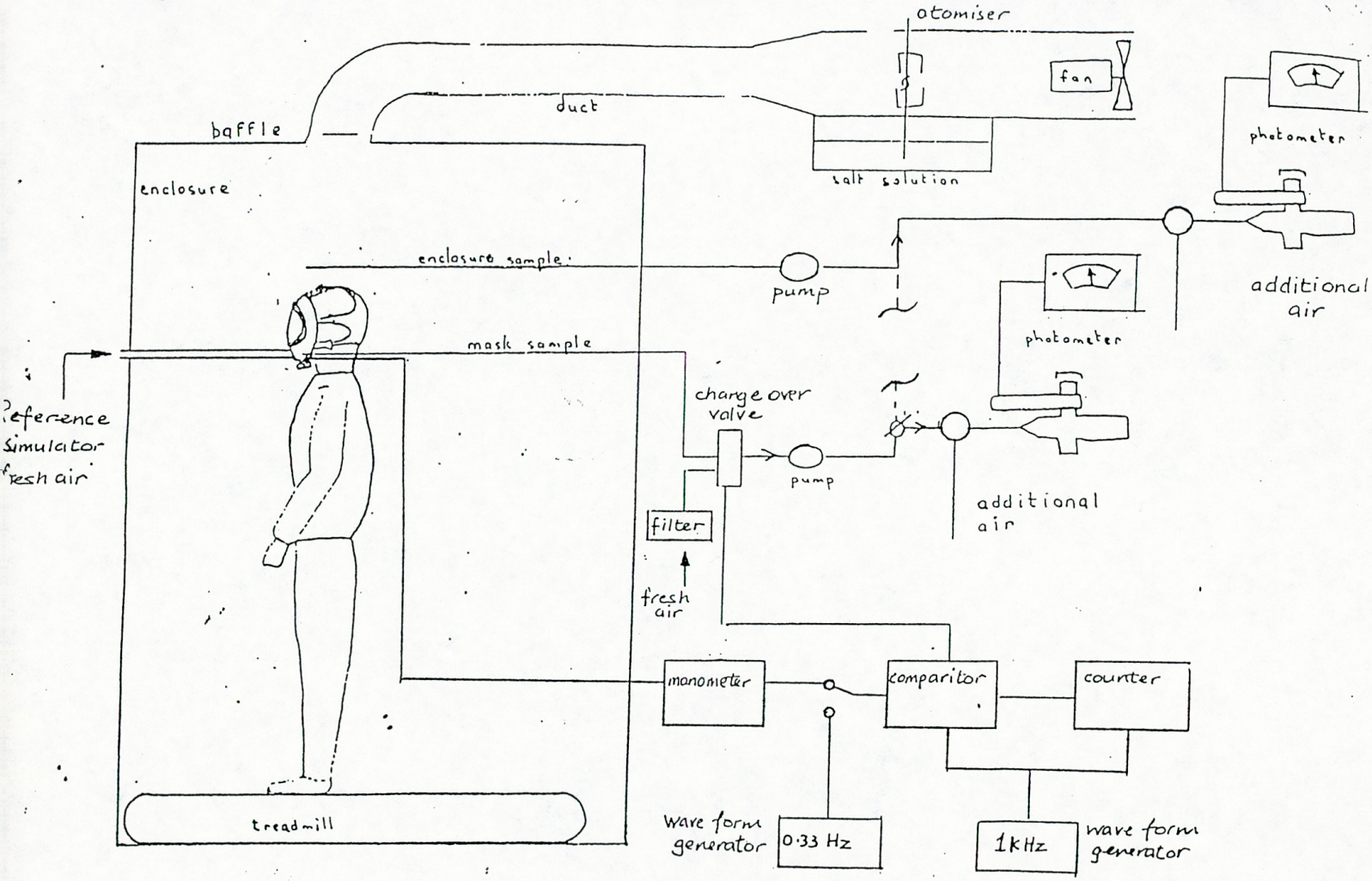


Figure 8 Apparatus used in the determination of inward leakage using sodium chloride

5.5 Flammability

The facepiece shall be tested for flammability for a short period with a test rig as shown on fig. 9 and fig. 10 . This test rig consists mainly of a propane storage tank with control device and fine pressure gauge, flash back arresters, 6 propane burners being adjustable in height, and with 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.

Fully open the propane control valve on each of the six burners. Initially close the air control valves on each of the six burners. Adjust the propane cylinder output regulator to a pressure* such that a flowmeter in the main propane supply line indicates a total flow to all six burners of 21 $\pm$ 0.5 litres/minute propane.

The temperature of the flame at a height of 250 mm above the burner tips and in the centre of the triangle formed by the burners, shall be (950 $\pm$ 50) °C.

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

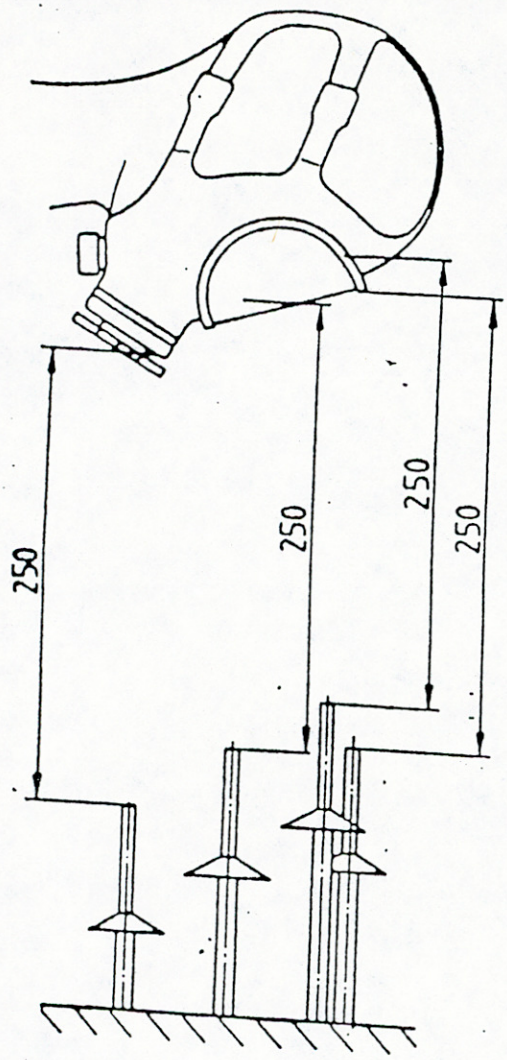
* Note

Dependent on the gas jet size in the TEKLU burner, the pressure regulator will need to be adjusted in the range 0.3 - 1.25 bar.

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

For comparing the tightness of the full face mask before and after the flammability test the same dummy head (Sheffield-head, metallic head etc.) is used and a pressure of - 10 mbar is created in the cavity of the mask.

(for editorial reasons following page is page 35)



Detail: Top view

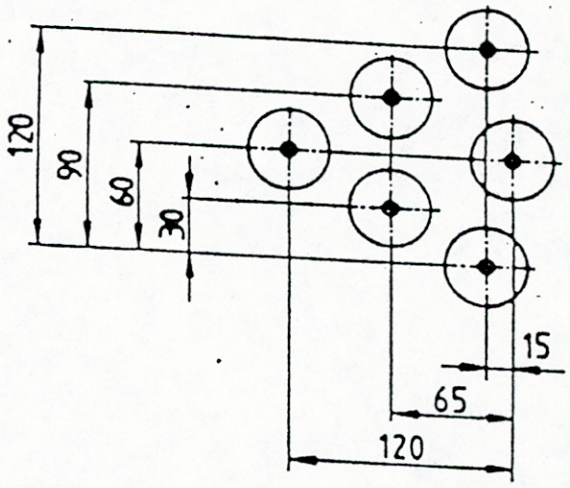


Figure 9 : Arrangement of the six propane burners

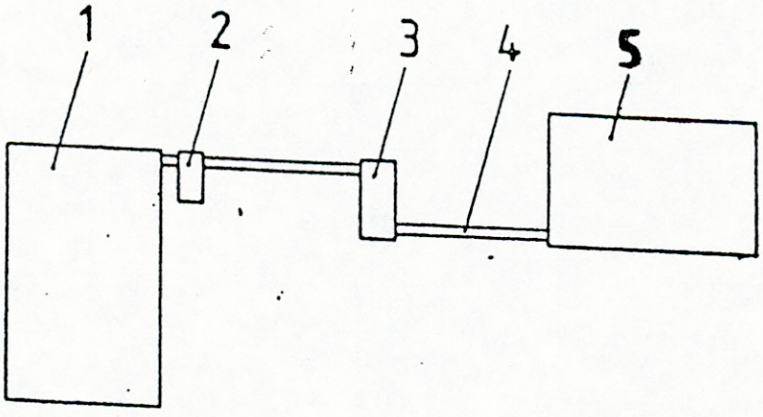


Figure 10: Scheme of a test rig for flammability of a full face mask

1 Propane storage tank
2 Fine pressure gauge and control device
3 Flash back arrester
4 Connecting hoses (of same length) leading to the 6 propane burners
5 Propane burners

5.6 Carbon dioxide content of the inhalation air

For this test the facepiece shall be fitted securely in a leak-tight manner but without deformation (see fig. 11) on a dummy head (type Sheffield).

Air shall be supplied to it from a 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 12.

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

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

The apparatus subjects the full face mask to a respiration cycle by the breathing machine, the respiratory air remaining in a circuit.

The carbon dioxide shall be of a value as specified in addition to the residual CO_2 passing through the CO_2-absorber when measured on a dry basis.

The CO_2 is fed into the breathing machine via a control valve, a flowmeter, a compensating bag and two non-return valves.

Immediately before the solenoid valve a small quantity of exhaled air is continuously withdrawn through a sampling line and then fed into the exhaled air via a CO_2 analyser.

5.7 Facepiece connector

Test time is 10 s. The facepiece is 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 is 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.

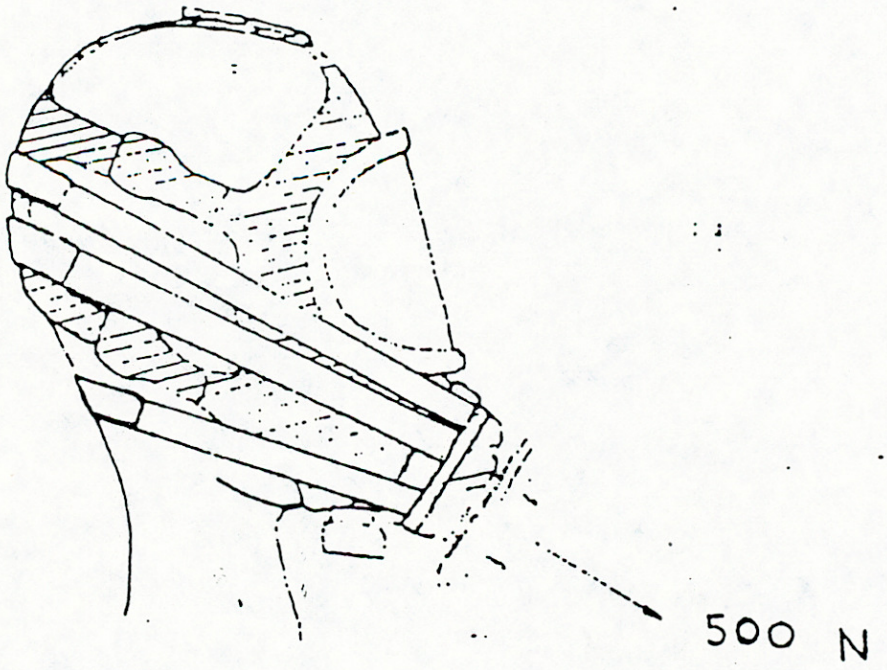


Figure 13 : Test Arrangement for Tensile Force

To measure the CO_2 content of the inhaled air, an equivalent amount of the stroke volume of the breathing machine/inhalation is drawn off continuously at the marked place by an auxiliary lung during the inhalation phase and fed to a CO_2 analyser. The total dead space of the gas path (excluding the breathing machine) of the test installation should not exceed 2000 ml.

The carbon dioxide content of the inspired air shall b measured and recorded continuously.

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

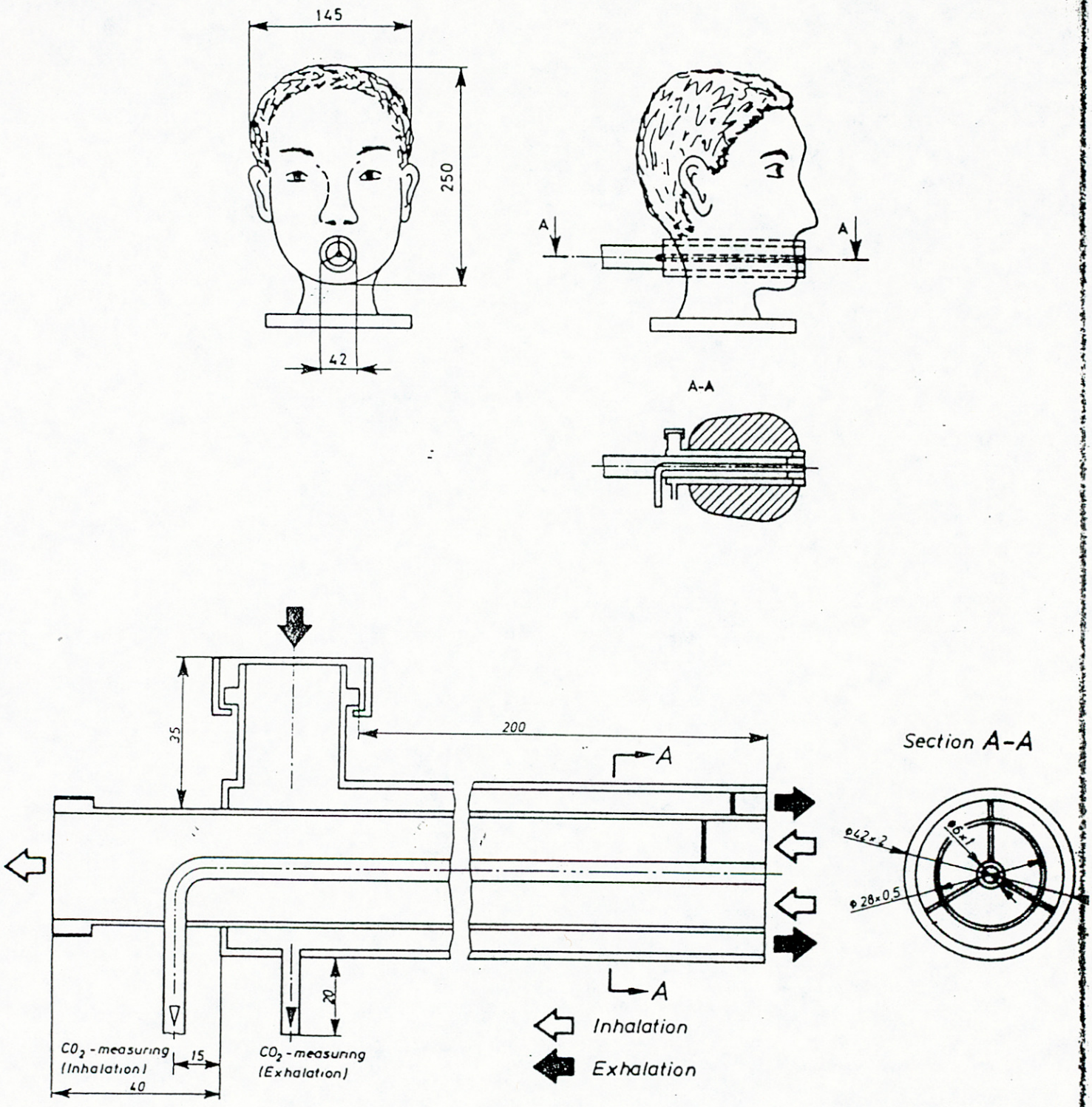


Figure 11: Dummy head (Sheffield head) for carbon dioxide content test of the inhalation air (dead space) for a full face mask

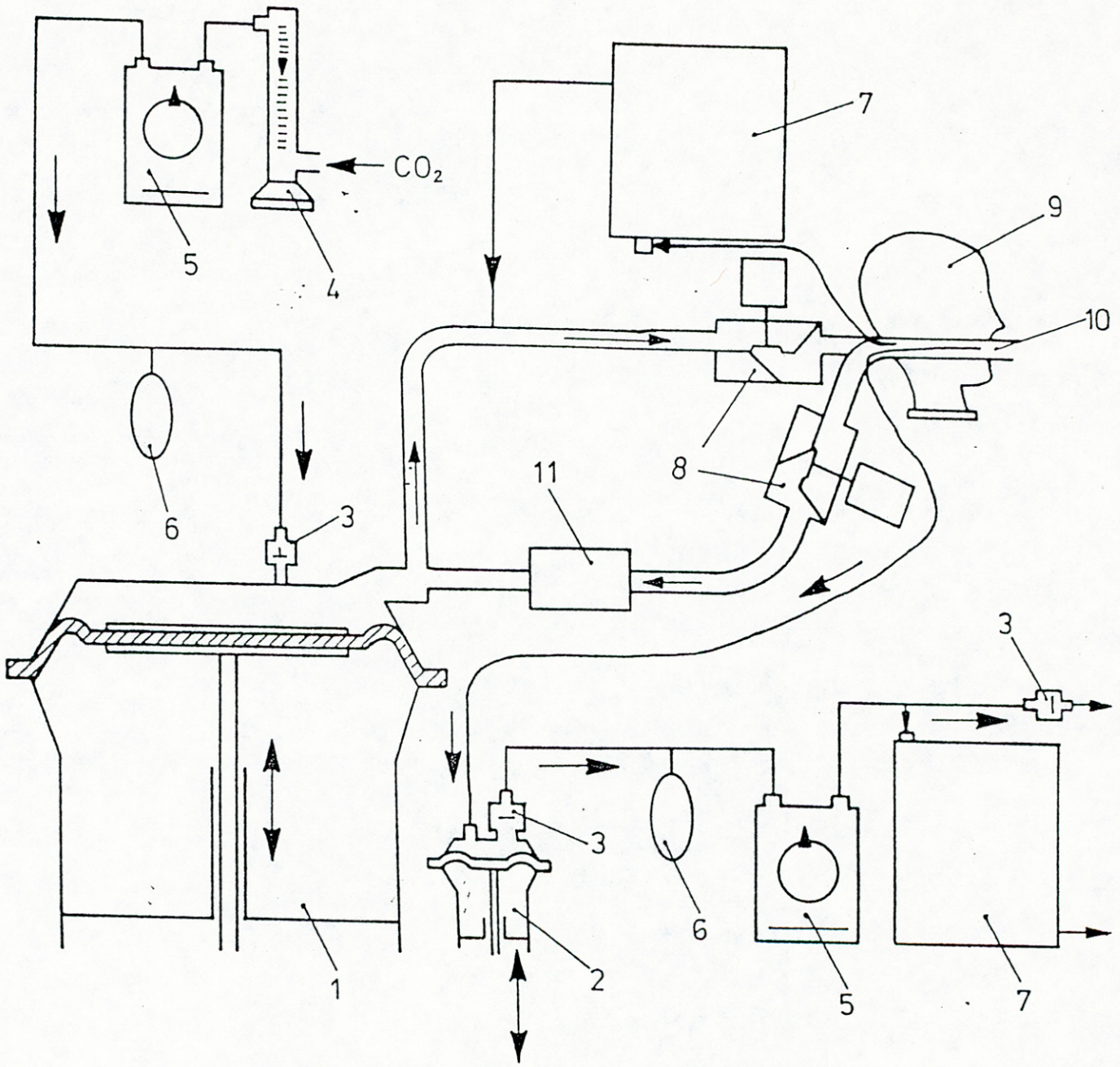


Figure 12: Scheme of test rig for dead space of facepiece

1 Breathing machine
2 Auxiliary lung
3 Non-return valve
4 Flow meter
5 Gas meter
6 Compensator
7 Carbon dioxide analyser
8 Solenoid valves
9 Dummy head
10 Sampling tube for inhalation air (see figure 16)
11 Carbon dioxide absorber

5.8 Field of vision

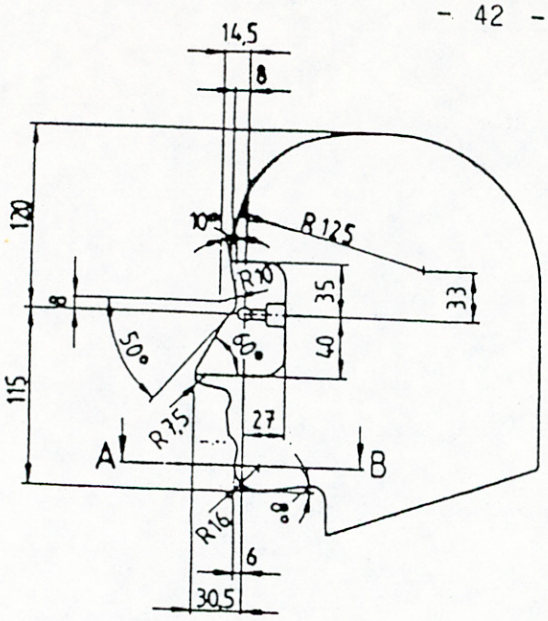
The field of vision shall be measured with an "apertometer" according to Stoll (fig. 14). A diagram (fig. 15) shall be used for the evaluation.
Procedure to measure the field of vision of a full face mask:

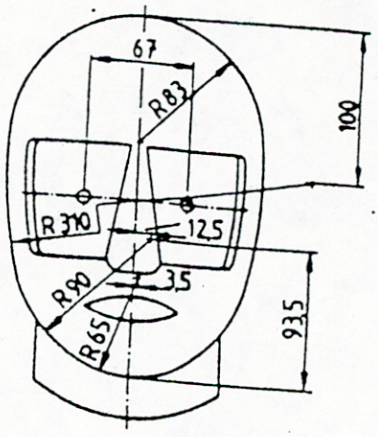
1 Carefully fit the full face mask to the dummy head, and with both eyes lit, adjust the facepiece until the outline of the visor is symmetrical on the hemispherical shell. Adjust the tensions of the straps to obtain a reasonable, secure fit.

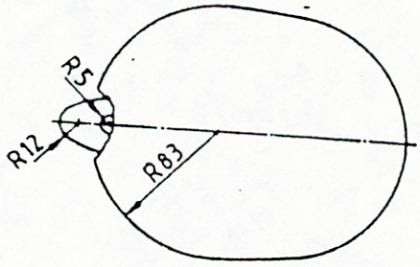
2 Map the positions of the field of vision of each eye individually on to the printed diagram, using the grid lines as a guide.

3 Carefully measure the areas of the total field of vision and the overlapped field of vision with a planimeter. The field of vision is the innermost line at any point of either the field of vision of the full face mask, or the natural field of vision of men as shown on the printed diagram.

Express the results as percentage of the area of the natural field of vision of men according to Stoll (already marked on the diagram).







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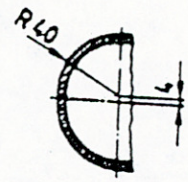
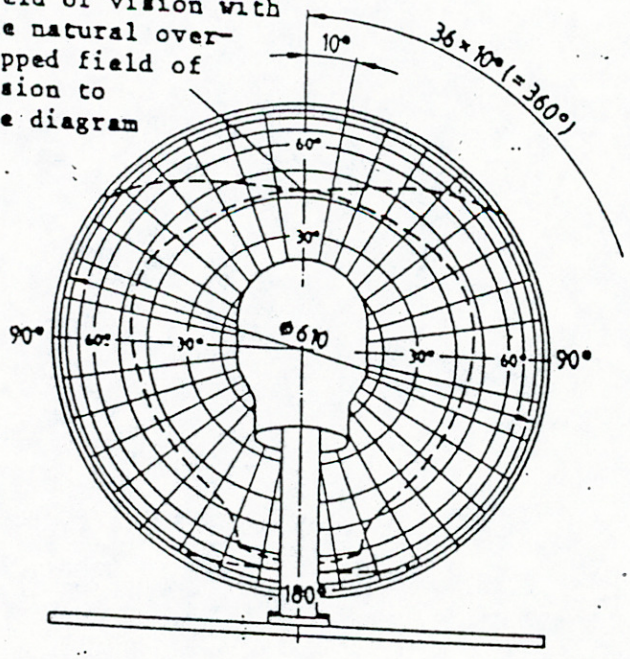


transfer the natural field of vision with the natural overlapped field of vision to the diagram



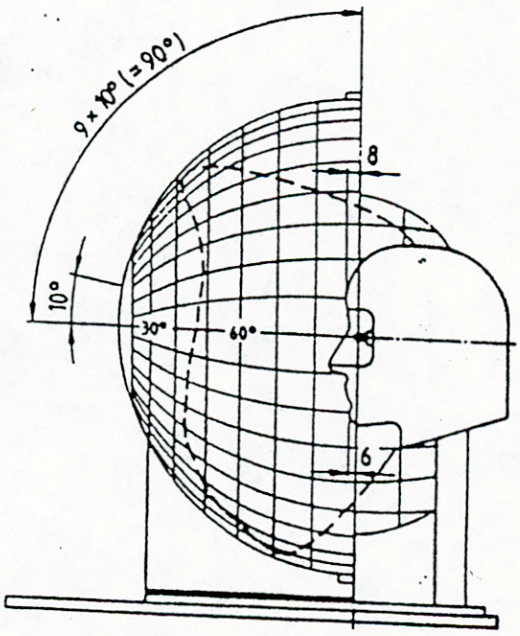
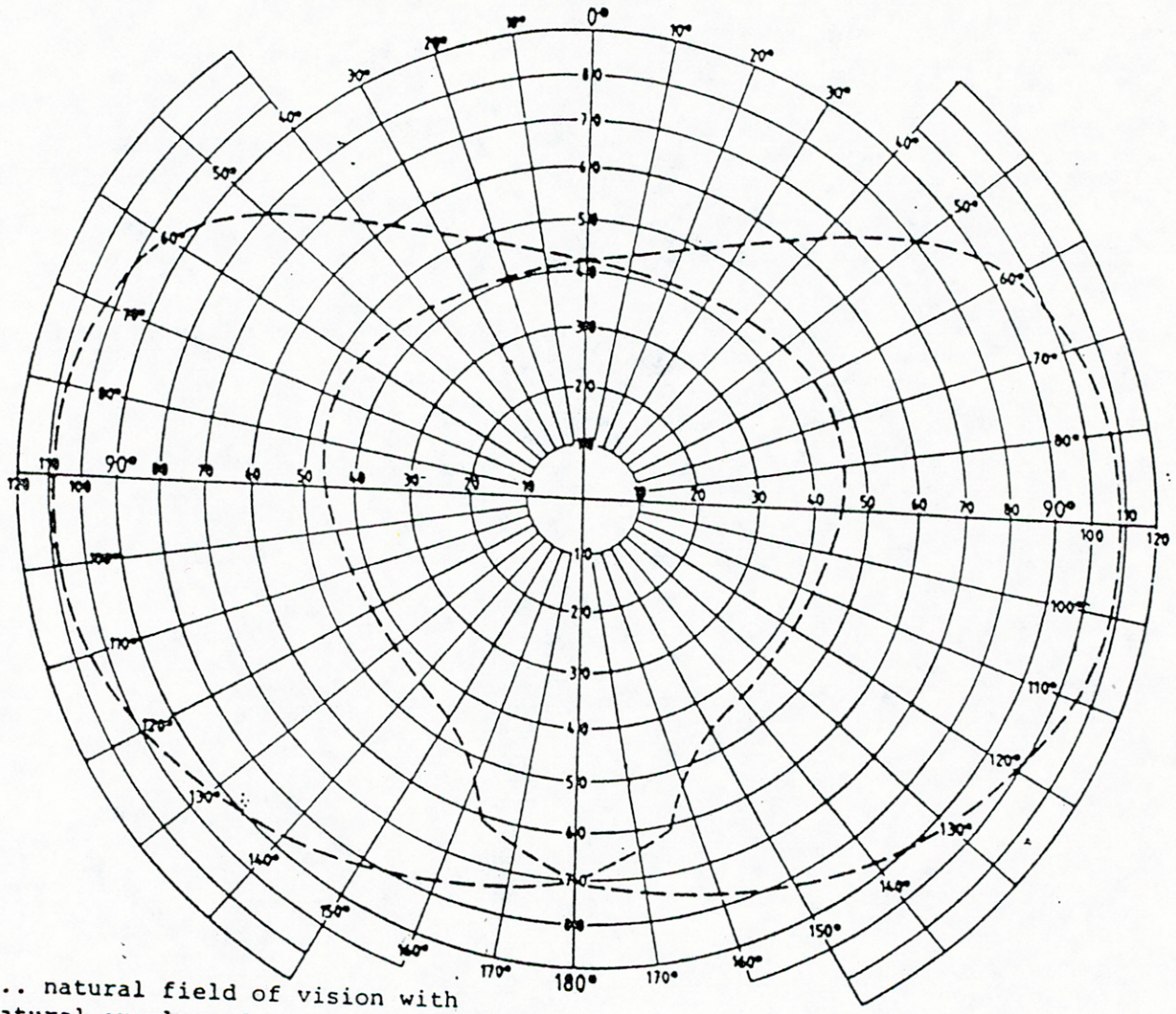


Fig. 14 : Apertometer

Fig. 15: Diagram of the apertometer



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

The circle closed surfaces of the diagram are of same ratio to each other as the adherent ball cups of the apertometer.

Semi-circular surface represented inside of the 90° circle = 126.9 cm²
Natural field of vision inside of the 90° circle (78,8%)... Bn_1 = 100.0 cm²
Natural field of vision outside of the 90° circle ..... Bn_2 = 12.0 cm²
Natural field of vision totally = $Bn_1 + Bn_2$ ..... Bn = 112.0 cm² 100 %

Natural overlapped field of vision ..... Bnü = 39.0 cm² 100 %

Shape of lenses: _____ facepiece model: _____
(dimensions) _____ _____

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 planimetered and noted in cm².

Planimetered area of effective field of vision (totally) ..... cm²
Planimetered area of effective overlapped field of vision ..... cm²

Effective field of vision (totally) ..... %
Effective oberlapped field of vision ..... %
Bn = natural field

5.9 Impact resistance of the eyepiece(s) or visor(s)

Impact resistance 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 (approx.)) falls normally from a height of 130 cm on the centre of the lens(es).

For comparing the tightness of the full face mask before and after the test the same dummy head is used and a pressure of - 10 mbar created in the cavity of the mask.

Five visors shall be tested.

5.10 Breathing resistance

The facepiece shall be fitted securely in a leak-tight manner but without deformation on a dummy head. The resistance is measured at the opening for the mouth of the dummy head and is measured using a breathing machine adjusted to 25 strokes/min and 2.0 l/stroke or a continuous flow of 160 l/min. A suitable pressure transducer shall be used.

The inhalation resistance is also tested at 30 and 95 l/min continuous flow.

The resistance value shall be corrected to 23 °C and 1 bar absolute.

6 Marking

6.1 All units of the same model shall be provided with a type identifying marking. Sub-assemblies and components with considerable bearing on safety shall be marked so that they can be identified. The manufacturer shall be identified by name, trade mark or other means of identification.

6.2 Where the reliable performance of components may be affected by aging, means of identifying the date (at least the year) of manufacture shall be marked.

For parts, which cannot be marked the relevant information shall be included in the instruction for use.

6.3 The marking shall be as clearly visible and as durable as possible.

7 Instructions for use

7.1 Instructions for use shall accompany all equipment.

7.2 Instructions for use shall be in a language acceptable to the country of application.

7.3 The instructions for use shall contain all information necessary for trained and qualified persons on

- application/limitation
- controls prior to use
- donning, fitting
- use
- maintenance
- storage

of the equipment.

7.4 The instructions shall be unambiguous. If helpful, illustrations, part numbers, marking etc. shall be added.

7.5 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

ANNEX A

Recommended test procedure for exhalation valve leakage

Test equipment

A small volume leak tight box attached to a tube with opening(s) between the box and tube in which the valve assemblies are mounted in suitable adaptors of low dead space (see figure 16).

A breathing machine delivering sinusoidal air flows corresponding to 20 strokes per minute.

Purifier containing absorbent.

A unit to saturate the air with water vapour at 37 °C.

An instrument capable of measuring test gas concentrations.

Test procedure

The test comprises as many valve assemblies as attached to the faceblank.

The test is performed at ambient temperature and relative humidity. The valve assemblies under test are fitted into the box with a suitable adaptor in a vertical position. The components are arranged according to whether a single or twin cylinder breathing machine is to be used (see figures 17 and 18).

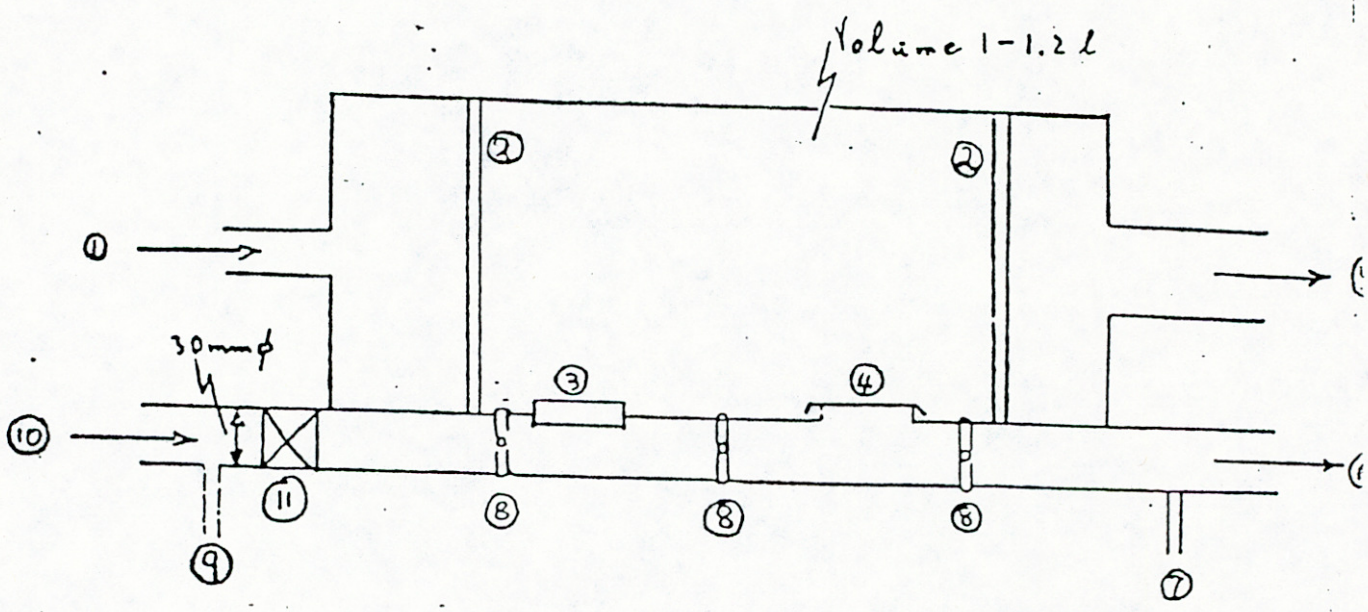
The inlet valve is adjusted so that the back pressure of the valve(s) under test is similar to that pertaining under its normal working conditions.

The breathing machine is set at 1.5 l/stroke, 20 strokes/min. A flow of test gas is maintained through the box. Samples of the air from before and after the valve assemblies are continuously analysed for test gas concentrations.

The test is run for a sufficient time to obtain a steady reading of the test gas concentration in the inspiratory air stream.

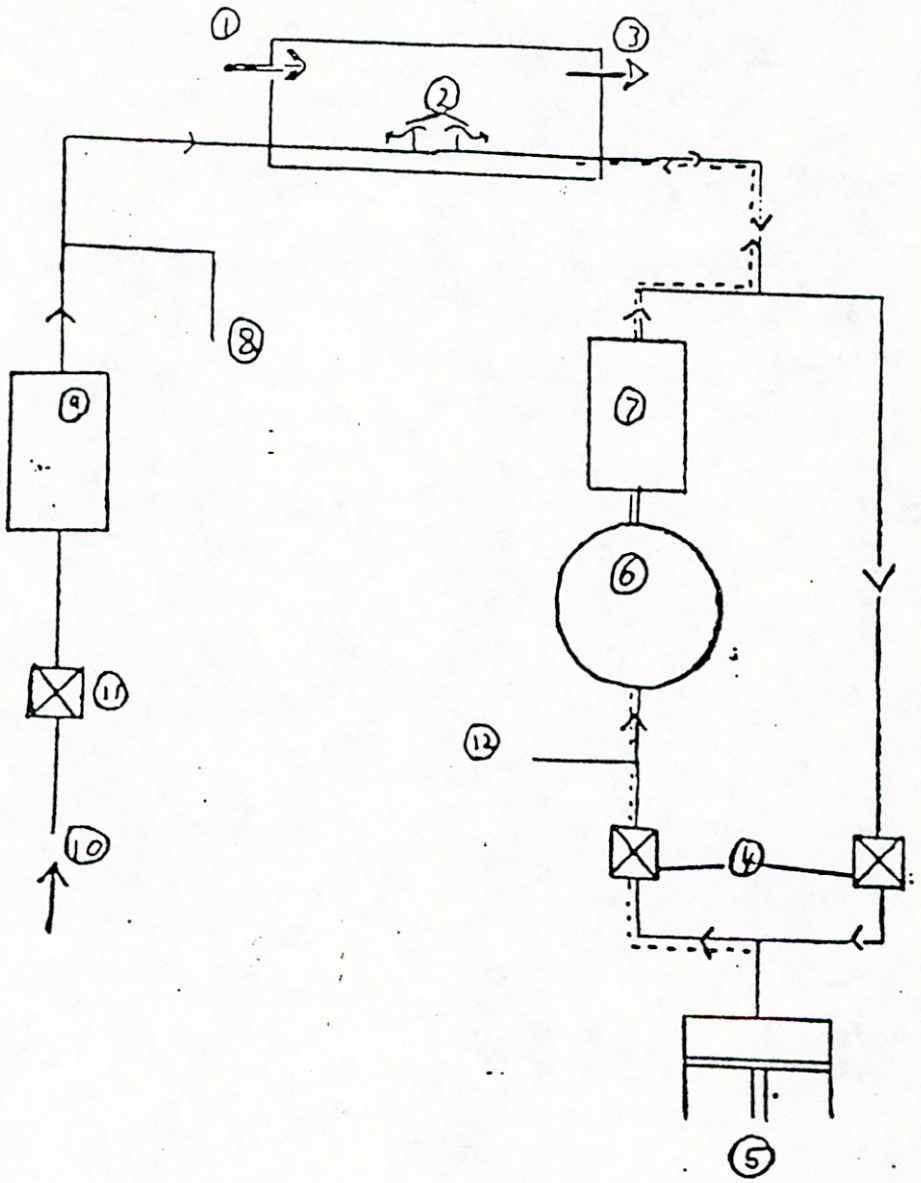
The difference in the test gas concentrations between the two samples is a measure of the total valve leakage. The test shall be carried out using carbon dioxide.

Figure 16 : Scheme of Valve Leakage Test Box



1 Test gas in (100 l/min cont. flow)
2 Baffle plates to promote smooth test gas flow
3 Blanking plate
4 Valve under test
5 Test gas out
6 To breathing machine (20 x 1,5 l/min)
7 Test gas sample
8 Pressure measurement ports
9 Reference gas sample
10 Saturated gas in
11 Non-return valve
(pressure drop at 30 l/min cont. flow: 1-1.5 mbar)

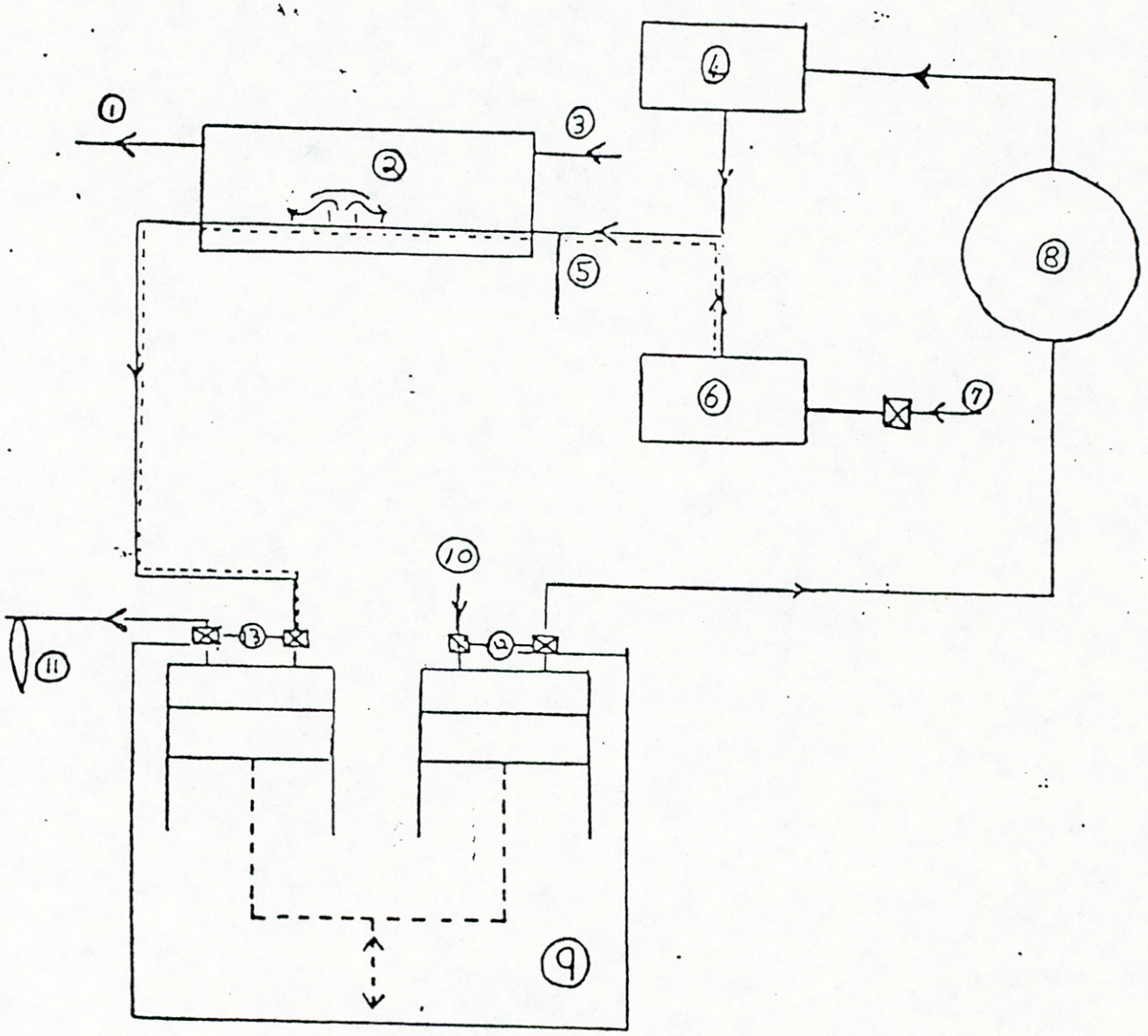
Figure 17 : Scheme of Valve Leakage Test: Single Cylinder Machine



1 Test gas in
2 Valve under test
3 Test gas out
4 Breathing machine valves
5 Breathing machine
6 Saturator
7 Purifier
8 Reference gas sample
9 Purifier
10 Laboratory air in
11 Adjustable non-return valve
12 Test gas sample

The difference, between levels of samples taken at points 1 and 12

Figure 18 : Scheme of Test Rig for Valve Leakage using Twin Cylinder Breathing Machine



1 Test gas out
2 Valve under test
3 Test gas in
4 Purifier
5 Reference gas sample
6 Purifier
7 Laboratory air in through non-return valve
8 Saturator
9 Twin cylinder breathing machine
10 Laboratory air in
11 Test gas sample
12 Breathing machine valves
13 Breathing machine valves

The difference in levels of the samples taken at points 3 and 11 is a measure of the valve leakage.

EUROPEAN STANDARD
NORME EUROPEENNE
EUROPÄISCHE NORM

DRAFT
~~prEN~~ 143
December 1986

English version

RESPIRATORY PROTECTIVE DEVICES

PARTICLE FILTERS

REQUIREMENTS, TESTING, MARKING

Anticipate - DIN future requirements

Document CEN/TC 79/SG 4 - 168 E was discussed during the meeting of CEN/TC 79/ SG 4 in Vienna, October 1986.
The decisions were incorporated into this draft.

Preamble

A given respiratory 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 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 and field of application

This European Standard refers to particle filters for respiratory protective devices, except escape apparatus and filtering facepieces. It specifies minimum requirements for particle filters for use as part of respiratory protective devices.

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

2 References

prEN 148 Respiratory Protective Equipment Connectors; Dimensions

3 Definition and description

Particle filters remove airborne particles.

4 Classification

Particle filters are classified according to their filtering capacity. There are three classes of particle filters: P1, P2 and P3. P1 filters are intended for solid particles only. P2 and P3 filters are subdivided according to their ability to remove both solid and liquid particles or solid particles only.

The protection provided by a P2 or P3 filter includes that provided by the corresponding (that is, solid, or solid and liquid) filter of lower class or classes.

5 Requirements

5.1 Construction

The connection between filter(s) and facepiece shall be robust and leaktight.

The connection between filter and facepice may be achieved by a permanent or special type of connection or by a screw thread connection (including threads other than standard threads). If a standard thread is used then it shall be in accordance with the relevant European Standard. If the filter is a twin filter designated to be used with a twin filter facepiece, it shall not be possible to connect it to the standard thread connector.

The filter shall be readily replaceable without use of special tools and shall be designed to be irreversible (other than filters for single use) to prevent incorrect assembly.

The maximum weight of filter(s) used in half masks is 300 g.

The maximum weight of filter(s) designated to be used directly connected to a full face mask is 500 g.

5.2 Materials

The filter shall be made of suitable materials to withstand normal usage and exposures to those temperatures, humidities and corrosive environments that are likely to be encountered.

Materials used for the construction of the filter shall be such that they do not constitute a hazard to the wearer, and the filter has a shelf life as marked (see 7) when properly stored.

5.3 Vibration

Before testing for breathing resistance, filtration efficiency and clogging, the filter shall be subjected to a vibration test in acoordance with 6.1 simulating rough usage of the filter.

After this treatment the filters shall show no mechanical defects and shall meet the requirements for breathing resistance, filtration efficiency and clogging.

5.4 Breathing resistance

The resistance imposed by the filter(s) to the flow of air shall be as low as possible and in no case exceed the maximum figures shown in table 1 when tested in accordance with 6.2.

Table 1 - Maximum breathing resistance

Filter class	Maximum resistance mbar[x]	
	at 30 l/min	at 95 l/min
P1	0,6	2,1
P2	0,7	2,4
P3	1,2	4,2

[x] 1 bar = 10^5 N/m^2 = 100 kPa

5.5 Filtration efficiency

The requirements shall be met before the temperature treatment described in 6.3. If the filter does not meet the requirements after the temperature treatment, the filter shall be marked with an expiry date.

Filters not passing the paraffin oil test shall be marked in accordance with 8.

The initial penetration of the test aerosols shall in no case exceed the figures shown in table 2 when tested in accordance with 6.3.1. and 6.3.2.

Table 2 - Maximum inital penetration

Filter class	Maximum initial penetration of test aerosols (%)	
	Sodium chloride test	Paraffin oil test
	95 l/min	95 l/min
P1	20	-
P2	6	2
P3	0,05	0,01

5.6 Clogging

The initial penetration requirements of 5.5 shall be satisfied before and after clogging test by each filter.

The clogging test with dolomite dust is for filters used in industry, and the clogging test with coal dust is for filters used in the coal mining industry.

5.6.1 Clogging test with dolomite dust for P1 and P2 filters

When tested in accordance with 6.4.1 the resistance of no filter shall exceed

Filter class P1 4 mbar

Filter class P2 5 mbar

when loaded with 1,5 g of dust.

5.6.2 Clogging test with coal dust for P1 and P2 filters

When tested in accordance with 6.4.2 the resistance of no filter shall exceed

Filter class P1	4 mbar
Filter class P2	5 mbar

when loaded with 1,5 g of dust. The test shall be stopped when the maximum allowable resistance has been reached, or when the predetermined amount of dust has been deposited, whichever occur first.

6 Methods of test

All performance tests shall be conducted so that ~~the~~ test air or test aerosol will pass through the filter horizontally.
Each test shall be conducted with filters conditioned by the vibration test described in 6.1.

When a single filter of a twin filter is tested separately the air flow specified for a test may be halved. If, however, it is possible that the single filter may be used alone, then the full air flow shall be used for testing.

6.1 Vibration

6.1.1 Test equipment

The apparatus as shown schematically in figure 1, consists of a steel case (K) which is fixed on a vertically moving piston (S), capable of being lifted up 20 mm by a rotating cam (N) and dropping down onto a steel plate (P) under its own mass as the cam rotates. The mass of the steel case shall be over 10 kg.

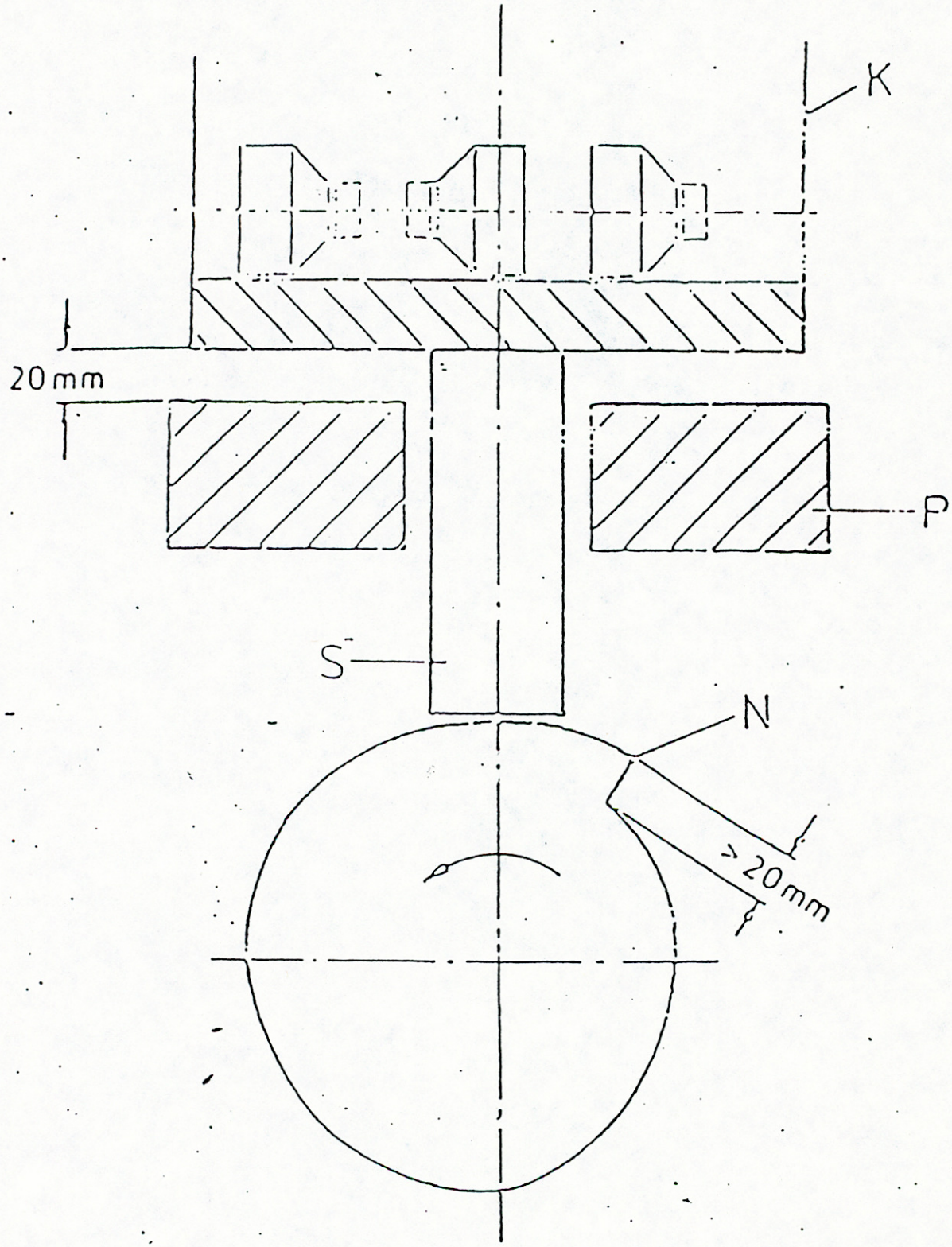


Figure 1 - Test equipment for vibration test

6.1.2 Test procedure

The filters, whether encapsulated or unencapsulated, shall be tested as received, removed from their packaging and mounted in the filter housing in which they are to be used.

The filters shall be placed on their sides in the case (K) so that they do not touch each other during the test allowing 6 mm horizontal movement and free vertical movement.

After vibration testing, any loose material that may have been released from the filter shall be removed prior to the performance testing.

The test rig is operated at the rate of approximately 100 rotations per minute for approximately 20 minutes and a total of 2000 rotations.

6.2 Breathing resistance

The filter shall be connected in a leaktinght manner by means of an adapter of suitable shape to the suitable test equipment.

Testing shall be carried out at two continuous flow rates (30 and 95 l/min) with air at room temperature, atmospheric pressure and of such humidity that condensation does not occur.

Each test shall be made with a minimum of 10 specimens.

6.3 Filtration efficiency

The filters shall be tested before and after the following temperature treatment. The filters shall be exposed

a) for 24 hours to dry atmosphere of 70°C
b) for 24 hours to temperature of -30°C.

The methods used for testing filters against solid and liquid aerosol are:

a) sodium chloride test according to 6.3.1
b) paraffin oil test according to 6.3.2

The method used for testing filters against solid and water based aerosols only is:

- sodium chloride test according to 6.3.1

Each test shall be made with a minimum of 10 specimens.

6.3.1 Sodium chloride test

An aerosol of sodium chloride particles is generated by atomising an aqueous solution of the salt and evaporating the water. The concentration of this aerosol is measured before and after the filter under test by means of flame photometry. Accurate determinations are possible in the range < 0.0001 % to 100 % filter penetration.

6.3.1.1 Test equipment

The apparatus is shown in figure 2. The aerosol is generated using a Collison atomiser filled with a 1 % solution of sodium chloride. The atomiser, which is shown in fig 3 consists of glass reservoir into which is sealed an atomiser head having three spray nozzles. Air is supplied to the atomiser at a pressure of 3.45 bar and the resulting liquid spray impinges on a baffle which removes the large particles. The particles which do not impact are removed in the air flow and, on mixing with dry air, the water evaporates leaving a dry sodium chloride aerosol.

The aerosol produced by this method is polydispersed with a mass media particle diameter of approximately 0.6 µm. The particle size distribution is given in fig 4. It has been found that the aerosol remains constant, within acceptable limits, with respect to particle size and concentration provided that the supply pressure is in the range 3.31-3.59 bar and the flow rate of air to the three nozzles is 12.5-13.0 l/min. The output is mixed with 82 l/min of dry air giving a total flow of 95 l/min.

The salt solution in the atomiser is consumed at a rate of approximately 15 ml/h. This loss is due in part to the atomisation of the solution and in part to evaporation of water from reservoir. The volume of the reservoir is such that the change in concentration and loss in volume of the solution during an 8 hour period will not cause an appreciable change in the characteristics of the test aerosol.

The sodium chloride aerosol is analysed before and after the filter under test by flame photometry. The photometer used for this analysis can be any suitable instrument having the required sensitivity, however a photometer specially designed to meet these requirements is available[x)].

The instrument is a hydrogen flame photometer. The hydrogen burner is housed in a vertical flame tube which opens at its lower end into the sample tube throught which the aerosol to be analysed flows. The flow of aerosol to the flame is controlled by convection and is held constant with a bleed valve.

A small quantity of filtered air is fed continuously into the sample tube downstream of the inlet to the flame tube. The function of this supply is to prevent room air, which may contain considerable quantities of sodium salts, from reaching the burner when there is no flow through the sample tube.

The hydrogen burner, which gives a flame symmetrical about the vertical axis, is surrounded by a heat proof glass tube. This tube must be optically homogeneous to minimise the effect on the light transmitted by the flame.

x) Information concerning the supplier of the photometer and the aerosol generator can be obtained from the secretariat of CEN TC 79.

Sodium chloride particles in air passing through the flame tube are vapourised giving the characteristic sodium emission at 589 nm. The intensity of this emission is proportional to the concentration of sodium in the air flow.

The intensity of the light emmitted by the flame is measured using a photomultiplier tube. To separate the sodium emission from background light of other wavelenghts a narrow band interference filter with appropriate sideband filters is used. This filter should preferably have a half-peak band width of no more than 5 nm.

As the photomultiplier output is only proportional to the incident light over a relatively small range, high light intensities are attenuated by neutral density filters. These filters are accurately calibrated in conjunction with the interference filter in use and so the actual light intensity can be calculated from the output of the photomultiplier. The signal from the photomultiplier is amplified and displayed on a meter or chart recorder.

Calibration of the flame photometer will depend on the detailed design of the instrument and the manufacturers instructions should be followed if reliable results are to be obtained. In general however, the methods which may be used are: multiple dilution of the aerosol, dilution of the atomiser solution or a combination of both. If aerosol or solution dilution is used alone the lower calibration limit is approximately two orders of magnitude higher than the ultimate sensitivity of the instrument.

Where a photomultiplier with attenuating filters is used for detection this is unimportant as the photomultiplier measurers a constant range of light levels over the entire range of the instrument and the values of the attenuating filters are known and invariable. Hence the calibration curve is linear at low concentrations and can safely be extrapolated to the lower values. The upper limit of linearity of the calibration curve is approximately 0.12 mg/m^3 due to re-absorption of light within the flame. Non-linear calibration is possible above this point up to approximately 15 mg/m^3. Where other detectors are used this may not be the case and a combination technique would be required to reach the ultimate sensitivity.

6.3.1.2 Test conditions

Particle size distribution of the test aerosol, see figure 4.

Flow rate of test aerosol	95 l/min
Aerosol concentration	(10 +/-2) mg/m^3
Air pressure to atomiser	(3,45 +/-0,14) bar
Flow rate to atomiser	(12,75 +/-0,25) l/min
Flow rate of diluting air	82 l/min
Flow rate of hydrogen to photometer	450-500 ml/min
Wavelenght of sodium emission	589 nm
Air temperature	ambient
Relative humidity	< 60 %

6.3.1.3 Test procedure

The test aerosol is fed into the test chamber, where the filter under test is fixed. A flow of 95 l/min is blown through the filter and the aerosol concentration is measured immediately before and after the filter by the photometer. The initial penetration shall be measured between 3 and 5 minutes.

6.3.1.4 Calculation of the penetration

$$P = \frac{C_2}{C_1} \cdot 100\ \%$$

where

P = penetration
C_1 = NaCl concentration before the filter
C_2 = NaCl concentration after the filter

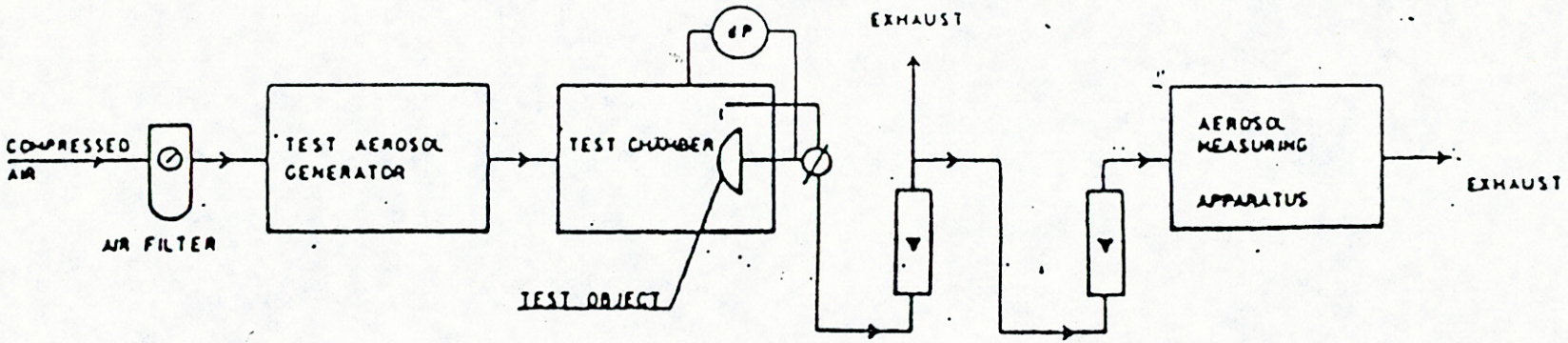


FIGURE 2

Apparatus for sodium chloride test

1 21 b Kilner jar or similar
2 Nozzle
3 Fibre washer
4,5 external diameter
2,0 internal diameter
0,8 thickness
4 Sleeve
5 Stem
6 Rubber gasket
7 Head
8 Rubber gasket
25,0 external diamter
10,0 internal diameter
1,5 thickness
Seals to be airtight
9 Nut
10 Screw cap

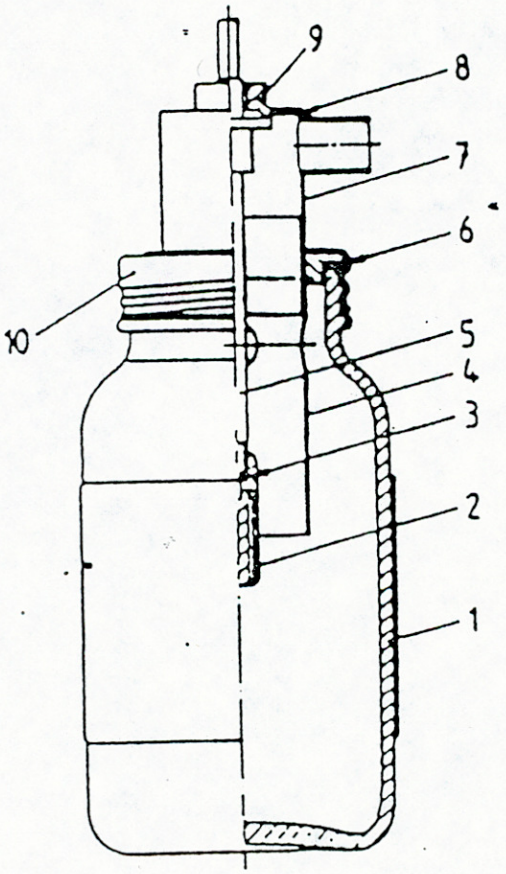


Figure 3 - Atomizer

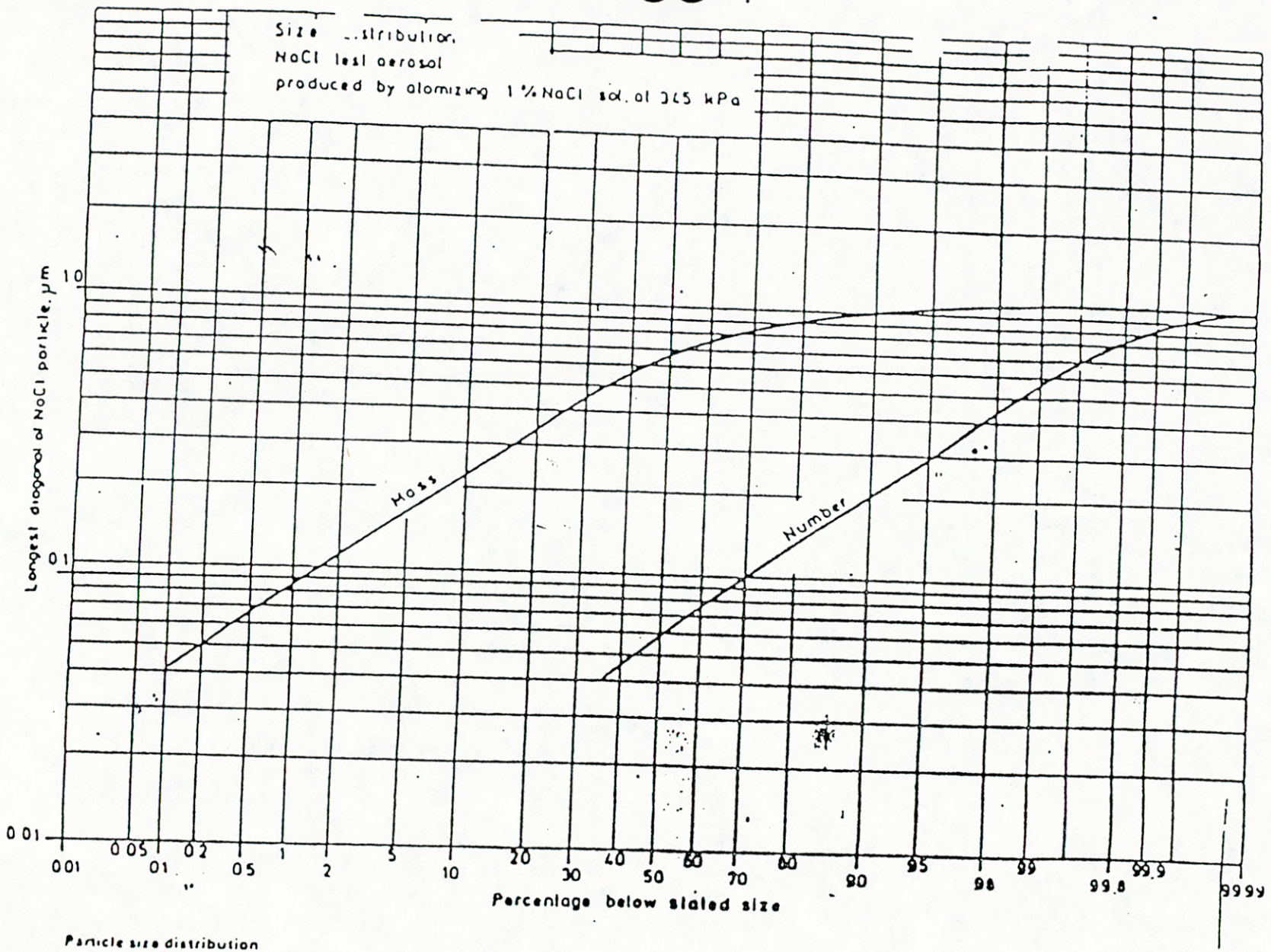


FIGURE 4 Particle size distribution

6.3.2 Paraffin oil test

An aerosol of paraffin oil droplets is generated by atomising heated paraffin oil. The concentration of this aerosol is measured before and after the filter under test by means of an aerosolphotometer. Accurate determinations are possible in the range < 0,003 % to 100 % filter penetration.

6.3.2.1 Test equipment

The apparatus is shown in figure 5. The aerosol is generated using an atomizer (figures 6 and 8). The atomization vessel (6) is filled with paraffin oil (paraffinum perliquidum CP 27 DAB 7 *)), so that the oil level is between the min/max-marks (10). The atomization vessel is heated by means of an electric heating device (8), so that the temperature of the oil is kept to 100°C by means of a thermostat (9). The temperature is measured by the thermometer (11). Filtered compressed air of 4 bars (3, 4) is preheated in (8) and blown through the multiple nozzle unit (12 and figure 8). Large droplets in the generated oil mist are separated in the controll nozzle (13) and in the spiral tube (15). In the mixing vessel (5) the oil droplets and oil vapour are diluted with 50 l/min filtered air, measured by the flowmeter (2). Since the diluting air is at room temperature, the oil vapour condenses in the mixing vessel. The generated aerosol is the test aerosol, which is reduces to the test concentration of (20 +/- 5) mg/m^3 by wasting an appropriate fraction of the oil mist (see figure 5, item 18 in connection with 11, 7, 10, 12 and 17) and by further dilution with filtered air at a flowrate of 83 l/min in the blowers actuated by air power (type Friedrichs-Antlinger, see figure 5, item 5 and figure 9). The test aerosol produced by this method is polydisperse. The particle size distribution is a logarithmic normal distribution with the median Stokes diameter of 0.4 µm (for the number distribution) and the logarithmic standard deviation 0.26 (see figure 7).

The test aerosol is fed into the test chamber (figure 5, (1)), where the filter under test is to be fixed (15). The excess of the aerosol is filtered by a high efficiency filter with a low flow resistance (10). A flow rate of 95 l/min is drawn through the filter under test. The test concentration is measured before and after the filter under test by means of an integrating light scattering photometer. The principle of the aerosolphotometer is shown in figure 10. The instrument is a 45° scattering photometer. The light source is directed to the measuring cell and to the photomultiplier. The direct beam to the multiplier is interrupted by a chopper, so that the scattered light from the particles is alwas corrected for the source intensity variations. The reference beam is attenuated by means of neutral density filters and of a neutral density wedge automatically to the intensity of the scattered light beam.

---

*) The physical properties of the oil are:
Density at 20°C 0.846 g/cm^3

Viscosity at 20°C 0.026 to 0.031 Pa s
Information concerning the suppliers of the paraffin oil, the aerosol generator and the aerosolphotometer can be obtained from the secretariat of CEN TC 79.

The intensity of the scattered light, which is a measure for the aerosol concentrations, is displayed.

6.3.2.2 Test conditions

Particle size distribution of the test aerosol see figure 7.

Flow rate throught the filter under test	95 l/min
Aerosol concentration	(20 +/- 5) mg/m^3
Air temperature	ambient
Air pressure to atomizer	(4 +/- 0.15) bar
Flow rate to atomizer	(13.5 +/- 0.5) l/min
Mixing air flow rate in aerosol generator	50 l/min
Flow rate of diluting air	83 l/min
Temperature of the oil in the generator	100–110°C

6.3.2.3 Test procedure

The test aerosol is fed into the test chamber, where the filter under test is fixed. A flow rate of 95 l/min is sucked through the filter by means of a suitable pump. The aerosol concentration is measured immediately before and after the filter by the aerosolphotometer.

6.3.2.4 Calculation of the penetration

$$P = \frac{l_2 - l_o}{l_1 - l_o} \times 100\ \%$$

where

P = penetration
l_1 = photometer reading after the filter
l_2 = photometer reading before the filter
l_o = photometer zero reading for clean air

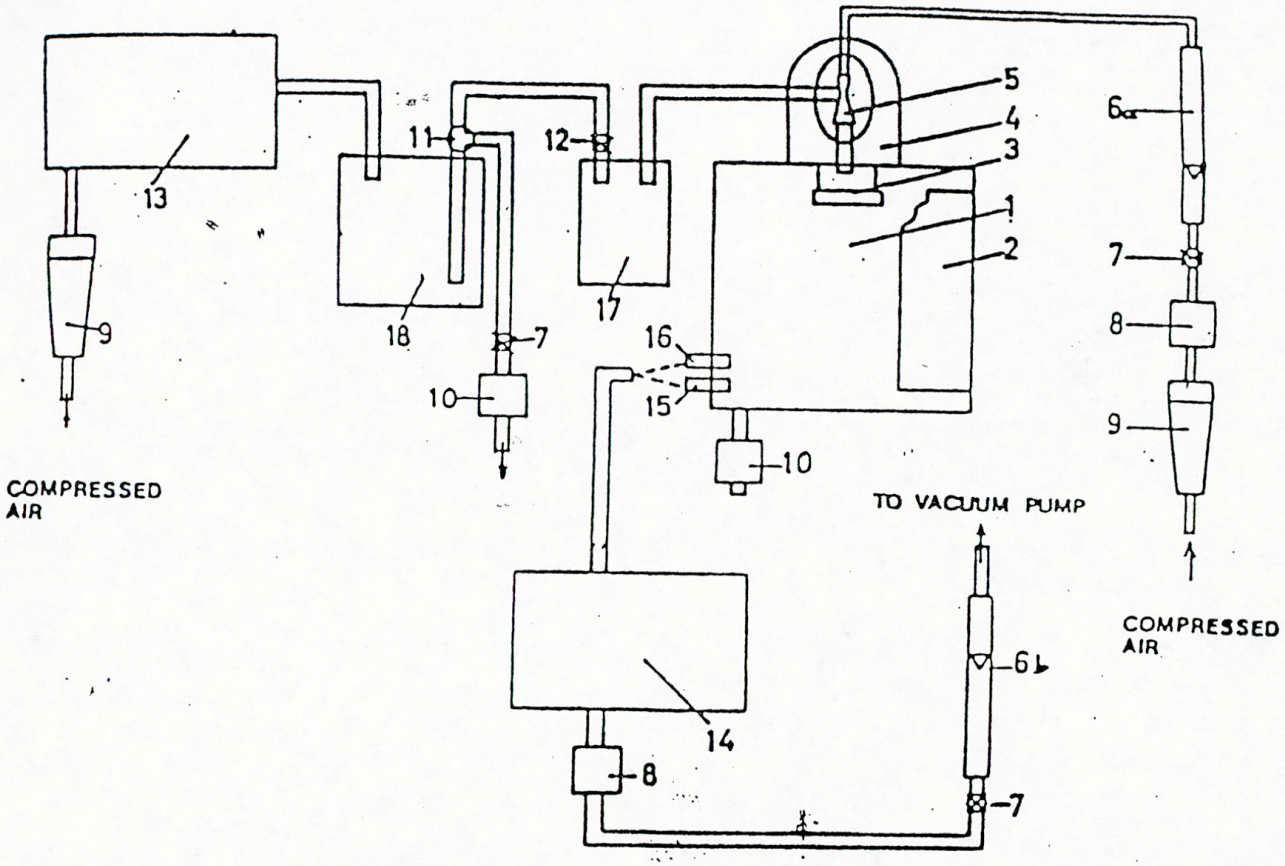


Figure 5 - Apparatus for paraffin oil test

Explanations to figure 5:

1 Testchamber: Lucite, diamter 500 mm, height 500 mm, covered with plywood on both sides

2 Tightly fitting door of the chamber

3 Dish for collecting oil running down the walls of the tube

Cover for the blowers actuated by air power

5 Blowers actuated by air power (type Friedrichs-Antlinger) for taking the concentrated oilmist into the chamber

6 Flowmeters, range 800–8000 l/h

a) for measuring the propellent air for the blowers (5000 l/h)
b) for measuring the test flowrate (95 l/min)

7 Valves controlling the flowrate

8 High efficiency filters

9 Reducing valves, range 1–5 bars at a prepressure of 6–10 bars

10 High efficiency filter with low resistance

11 Tee for taking out the amount of oilmist necessary for testing

12 Needle valve controlling the oilmist concentration in the chamber

13 Oilmist generator

14 Aerosolphotometer

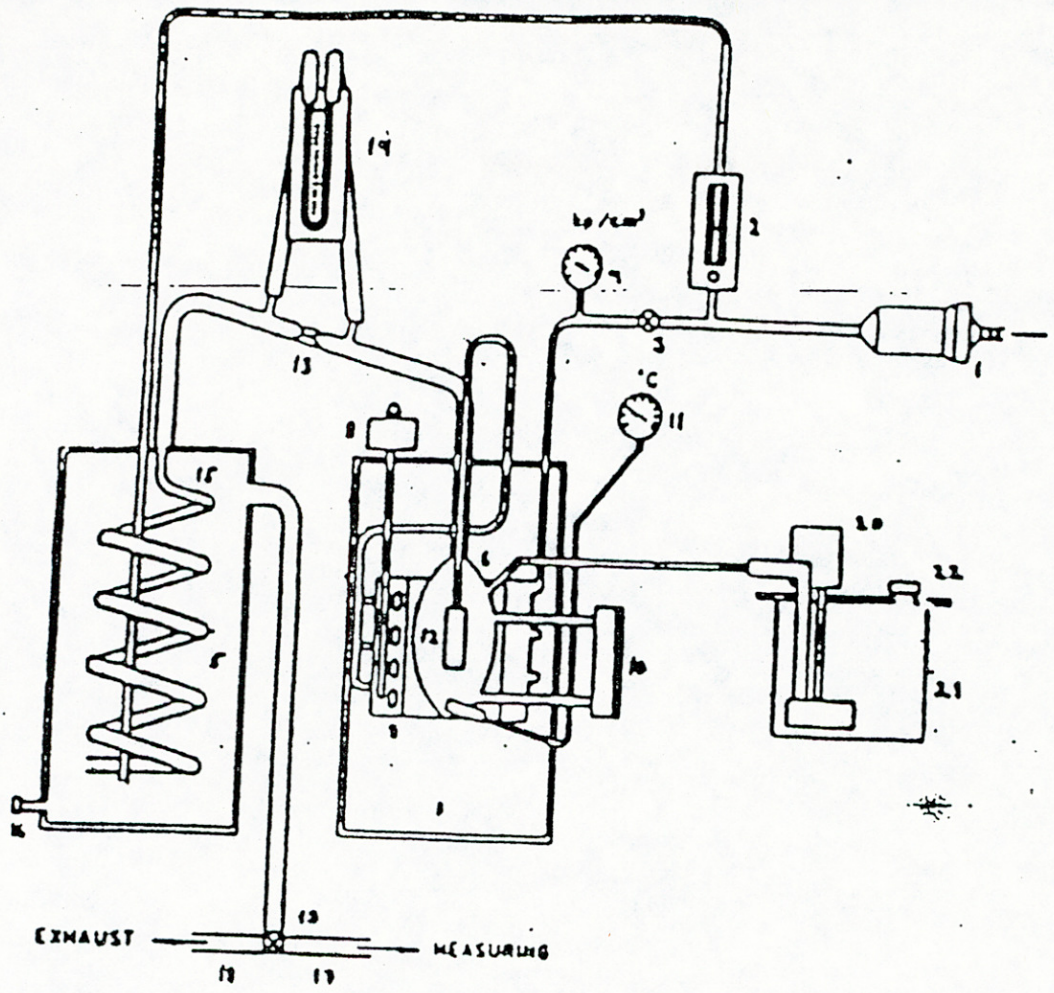
15 Connecting pipe to test object

16 Probe for measuring the oilmist concentration in the chamber

The aerosolphotometer is connected with 15 or 16 when required by means of a short tube. The connecting pipe not employed is to be closed tightly. The tubing for the oilmist are textile reinforced plastic tubes with an inner diamter of 19 mm.

17 Woulff's bottle

18 Buffer volume of 5 l



1 5 bar air inlet with airfilter
2 flowmeter
3 pressure reducer
4 manometer
5 mixing vessel
6 atomization vessel
7 thermostat vessel
8 heating jacket
9 thermostat
10 oil-level indicator
11 thermometer
12 atomization nozzle
13 control nozzle
14 U-tube manometers
15 spiral tube
16 drainage screw
17 outlet to measuring device
18 waste outlet
19 change-over valve
20 oil pump
21 oil supply container
22 locking screw

Figure 6 - Generator for paraffin oil aerosol

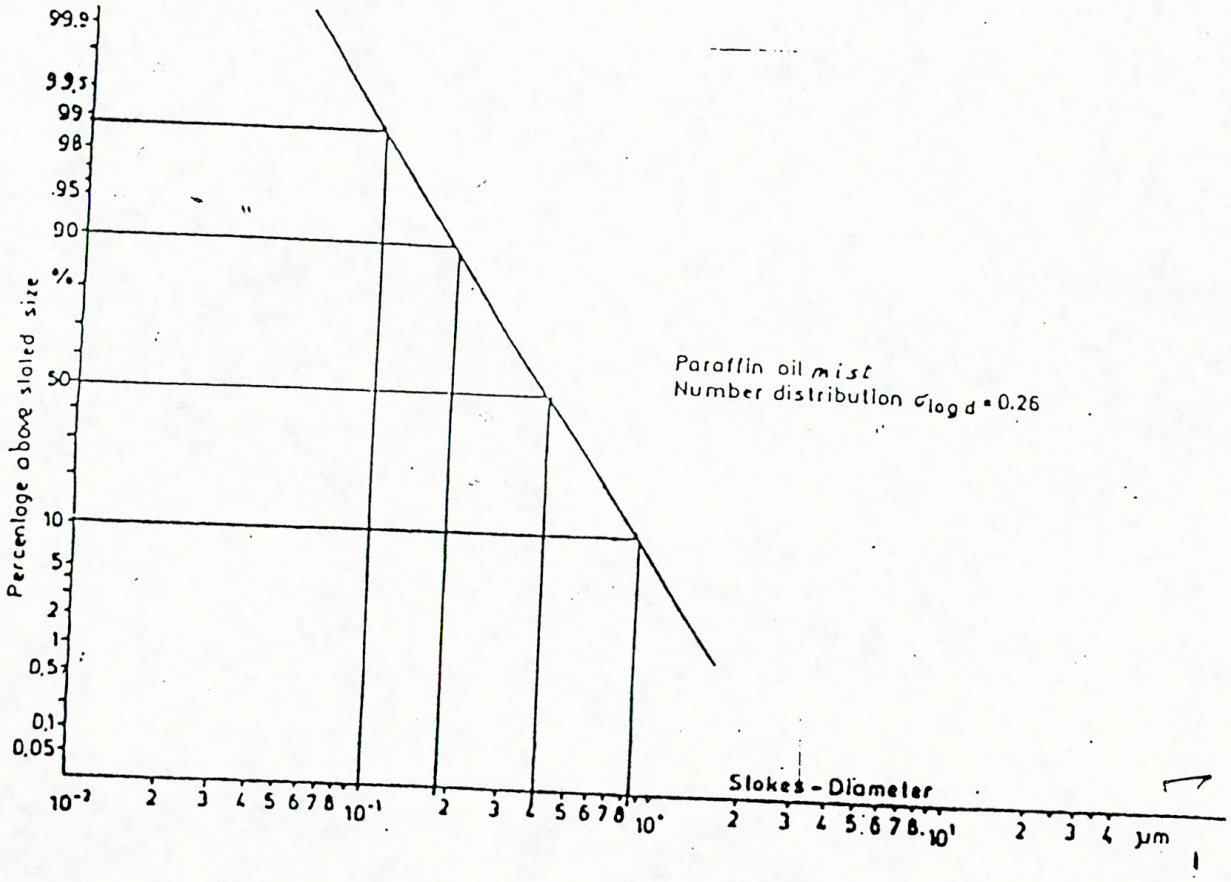


Figure 7 - Particle size distribution of paraffin oil mist

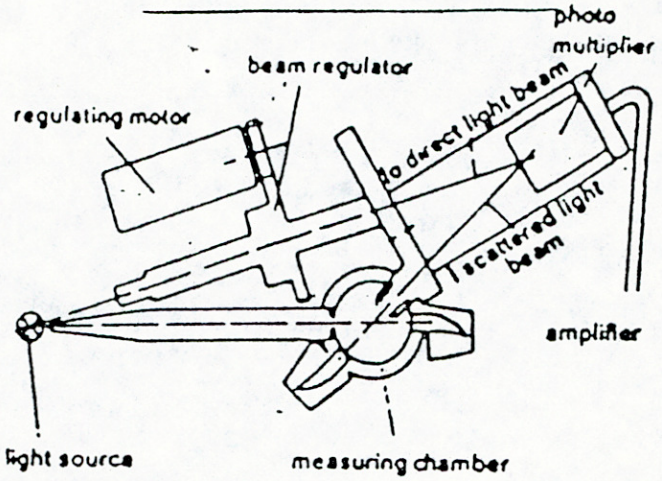


Fig. 10
Scheme of the Aerosolphotometer

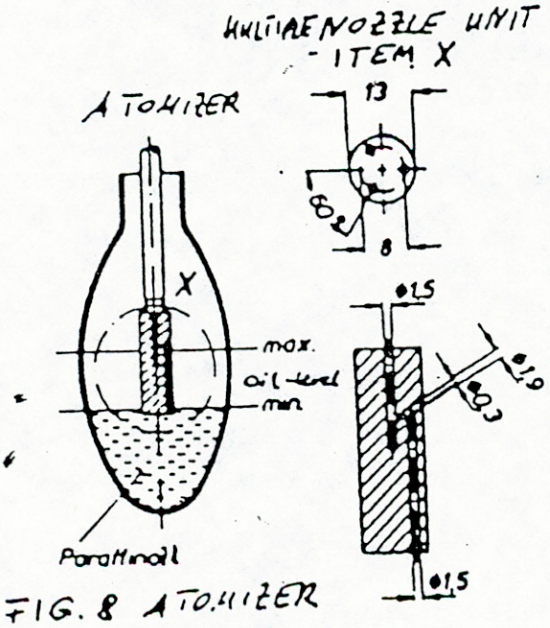


FIG. 8 ATOMIZER

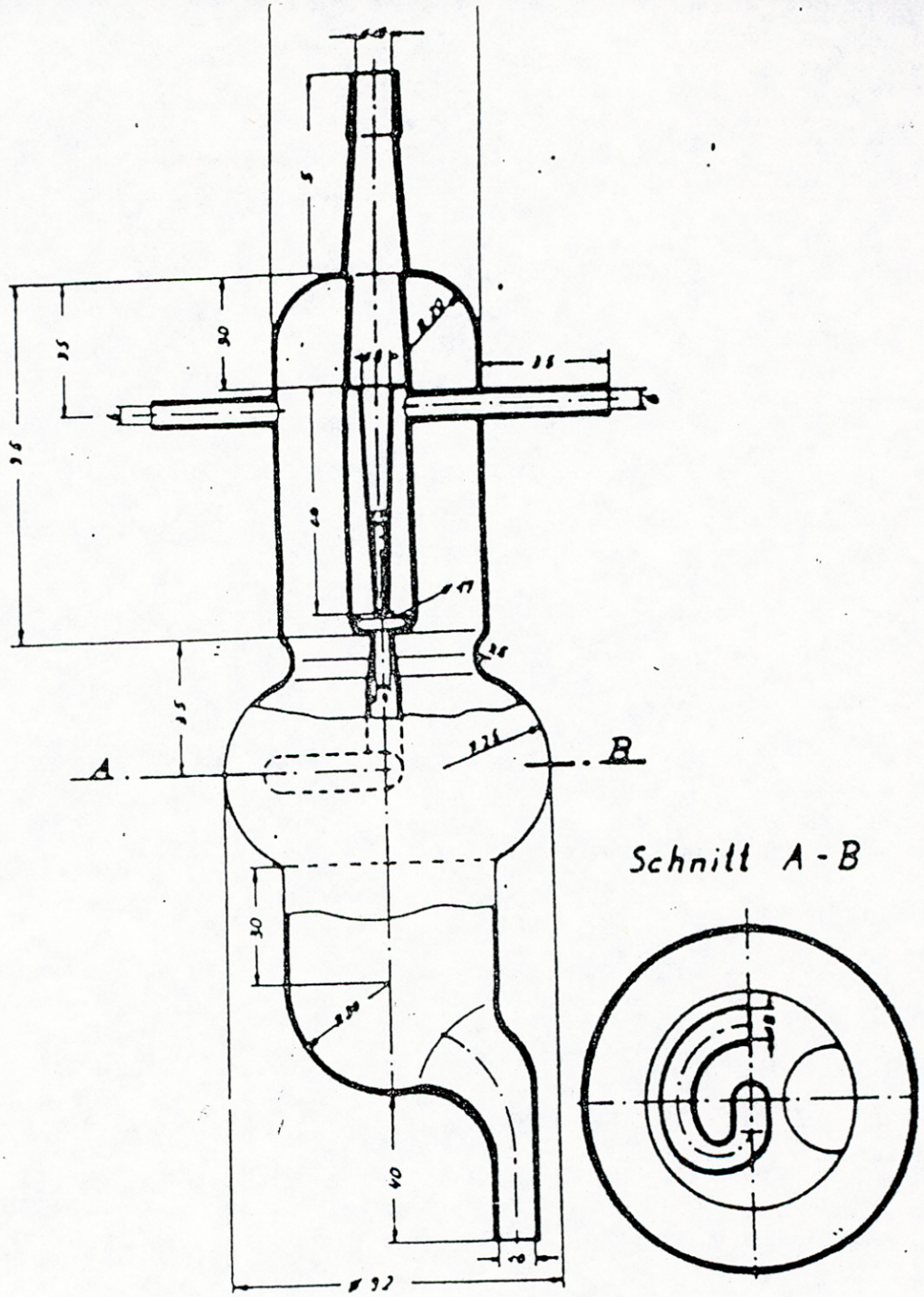


Figure 9. Blowers actuated by air power
(Friedrichs-Antlinger. JENAer GLAS D 50)

6.4.1 Clogging test with dolomite dust

The test consists of drawing dust laden air through the filter under test, and determining the quantity of dust deposited on the filter when a specified breathing resistance is reached.

The filter is tested mounted on a suitable adapter. Optionally it can be tested mounted on a face piece, but then the pressure drop introduced by the features of the face piece (inhalation valve, for instance) has to be taken in consideration in the results.

In both cases a tight seal on the holder is necessary.

6.4.1.1 Test equipment

The apparatus is shown diagrammatically in figure 11. The working area of the test chamber has a suggested square section of 650 x 650 mm.

6.4.1.2 Test conditions

- Dust: DRB 4/15 dolomite. The dust is available from Institut National de Recherche et de Sécurité, Centre de Recherche, 54500 VANDOEUVRE, France.

  The particle size distribution of the airborne dust at the working area of the dust chamber is given in figure 12.

  This characteristic is an essential parameter, which has to be verified prior to any measurement, specially if the geometry of the test chamber is somewhat different from the model described in this document.

- Continuous flow through the dust chamber: 60 m^3/h, linear speed 4 cm/s.

- Continuous flow through the filter: 95 l/min.

- Concentration of the dust: (400 +/- 100) mg/m^3.

- Temperature of the air: (23 +/- 2) ^{o}C.

- Relative humidity of the air: (45 +/- 15) %.

Testing time: To be tested until a load of 1,5 g of dust has been deposited on the filter or the breating resistance has reached 4 mbar for a P1 filter or 5 mbar for a P2 filter.

6.4.1.3 Test procedure

Dust from the distributor is conveyed to the dust chamber where it is dispersed into the air stream of 60 m^3/h.

The filter under test is mounted on a suitable adapter located in the dust chamber. A flow of 95 l/min is drawn throught the filter under test until the resistance of the filter has reached the specified value. The amount of dust deposited on the filter is determined by weighing the filter after its removal from the dust chamber and elimination of its external casing, the filter having been weighed before the test.

Optionally the amount of dust can be measured indirectly by the mean of a probe equiped with a preweighted glass fiber filter open face (dia 37 mm), and located as per drawing 13. the air from the dust chamber is drawn throught the probe at a rate of 2 liters/min.

The glass fiber filter is replaced every 15 minutes. The amount of dust collected is measured. The corresponding amount of dust on the filter is obtained by multiplying by 95/2.

A curve is plotted of the pressure drop trough the filter versus the cumulative amount of dust colledted until the 4 or 5 mbar limit is reached.

At that point, the cumulative amount can be confirmed by measuring the weight increase of the filter.

6.4.1.4 Estimation of the results

Breathing resistance shall be measured before and during the loading process.

The amount of dust deposited at the specified pressure drop is recorded.

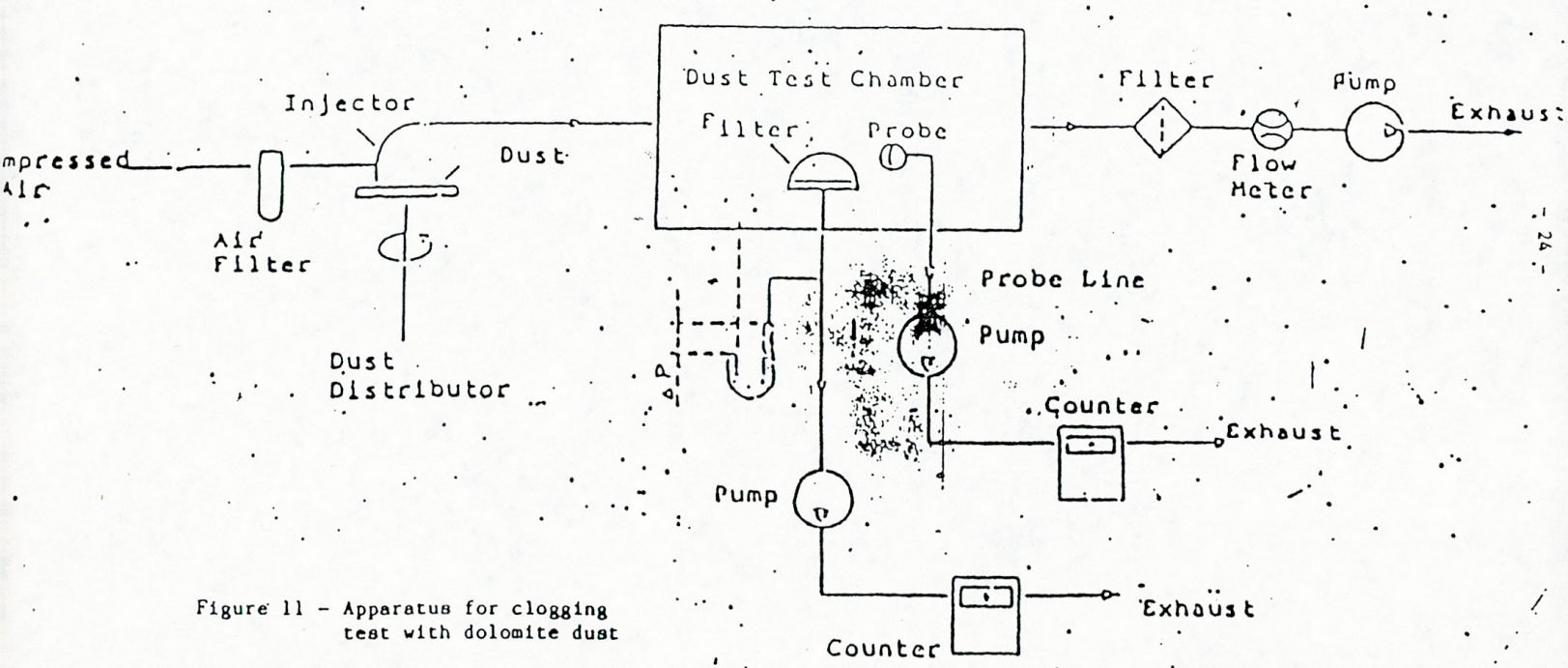


Figure 11 – Apparatus for clogging test with dolomite dust

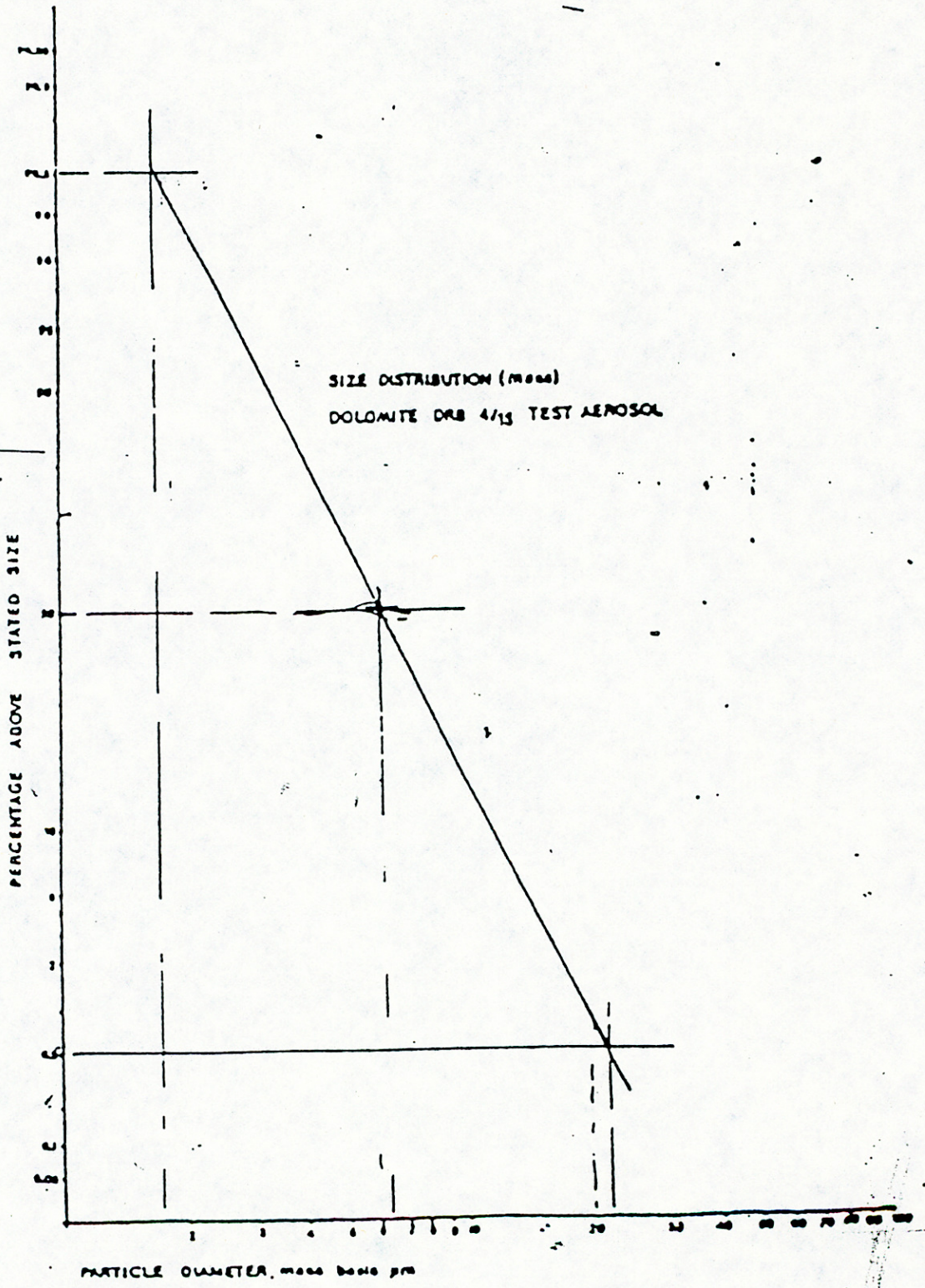
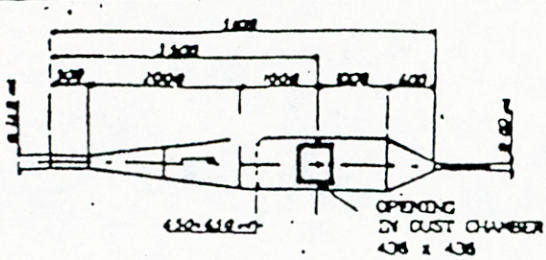
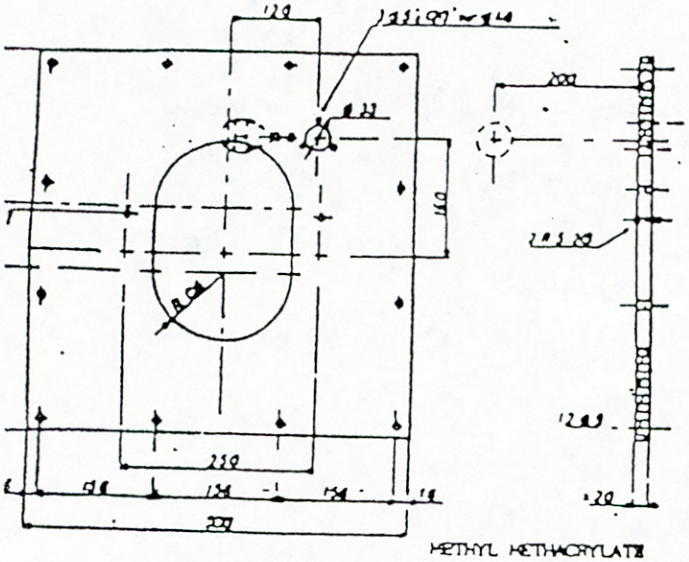
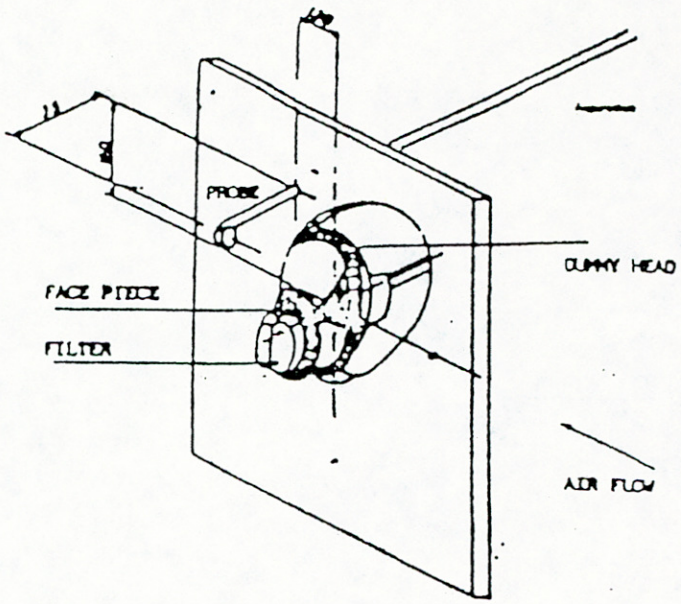


Figure 12 - Particle size distribution of dolomite dust

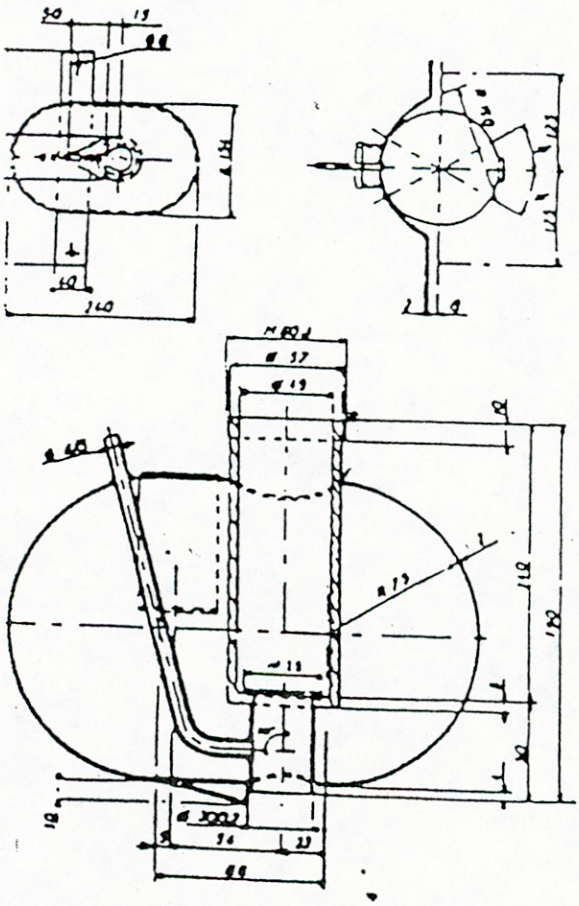




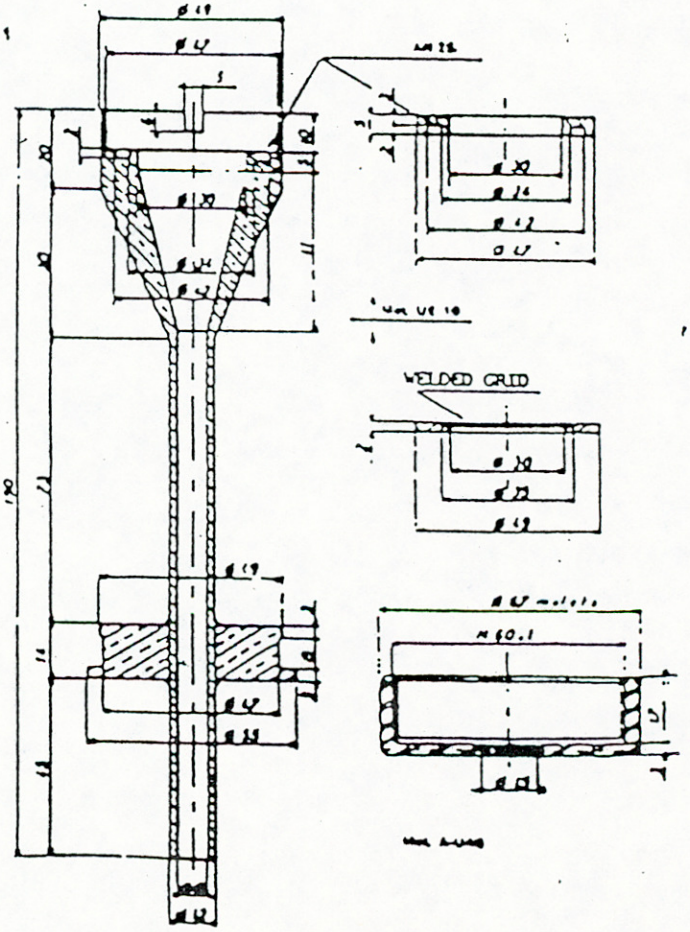
DUMMY HEAD ADAPTER



RECOMMENDED PROBE POSITION



DUMMY HEAD CONFIGURATION



DUMMY HEAD FILTER HOLDER

FILE 13 D

6.4.2 Clogging test with coal dust

The test consists of drawing dust laden air through the filter under test and determining the pressure drop across the filter when the filter has collected 1,5 g of coal dust. The test is conducted both with air at normal (30 to 60 %) relative humidity and with air at approximately 95 % relative humidity.

6.4.2.1 Test equipment

The apparatus is shown diagramatically in figure 10, critical dimensions are shown in figure 14.

Dust from hopper H is conveyed by the rotating turntable T at a rate of 0.5 g/min to point below nozzle A where it is entrained with the airstream entering the mixing chamber C through nozzle A at a flow rate of 8.5 l/min. Addition air enters C through the side tube B to give 95 l/min flow through the filter under test, F, flow meter R and regulating valve V to a suction pump. The pressure drop across the filter is indicated by manometer M. For tests at high humidity the two-way valve K is turned so that the addition air is drawn through humidifier W. For tests at ambient humidity, K is turned so that air is drawn directly from atmosphere. The required flow through A is regulated and monitored using valve E and manometer N.

6.4.2.2 Test conditions

Dust: Coal dust prepared from Grimethorpe Washed Singles (upper seams) NCB
Coal Rank Code 502, volatile matter 35 %, ground by ball and sieveing the portion which passes a 63 micrometer aperture x).

Typical size distribution is given in table 3.

Continuous test flow rate: 95 l/min
Temperature of the air: (23 +/-2) °C
Relative humidity of the air: 30 to 60 % and 95 %

x) Information concerning the supplier can be obtained from the secretariat of CEN TC 79.

Table 3 - Particle size distribution

Coulter counter		Sedimentation analysis	
Size (Equivalent spherical diameter) µm	Number particles oversize (No.2,5 µm=100) %	Size (Stokes diameter) µm	Weight oversize %
2.5	100	2.5	89.0
3.0	65	3.0	87.5
5.0	27	5.0	80.5
7.0	14.6	7.0	77.0
10.0	7.7	10.0	65.0
15.0	3.5	15.0	52.5
20.0	1.9	20.0	36.0
25.0	1.1	25.0	31.2
30.0	0.6	30.0	23.2
35.0	0.3	35.0	15.7
40.0	0.2	40.0	9.3

6.4.2.3 Test procedure

After weighing, the filter under test is connected into the air circuit at the top of chamber C. Air is drawn through the filter at a rate of 95 l/min and the flow through nozzle A is adjusted to 8.5 l/min. After the air flow has passed through the filter for 3 minutes, to allow the filter to reach equilibrium, sufficient dust is introduced into the hopper H so that the filter may collect 1,5 g of dust (as determined by prior calibration, approximately 70 % of the dust introduced into H will be collected on the filter under test). The test shall be stopped when either 1,5 g of dust has been collected or if the pressure drop across the filter exceeds 4 mbar for a P1 filter or 5 mbar for a P2 filter.

After collection of approximately 1,5 g of dust, the filter is removed from the chamber, brushed to remove dust on the exterior of the filter assembly and reweighed.

Filters without pre-filters - nine different filters are tested under each humidity condition. The mean final pressure drop and dust collection under each humidity condition is calculated. Filters with pre-filters - three main filters, each tested with three new pre-filters, shall be tested under each humidity condition.

In the case of respirators fitted with more than one filter assembly - the complete filter system shall be tested as a single unit.

6.4.2.4 Estimation of the results

The breathing resistance and the penetration shall be measured before and after the loading with coal dust.

The amount of dust deposited on the filter is determined.

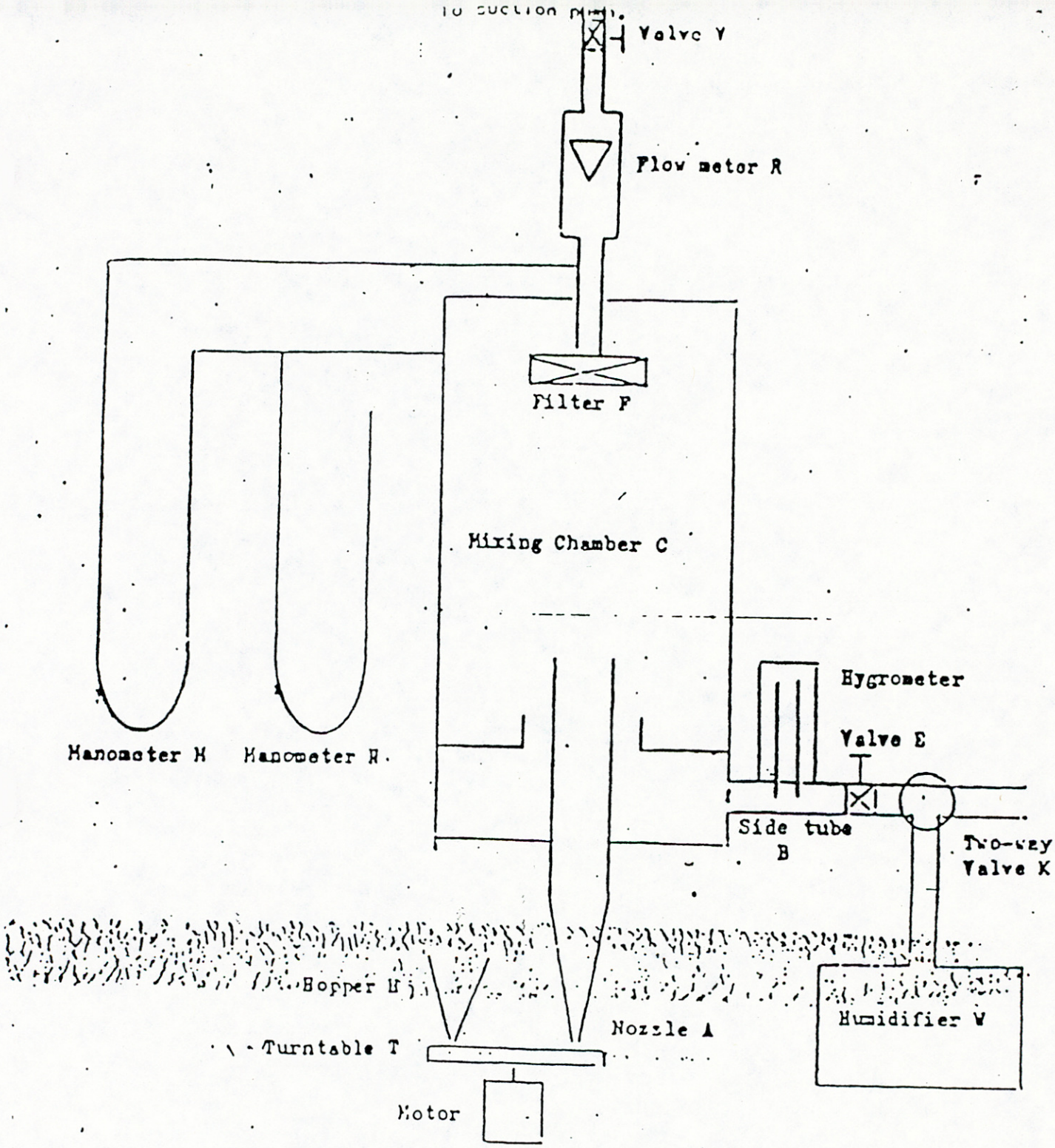
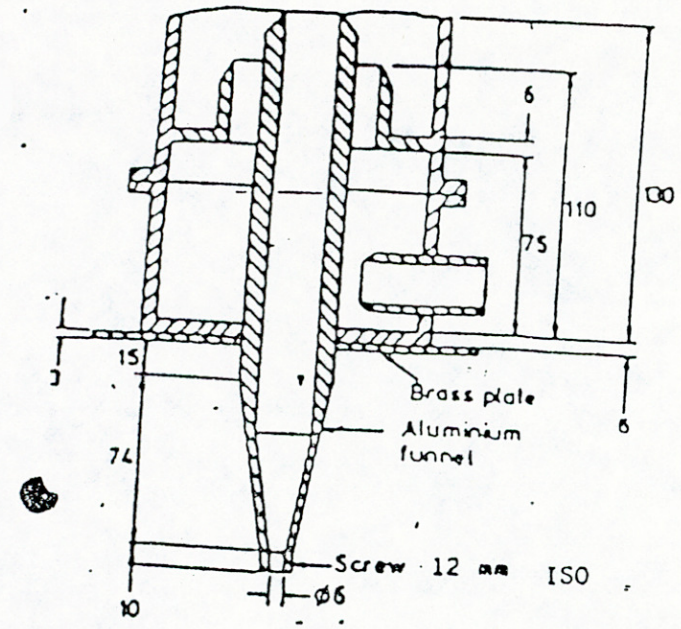
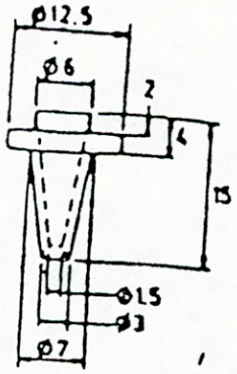
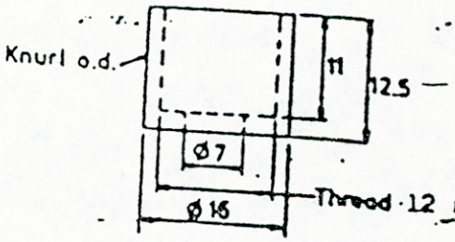


Figure 14 - Coal dust clogging test apparatus

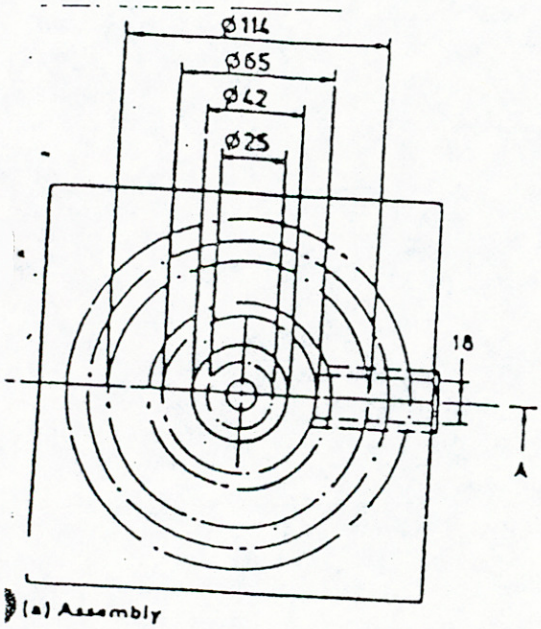




(b) Brass nozzle, A



(c) Brass retaining ring



(a) Assembly

Detail of base of mixing chamber C and nozzle A as shown in figure

Figure 15 - Details of coal dust clogging test apparatus

7. Directions for use

7.1 Directions for us shall accompany every pack.

7.2 They shall:

7.2.1 Be in the language of the country of application.

7.2.2 Be sufficiently illustrated to exclude any doubt about which article it is dealing with, respectively through number and mark ascertain that the filter can be identified.

7.2.3 Describe how the filter shall be inserted in the mask to be ready for operation.

7.2.4 Shall comprise the application and limitations to use eg. is the filter intend to be used in industry or in the coal mining industry.

7.2.5 Give reference to the approval document for filters described.

7.3 Give any other information, that the manufacturer may consider relevant.

8. Marking

8.1 All encapsulations of encapsulated filters and all packages containing unencapsulated filters shall be marked with:

8.1.1 Type and class: P1, P2 or P3.

8.1.2 Colour code: white
(Silver or light metal in regarded as a neutral colour.)

8.1.3 Manufacturers' name, trade mark or other means of identification and the number of this standard.

8.1.4 All filters, including unencapsulated which do not pass the paraffin-oil test must be cleary marked "For use against solid and water based aerosols only".

8.1.5 The date (at least the year) of expiry, when the filter does not meet the requrements after the temperature treatment.

8.1.6 The sentence "See directions for use" in the language of the country of application.

8.2 The marking shall be as clearly visible and as durable as possible.

Part 9

Document ~~CEN~~/TC 79/SG 4 - 178 E

EUROPEAN STANDARD
NORME EUROPEENNE
EUROPÄISCHE NORM

DRAFT
~~pr~~EN 141
December 1986

English version

RESPIRATORY PROTECTIVE DEVICES

GAS FILTERS AND COMBINED FILTERS

REQUIREMENTS, TESTING, MARKING

Anticipates - DIN future requirements

Document CEN/TC 79/SG 4 - 169 E was discussed during the meetings of CEN/TC 79/SG 4 in Vienna, October 1986. The decisions were incorporated into this draft.

Preamble:

A given respiratory 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 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 and field of application

This European Standard refers to gas filters and combined filters for respiratory protective devices, except escape apparatus and filtering facepieces. It specifies minimum requirements for gas filters and combined filters for use as part of respiratory protective devices.

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

2 References

prEN 143	Respiratory Protective Devices; Particle Filters, Requirements, Testing, Marking
prEN 148	Respiratory Protective Devices Connectors; Dimensions

3 Definition and description

Gas filters remove specified gases and vapours.

Combined filters remove dispersed solid and/or liquid particles, and specified gases and vapours.

4 Classification

According to their application and protection capacity gas and combined filters are classified in types and classes.

4.1 Types of filters

Gas filters are contained in one of the following types or combinations of them. If a filter is a combination of types, it shall meet the requirements of each type separately.

4.1.1 Types A, B, E and K

Type A: For use against certain organic gases and vapours with a boiling point higher than 65° C as specified by the manufacturer.

The requirements for filters for use against organic low boiling compounds will be given in a separate standard.

Type B: For use against certain inorganic gases and vapours as specified by the manufacturer (excluding carbon monoxide)

Type E: For use against sulphur dioxide and other acid gases and vapours as specified by the manufacturer

Type K: For use against ammonia and organic ammonia derivatives as specified by the manufacturer

4.1.2 Special filters

Type NO–P3: For use against nitrogen oxides, e.g. NO, NO_2, NO_x.

Type Hg–P3: For use against mercury.

Special filters shall always include a P3 filter.

4.2 Classes of filters

Gas filters of types A, B, E, and K are classified in one of the following classes

Class 1	Low capacity filters
Class 2	Medium capacity filters
Class 3	High capacity filters

The protection provided by a class 2 or class 3 filter includes that provided by the corresponding filter of lower class or classes.

Only one class of special filters has been specified.

5 Requirements

If the gas filter is combined with a particle filter, the combined filter shall meet the penetration requirement for the particle filter as described in prEN 143 in addition to the requirements described below.

5.1 Construction

The connection between filter(s) and facepiece shall be robust and leaktight.

The connection between filter and facepiece may be achieved by a permanent or special type of connection or by a screw thread connection (including threads other than standard threads). If a standard thread is used it shall be in accordance with the relevant European Standard. If the filter is a twin filter designated to be used with a twin filter facepiece, it shall not be possible to connect it to the standard thread connector.

The filter shall be readily replaceable without use of special tools and shall be designed or marked to prevent incorrect assembly.

The particle filter of combined filters shall be on the influent side of the gas filter.

The maximum weight of filter(s) used in half masks is 300 g.

The maximum weight of filter(s) designated to be used directly connected to a full face mask is 500 g.

5.2 Materials

The filter shall be made of suitable material to withstand normal usage and exposures to those temperatures, humidities and corrosive environments that are likely to be encountered. Internally it shall withstand corrosion by the filtering media.

Dust from the filter media released by the air flow through the filter must not constitute a hazard or nuisance for the wearer.

The manufacturer shall state the data of expiring of shelf life and shall guarantee the shelf life of the filter when stored properly with unbroken seal.

5.3 Vibration

Before testing for breathing resistance and protection capacity the filters shall be subjected to a vibration test in accordance with 6.1 simulating rough usage of the filter.

After this treatment the filters shall show no mechanical defects and shall meet the requirements for breathing resistance and protection capacity.

5.4 Breathing resistance

The resistance imposed by filter(s) to the flow of air shall be as low as possible and in no case exceed the maximum figures shown in table 1 when tested in accordance with 6.2.

Table 1 - Maximum breathing resistance

Filter type and class	Maximum resistance mbar[x)] at 30 l/min	at 95 l/min
Types A,B,E, and K		
1	1,0	4,0
1-P1	1,6	6,1
1-P2	1,7	6,4
1-P3	2,2	8,2
2	1,4	5,6
2-P1	2,0	7,7
2-P2	2,1	8,0
2-P3	2,6	9,8
3	1,6	6,4
3-P1	2,2	8,5
3-P2	2,3	8,8
3-P3	2,8	10,6
NO-P3	2,6	9,8
Hg-P3	2,6	9,8

Note: For particle filters P1, P2 and P3, see EN 143.

x) 1 bar = $10^5 N/m^2$ = 100 kPa

5.5 Protection capacity

When tested in accordance with 6.3 the filters shall meet the following requirements:

5.5.1 Filters type A, B, E and K

Table 2 - Protection capacity

Filter type and class	Test gas	Minimum capacity at test condition 8	Minimum breakthrough time at test condition min
A 1	CCl_4	15,4	80
B 1	Cl_2	1,8	20
	H_2S	1,7	40
	HCN	0,84	25
E 1	SO_2	1,6	20
K 1	NH_3	1,05	50
A 2	CCl_4	38,4	40
B 2	Cl_2	9,0	20
	H_2S	8,5	40
	HCN	4,2	25
E 2	SO_2	8,0	20
K 2	NH_3	4,2	40
A 3	CCl_4	115,2	60
B-3	Cl_2	27,0	30
	H_2S	25,6	60
	HCN	11,8	35
E 3	SO_2	23,9	30
K 3	NH_3	12,6	60

5.5.2 Special filters

Table 3 - Protection capacity

Filter type	Test gas	Minimum capacity at test condition (g)	Minimum breakthrough time at test condition
NO-P3	NO	1.88	20 min
	NO_2	2.87	20 min
Hg-P3	Hg (Vapour)	2.34	100 hours

6 Methods of test:

All performance tests shall be conducted so that the test gas or air will pass through the filter horizontally. Each test shall be conducted with at least 3 specimens conditioned only by the vibration test described in 6.1.

If the gas filter is combined with a particle filter, the combined filter shall be submitted for penetration test for the particle filter as described in prEN 143 in addition to the tests described below.

When a single filter of a twin filter is tested separately the air flow specified for a test may be halved. If, however, it is possible that the single filter may be used alone, then the full air flow shall be used for testing.

6.1 Vibration

6.1.1 Test equipment

The apparatus as shown schematically in figure 1, consists of a steel case (K) which is fixed on a vertically moving piston (S), capable of being lifted up 20 mm by a rotating cam (N) and dropping down onto a steel plate (P) under its own mass as the cam rotates. The mass of the steel case shall be over 10 kg.

6.1.2 Test procedure

The filters shall be tested as received, removed from their packing but still sealed.

The filters shall be placed on their sides in the case (K) so that they do not touch each other during the test, allowing 6 mm horizontal movement and free vertical movement. After vibration testing any loose material that may have been released from the filter shall be removed prior to the performance testing.

The test rig is operated at the rate of approximately 100 rotations per minute for approximately 20 minutes and a total of 2000 rotations.

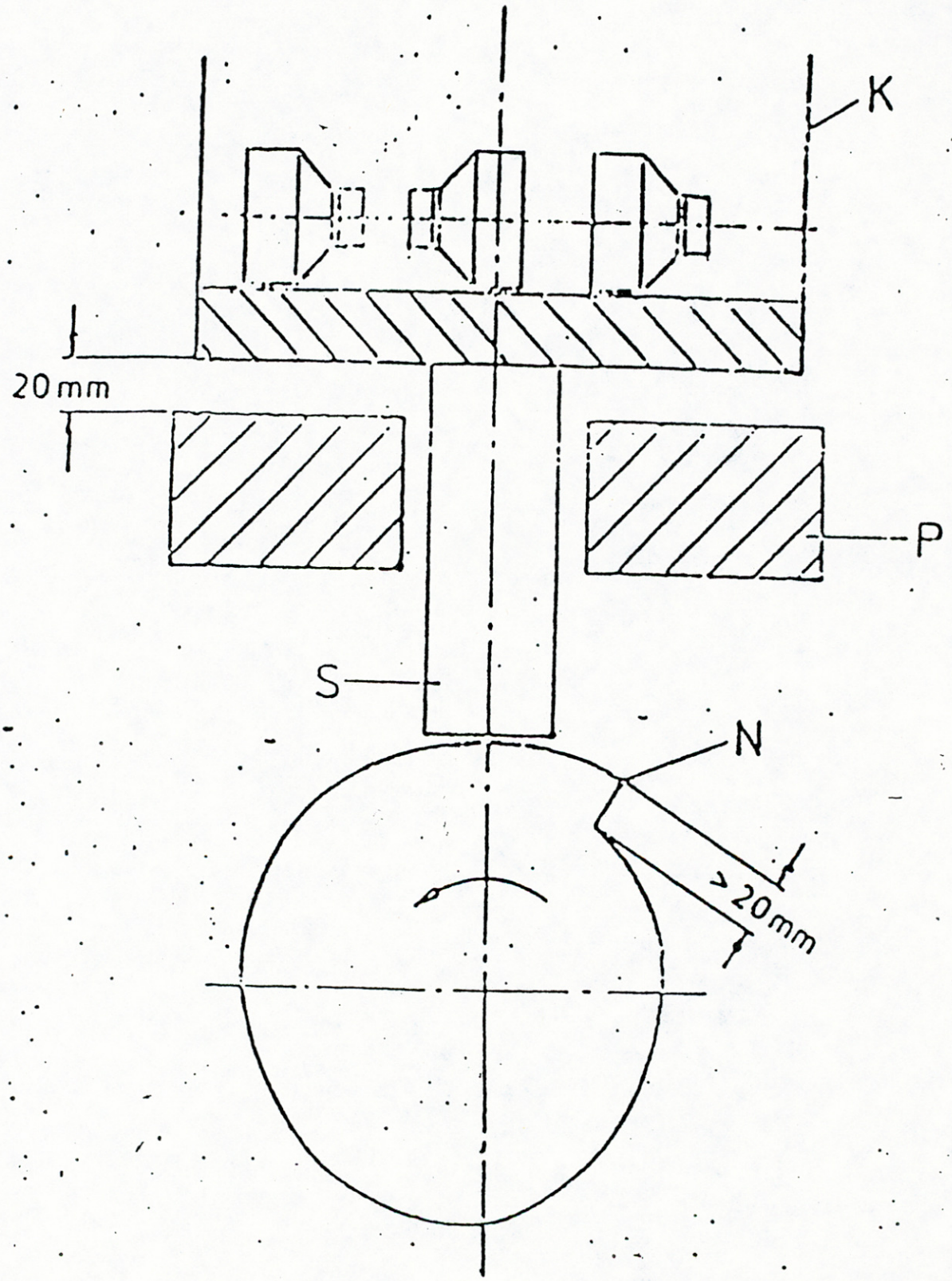


Figure 1 - Test equipment for vibration test

6.2 Breathing resistance

After vibration test the filter shall be connected in a leak-tight manner by means of an adapter of suitable shape to the suitable test equipment.

Testing shall be carried out at two flow rates (30 and 95 l/min) with air at room temperature, normal atmosperic pressure and of such humidity that condensation does not occur.

6.3 Protection capacity

Protection capacity shall be tested after the vibration and breathing resistance tests.

Each test shall be made with a minimum of three specimens. For each test gas a new corresponding filter shall be used.

Any convenient experimental method may be employed for obtaining the specified influent concentration, and for measuring the effluent concentration, provided they conform with the following limits:

Influent concentration: within $\pm$ 10 % of specified value

Effluent concentration: within $\pm$ 20 % of specified value

The recorded breakthrough time should be adjusted if necessary by simple proportion to conform with the specified influent concentration.

Protection capacity (minimum breakthrough time) is measured at a flow rate of (30 $\pm$ 0,5) l/min, at (70 $\pm$ 2) % relative humidity at (20 $\pm$ 1 °C)

6.3.1 Filters type A, B, E and K

Table 4 - Test conditions for gas filters of types A,B,E and K

Filter type and class	Test gas	Test gas concentration in air		Breakthrough concentration **
		% by volume	mg/l	(ppm)
A1	CCl_4	0,1	6,4	10
B1	Cl_2	0,1	3,0	0,5
	H_2S	0,1	1,4	10
	HCN	0,1	1,1	10[x]
E1	SO_2	0,1	2,7	5
K1	NH_3	0,1	0,7	25
A2	CCl_4	0,5	32,0	10
B2	Cl_2	0,5	15,0	0,5
	H_2S	0,5	7,1	10
	HCN	0,5	5,6	10[x]
E2	SO_2	0,5	13,3	5
K2	NH_3	0,5	3,5	25
A3	CCl_4	1,0	64,0	10
B3	Cl_2	1,0	30,0	0,5
	H_2S	1,0	14,2	10
	HCN	1,0	11,2	10[x]
E3	SO_2	1,0	26,6	5
K3	NH_3	1,0	7,0	25

[x] C_2N_2 may sometimes be present in the effluent air. The total concentration of (C_2N_2 + HCN) should not exceed 10 ppm at breakthrough.

** The breakthrough concentration is an arbitrary value and it is used only to define the end point of the filter capacity under laboratory testing conditions.

6.3.2 Special filters

Table 5 - Test conditions for special filters.

Filter type	Test gas	Test gas concentration in air	Breakthrough concentration
NO-P3	NO^{x}	0.25 % by volume 3.1 mg/l	5 ppm^{xx}
	$NO_2{}^{x}$	0.25 % by volume 4.8 mg/l	5 ppm^{xx}
Hg-P3	Hg (vapour)	1.6 ml/m^3 (13±1)mg/m^3	0.1 mg/m^3

x The test gas shall be at least 95 % pure. This is probably best obtained as compressed gas in cylinders.

xx Both NO and NO_2 may be present in the effluent air. The total concentration of (NO + NO_2) must not exceed 5 ppm. A detection method must be used which is capable of differentiating NO and NO_2.

7 Directions for use

7.1 Directions for use shall accompany every pack.

7.2 They shall:

7.2.1 Be in the language of the country of application.

7.2.2 Be sufficiently illustrated to exclude any doubt which article it is dealing with, respectively through number and mark ascertain that the filter can be identified.

7.2.3 Describe how the filter shall be inserted in the mask to be ready for operation.

7.2.4 Shall comprice the application and limitations to use.

7.2.5 Give reference to the approval document for filters described.

7.2.6 Give any other information, that the manufacturer may consider relevant.

8 Marking

8.1 All filters shall be marked with:

8.1.1 Type, class and colour code

Type	Class	Colour
A	1, 2 or 3	Brown
B	1, 2 or 3	Grey
E	1, 2 or 3	Yellow
K	1, 2 or 3	Green
P	1, 2 or 3	White

or combinations of them.

NO-P3	Special filter	Blue-white
Hg-P3	" "	Red-white

Type NO-P3 filter shall be marked with the sentence: "For single use only". Type Hg-P3 filter shall be marked with the sentence: "Maximum use time 50 hours".

(Silver or light metal is regarded as a neutral colour.)

.1.2 Subassemblies and piece parts with considerable bearing on safety shall be marked so that they can be identified.

.1.3 Manufacturers' name, trade mark or other means of identification and the number of this standard.

.1.4 Year and month of expiry.

.1.5 The sentence "See directions of use" in the language of the country of application.

.2 The marking shall be as clearly visible and as durable as possible.

Draft for Development

Respiratory protective equipment

Part 14. Specification for power assisted particle filtering devices incorporating full face masks, half masks and quarter masks

Projet à développer
Appareils de protection respiratoire
Partie 14. Appareils filtrants contre les particules à ventilation assistée avec masques complets, demi-masques et quarts de masques

Entwurf zur weiteren Ausarbeitung
Atem schutzgeräte
Teil 14. Vollmasken, Halbmasken und Viertelmasken mit Partikelfilter und Gebläse

British Standards Institution

Contents

This publication is not to be regarded as a British Standard

It is being issued in the Draft for Development series of publications and is of a provisional nature because the draft European Standard that it reproduces, prEN 147 'Respiratory protective equipment – Power assisted particle filtering devices incorporating full face masks, half masks and quarter masks' is under further review to improve certain of its contents. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

A review of this Draft for Development will be carried out not later than two years after its publication.

Notification of the start of the review period, with a request for the submission of comments from users of this Draft for Development will be made in an announcement in the appropriate issue of *BSI News*. Observations which it is felt should receive attention before the official call for comments will be welcomed.

According to the replies received, the responsible BSI Committee will judge whether the Draft for Development can be converted into a British Standard or what other action should be taken.

Foreword

This Draft for Development has been prepared under the direction of the Personal Safety Equipment Standards Committee and its technical content is identical with that agreed at the meeting of CEN/TC 79, Respiratory protection, held in November 1985.

This Draft for Development is one of a series dealing with respiratory protection devices based on CEN draft documents and is being published in this way to enable experience to be gained in its use within the UK.

Other Parts published or in preparation in this series are as follows:

Part 1	Glossary of terms
Part 2	Classification
Part 3	Nomenclature of piece parts
Part 4	Schedule of equivalent terms
Part 5*	Specification for full face masks
Part 6*	Specification for half and quarter masks
Part 7*	Specification for mouthpieces
Part 8*	Specification for particle filters
Part 9*	Specification for gas and combined filters
Part 10*	Specification for fresh air hose breathing apparatus
Part 11*	Specification for compressed air line breathing apparatus
Part 12*	Specification for self-contained open circuit breathing apparatus
Part 13*	Specification for powered particle filtering devices incorporating helmets and hoods

* In preparation.

Specification

0 Introduction

A given piece of respiratory equipment can only be approved when the individual components satisfy the requirements of specifications which may be complete standards or parts of standards and man 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 weight distribution and respiratory characteristics are similar to those of the complete apparatus.

1 Object and field of application

This Draft for Development specifies minimum requirements for power assisted respiratory protection devices which incorporate a full face mask, half mask or a quarter mask together with a particle filter. It does not cover devices designed for use in circumstances where there is or might be an oxygen deficiency (i.e. oxygen less than 17 % by volume). It also does not cover respiratory protection devices designed for escape purposes.

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

2 References

BS 3928 Method for sodium flame test for air filters (other than for air supply to i.c. engines and compressors)

BS 4400 Sodium chloride particulate test for respirator filters

BS 5501 Electrical apparatus for potentially explosive atmospheres
Part 7 Intrinsic safety 'i'

BS 5969 Specification for sound level meters

DD 97 Respiratory protective equipment
*Part 5 Specification for full face masks
*Part 6 Specification for half and quarter masks
*Part 8 Specification for particle filters

3 Definitions and description

3.1 power assisted particle filtering device incorporating a full face mask, a half mask or a quarter mask. A device dependent on the ambient air. The device provides protection against solid, or solid and liquid aerosols of negligible volatility and decomposition or a combination of such aerosols. The device consists of:

(a) a full face mask, half mask or quarter mask;

(b) a power-operated blower which supplies filtered ambient air to the facepiece at a flow rate which maintains positive pressure inside the face piece up to peak inhalation flow of 120 L/min, (the energy supply for the blower may or may not be carried on the person);

(c) a filter or filters through which all the air supplied to the facepiece passes and which gives protection against solid and/or liquid aerosols or any combination of these (where the aerosol is wholly or partly liquid then the liquid has to be either water or have negligible volatility);

(d) an exhalation valve(s) through which surplus and exhaled air is discharged.

3.2 manufacturer's minimum design flow rate. The flow rate, as stated by the manufacturer, above which the class requirements are met.

4 Classification and designation

Devices are classified and designated as a function of their maximum total inward leakage as given in table 1.

Table 1. Classification of devices

Class	Maximum total inward leakage (power-on)
	%
PM 1	5
PM 2	1
PM 3	0.05

The total inward leakage shall be measured against sodium chloride at the manufacturer's minimum design flow rate which shall not be less than 120 L/min.

NOTE. The 'power-off' state is considered to be an abnormal situation. In this state total inward leakage is measured as required by 5.3.

5 Requirements

5.1 Materials

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

5.1.2 *Cleaning and disinfection.* The materials used shall withstand the cleaning and disinfecting agents recommended by the manufacturer.

*In preparation.

5.2 Facepieces

5.2.1 *General.* Where the facepiece is fitted with the standard thread connection as defined in DD 97 : Part 5 and therefore can be used with other equipment, for example with filters, it shall comply with the requirements of DD 97 : Part 5 or DD 97 : Part 6 as appropriate.

Where the facepiece is designed solely for use as a power assisted respirator it shall not be fitted with the standard thread connection and shall meet the requirements of 5.2.2 for full face masks and of 5.2.3 for half masks and quarter masks.

5.2.2 *Full face masks*

5.2.2.1 *Connection to full face mask*

5.2.2.1.1 The connection to the full face mask shall be gastight and shall withstand a tensile force of 500 N applied axially. Test time shall be approximately 10 s and the facepiece shall be held by the faceblank.

5.2.2.1.2 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.

5.2.2.2 *Exhalation valve*

5.2.2.2.1 A full face mask shall have at least one exhalation valve to allow the escape of exhaled air and, where applicable, any excess air delivered by the air supply.

5.2.2.2.2 The exhalation valve(s) shall be protected against dirt and mechanical damage and shall be shrouded or shall include any other device that may be necessary to comply with 5.3.

5.2.2.2.3 The exhalation valve(s) shall continue to operate correctly after a continuous exhalation flow of 300 L/min (short term, approximately 1 min). This shall be done immediately after the test in 6.4.

5.2.2.2.4 The exhalation valve housing, mounted in the facepiece shall withstand axially a tensile force of 150 N (short term, approximately 10 s).

5.2.2.3 *Head harness*

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

5.2.2.3.2 The head harness shall be adjustable and shall hold the full face mask firmly and comfortably in position.

5.2.2.3.3 Each strap shall withstand a pull of 150 N in the direction of pulling when the full face mask is donned (short term, approximately 10 s).

5.2.2.4 *Oculars and visor(s)*

5.2.2.4.1 Oculars and anti-fog discs designed to serve as oculars shall be attached in a reliable and gastight manner to the face blank.

5.2.2.4.2 Oculars shall not distort vision nor shall misting occur as subjectively determined in the course of testing as in 6.1.

5.2.2.4.3 The field of vision shall be adequate as determined in 6.1 and when tested in accordance with 6.7 of DD 97 : Part 5 shall meet the following requirements.

(a) The effective field of vision of a full face mask fitted with a single visor 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 %.

(b) The effective field of vision of a full face mask with two oculars shall be not less than 70 %, and the overlapped field of vision shall be not less than 20 %.

5.2.2.4.4 When tested in accordance with 6.8 of DD 97 : Part 5 oculars or visor shall not be damaged in any way that may make the mask ineffective. The effectiveness is tested in accordance with 6.8 of DD 97 : Part 5 by comparing the tightness of the full face mask before and after the test; when tested for leak tightness, the facepiece shall not indicate increased leakage after the test.

5.2.2.5 *Speech diaphragm.* Where the facepiece is designed with a speech diaphragm it shall be protected against mechanical damage and shall withstand a positive pressure of 15 mbar* and negative pressure of 80 mbar (static pressure).

5.2.2.6 *Resistance to temperature.* The facepiece shall show no appreciable deformation and there shall be no distortion of the lenses or visor after the facepiece has been exposed:

(a) for 72 h in a dry atmosphere at 70 °C; and

(b) for 72 h in an atmosphere of 70 °C and a relative humidity greater than 95 %; and

(c) for 24 h at −30 °C; and

(d) returned to ambient conditions.

5.2.3 *Half and quarter masks*

5.2.3.1 *Facepiece connector*

5.2.3.1.1 The connection shall be gastight.

5.2.3.1.2 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.

5.2.3.2 *Exhalation valve(s)*

5.2.3.2.1 A half or quarter mask shall have at least one exhalation valve to allow the escape of exhaled air and, where applicable, any excess air delivered by the air supply.

5.2.3.2.2 The exhalation valve shall be protected against dirt and mechanical damage and shall be shrouded or shall include any other device that may be necessary to comply with 5.3.

*1 mbar = 100 N/m² = 100 Pa.

5.2.3.2.3 The exhalation valve shall continue to operate correctly after a continuous exhalation flow of 300 L/min (short term, approximately 1 min). This shall be done immediately after 5.7.

5.2.3.2.4 Where the exhalation valve housing is attached to the face blank, it shall withstand axially a tensile force of 50 N (short term, approximately 10 s).

5.2.3.3 *Head harness*

5.2.3.3.1 The head harness shall be designed so that the half or quarter mask can be donned and removed easily.

5.2.3.3.2 The head harness shall be adjustable and shall hold the half or quarter mask firmly and comfortably in position.

5.2.3.3.3 Each strap shall withstand a pull of 50 N in the direction of pulling when the half or quarter mask is donned (short term, 10 s).

5.2.3.4 *Field of vision.* The field of vision shall be adequate as determined in 6.1.

If the field of vision has to be tested by an independent test method the half or quarter mask should be tested in accordance with 5.2.2.4.3. This also applies when the rest of the equipment (intended to be used with the half or quarter mask) is connected.

5.3 Total inward leakage

When tested using the power assisted air supply at the manufacturer's minimum design flow rate by the method described in 6.1, the mean total inward leakage (TIL) of the test aerosol for each of the exercises shall be within the levels set in clause 4, for each of ten test subjects. The equipment shall also be tested on three test subjects only for TIL with the power off. Maximum TIL results shall be not greater than those given in table 2 for each class.

Table 2. 'Power-on' and 'power-off' classification requirements

Class	'Power-on' maximum total inward leakage*	'Power-off' maximum total inward leakage
	%	%
PM 1	5	10
PM 2	1	10
PM 3	0.05	5

*As specified in clause 4.

5.4 Exhalation valve

The exhalation valve shall be so designed that it does not reverse when tested in accordance with 6.2.1.

5.5 Breathing resistance

5.5.1 *General.* The breathing resistance as specified in 5.5.2 and 5.5.3 shall be measured after the clogging tests specified in 5.7 have been completed.

5.5.2 *Inhalation resistance.* When tested in accordance with 6.2.1 the inhalation resistance shall not exceed 11 mbar. When tested in accordance with 6.2.2 the peak inhalation resistance shall not exceed 3.5 mbar.

5.5.3 *Exhalation resistance.* When tested in accordance with 6.2.2 the exhalation resistance shall not exceed 7 mbar.

5.6 Air supply

5.6.1 When mounted on a dummy head and tested in accordance with 6.4 at the extremes of operating temperatures and humidities as claimed in the instructions (see clause 8) the flow into the facepiece shall exceed the manufacturer's minimum design flow rate which shall not be less than 120 L/min for the manufacturer's design duration which shall not be less than 4 h.

5.6.2 The air supply shall not be capable of being switched off inadvertently.

5.7 Resistance to clogging

At the end of the clogging test in accordance with 6.3, the flow rate shall not drop below the manufacturer's minimum design flow rate and the filters shall meet the penetration requirements of 5.10.

5.8 Electrical components

If the power supply is a battery it shall be a non-spillable type, and where necessary shall be provided with a safe venting device.

Electrical components shall be so designed that it is not possible inadvertently to reduce or reverse the air flow.

If the device is claimed to be intrinsically safe it shall comply with BS 5501.

5.9 Hoses

Any breathing hose shall permit free head movement and shall not restrict or close off the air supply under chin or arm pressure.

5.10 Filters

Filters, other than pre-filters shall be designed to be irreversible and shall be readily replaceable without the use of special tools. The performance of the filters shall conform to table 3 and shall be tested using the test methods described in DD 97 : Part 8 at the initial flow rate measured in 6.4.

Table 3. Performance requirements and designation of filters

Class	Maximum initial penetration	
	Sodium chloride	Paraffin oil
	%	%
PM 1	5	2
PM 2	1	0.5
PM 3	0.05	0.03

Filters suitable for use against solid and liquid aerosols shall be tested against sodium chloride and paraffin oil.

Filters suitable only for use against solid aerosols and water based aerosols shall be tested against sodium chloride only.

5.11 Noise

The noise generated by the device shall not exceed 75 dB(A) when measured in front of the ear entrance using the method described in 6.5 and shall be measured on a test subject using the complete set of filters designed to be used with the device.

5.12 Carbon dioxide content of the inhalation air

When tested in accordance with 6.6 but with the power switched off, the carbon dioxide content of the inhalation air shall not exceed an average of 2 % by volume.

5.13 Resistance to flame

The device shall not grossly deform, decompose or continue to burn after testing in accordance with 6.7.

6 Testing

6.1 Total inward leakage

6.1.1 *Principle.* Each test subject, wearing the complete device to be tested walks on a horizontal treadmill surrounded by a standard cloud of sodium chloride particles. The flow rate is adjusted to, and maintained at the manufacturer's minimum design flow rate using a variable voltage supply. The battery fitted to the device is not used. The percentage inward leakage of the test cloud into the breathing zone is measured by means of flame photometry. Determination of the inward leakage is possible in the range of 0.001 % to 100 % penetration. Dilution of the test cloud by the clean air emanating from the respirator under test does not affect the accuracy of measurement of inward leakage because of the large volume continuous replacement.

6.1.2 *Test subjects and number of tests.* Two devices shall be tested, each being tested on five test subjects. Each test shall be carried out using a new filter.

6.1.3 *Test equipment.* The test cloud of sodium chloride particles is formed by the evaporation of an atomized 2 % aqueous solution of reagent grade sodium chloride. The single atomizer is of the Collison type as specified in BS 3928. The atomizer is supplied with air at a pressure of 7 bar and a flow of 100 L/min. The atomizer shall be situated in a duct through which a constant flow of air is maintained. A typical test arrangement is shown in figure 1.

The duct shall lead into the top of an enclosure positioned over a treadmill; the enclosure shall be large enough to permit walking on the treadmill without interference.

The mean air flow through the enclosure measured with a subject standing centrally on the treadmill shall be between 0.15 m/s and 0.2 m/s. The air flow at any point in the effective working volume of the enclosure shall be not less than 0.10 m/s, i.e. measurements shall not be made at points nearer than 100 mm to the sides of the enclosure, below 750 mm from the base of the enclosure nor above a height at which the sodium chloride concentration differs by more than 10 % from the average concentration. The relative humidity of the air within the enclosure when the atomizer is in operation shall not exceed 60 %, this may necessitate drying the air before it flows past the atomizer. The air temperature shall be not less than 15 °C.

The mean sodium chloride concentration within the effective working volume of the enclosure shall be 8 ± 4 mg/m^3 and the variation throughout the effective working volume shall be not more than ± 10 %. If necessary a baffle may be placed at the end of the duct in order to achieve these conditions. The particle size distribution shall be 0.02 µm to 2 µm equivalent aerodynamic diameter with a median diameter of 0.6 µm.

The concentration of sodium chloride is determined by flame photometry, the design of the photometer is specified in BS 3928 and BS 4400. The sample tubes shall consist of plastics tubing with a nominal inside diameter of 4 mm through which air is drawn at a rate of 3 L/min by means of a suitable pump. The pump shall be chosen so as to minimize aerosol losses within the pump and also to minimize the change in flow rate caused by changing pressure within the sampling zone.

NOTE 1. Some types of reciprocating diaphragm pumps have proved to be suitable.

The sample shall then be diluted with a further 9 L/min of clean air before being fed to the flame tube of the photometer. Two separate sample tubes shall be provided, one to measure the ambient concentration within the enclosure and one to measure the concentration in the wearer's breathing zone. A test probe with a minimum bore of 1.5 mm may be fitted to the latter sample tube in order to obtain a sample from the required region, the design of the probe shall be chosen to suit the device being tested. The sample tube connected to the facepiece shall be as flexible as possible.

NOTE 2. The sample tube is preferably made of silicone or other rubber.

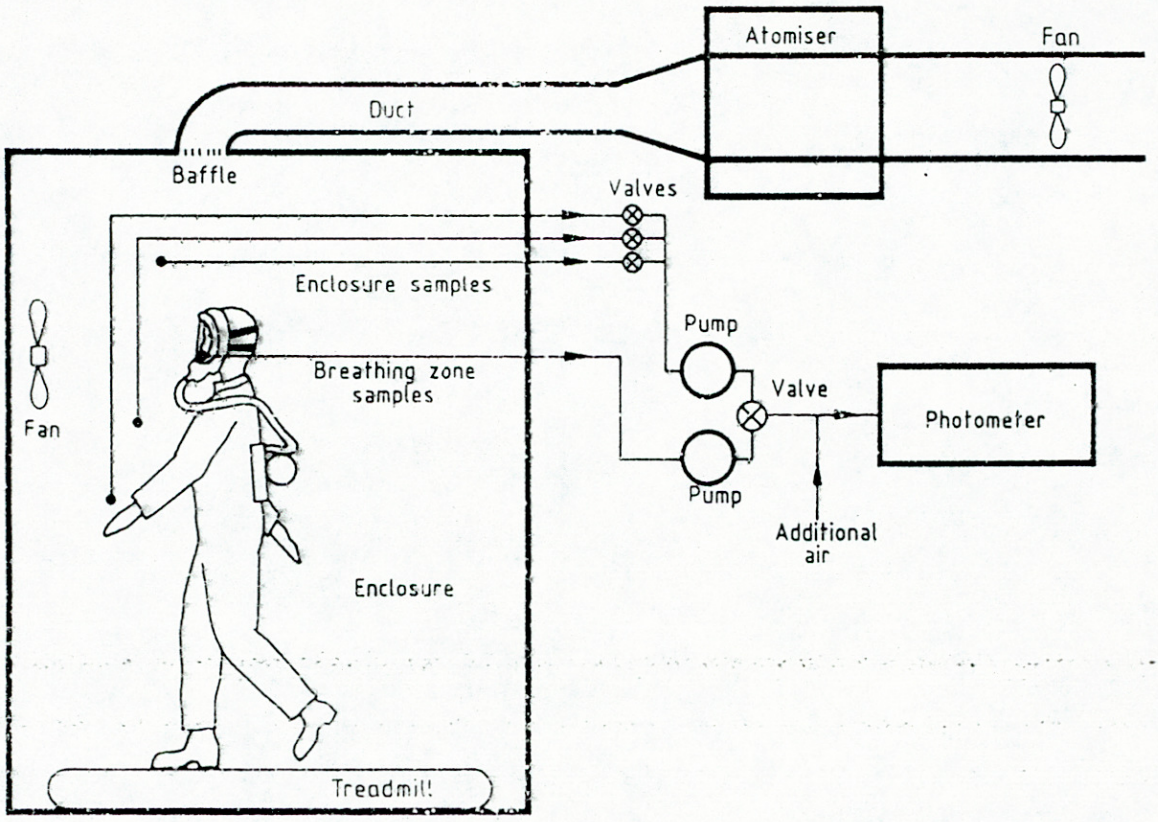


Figure 1. Schematic diagram of apparatus used in the determination of total inward leakage

This tube or probe shall not affect the face seal during head movements.

6.1.4 *Test procedure.* All the sample tubes shall initially be placed in close proximity to one another within the enclosure and the resistance of the sample tubes adjusted, e.g. by means of a screw clip, so that identical readings for the sodium chloride concentration are obtained from each sample tube (this is in effect a calibration).

Provide the test subject with the device and the manufacturer's fitting instructions and allow the test subject to fit the device satisfactorily.

Check the zero reading of the test equipment before commencing the tests.

Adjust the flow rate to the manufacturer's minimum design flow rate.

The test subject, wearing the equipment, shall stand on the treadmill and the concentration of the test cloud shall be checked at head, chest and waist height.

The test subject shall then stand on the treadmill for a further two to three minutes in order to allow the concentration within the wearer's breathing zone to stabilize.

After this period the following exercises shall be performed by the test subject:

(a) standing in an upright position for 2 min;

(b) walking for 4 min at 6 km/h on the treadmill;

(c) then whilst still walking

(1) turning head from side to side (approximately 15 times) at his own but normal speed for 2 min;

(2) moving head up and down (approximately 15 times) at his own but normal speed for 2 min;

(3) reciting alphabet aloud for 2 min;

(d) followed by walking for 2 min at 6 km/h on the treadmill;

(e) standing in an upright position for 2 min.

Measure the salt concentration within the breathing zone during the whole period of the exercises.

6.1.5 *Calculation and expression of results.* The total inward leakage (TIL) expressed as a percentage for each of the exercises is calculated from the equation

$$TIL = \frac{C_b}{C_e} \times 100$$

where

C_b is the mean concentration in breathing zone for each exercise and for each test subject;

C_e is the concentration in enclosure.

6.2 Breathing resistance

6.2.1 *Respirator power supply switched off.* The device shall be mounted on a Sheffield dummy head attached to a breathing machine adjusted to 25 strokes/min and 2 L/stroke. The inhalation resistance shall be measured near the mouth of the dummy head.

6.2.2 *Respirator power supply switched on.* The device shall be fitted on a Sheffield dummy head and operated according to the instructions for use with fully charged batteries and a clean filter. The resistance shall be measured near the mouth of the dummy to which a breathing machine adjusted to 25 strokes/min and 2 L/stroke is applied.

6.3 Clogging tests

The clogging test is that described in DD 97 : Part 8.

The filter and fan shall be in the test atmosphere for the test. The device is operated at a dust concentration of 400 ± 100 mg/m^3 until the product of dust concentration and the testing time is:

400 mg·h/m^3 for PM 1 and PM 2 and
200 mg·h/m^3 for PM 3

e.g. for a PM 1 filter 400 mg/m^3 for 1 h or 300 mg/m^3 for 1.33 h.

At the end of this test the device is taken out of the dust chamber, cleaned on the outside if necessary, and tested for flow rate and for the penetration requirements at this flow rate in accordance with DD 97 : Part 8.

6.4 Determination of air supply flow rate

6.4.1 *Principle.* The flow of filtered air to the device is measured at zero back pressure. The initial flow rate and the flow rate after 4 h are measured.

6.4.2 *Apparatus*

6.4.2.1 *Dummy head* fitted with mouth tube and pressure port at the mouth (Sheffield head).

6.4.2.2 *Vacuum cleaner* or other means of extracting in excess of 250 L/min of air at −5 mbar pressure.

6.4.2.3 *Control means* for extraction system such as a variable power regulator for the motor or an adjustable bleed in the air supply pipework.

6.4.2.4 *Flowmeter* calibrated from 50 L/min to 500 L/min.

6.4.2.5 *Micromanometer* capable of detecting a pressure difference of ± 0.05 mbar and with a range not less than 10 mbar.

NOTE. An inclined liquid manometer or an electronic micromanometer is recommended.

6.4.2.6 *Tubing* for connections.

6.4.3 *Preparation of device and apparatus*

6.4.3.1 *General.* Fit a fully charged battery and a new filter(s) to the device.

In order to ensure a fully charged battery the following procedure is recommended.

Operate the respirator normally until there is an audible decrease in air flow. Place the battery on charge in accordance with the manufacturer's instructions, or, if no instructions are given, charge for a period of 14.5 h.

6.4.3.2 *Devices fitted with full face pieces.* Fit the full facepiece in a leak tight manner to the dummy head and connect the micromanometer, flowmeter and vacuum cleaner system as outlined in figure 2.

6.4.3.3 *Devices fitted with half masks and quarter masks.* Seal the device with PVC tape onto the dummy head ensuring a leak tight fit. Connect the other parts of the apparatus as shown in figure 3.

6.4.4 *Procedure : initial flow rate*

6.4.4.1 Connect the respirator power pack to the facepiece and switch on.

6.4.4.2 Switch on and adjust the suction device so that zero pressure is indicated within the facepiece by the micromanometer.

6.4.4.3 Record the flow from the facepiece.

It is possible that the flow past the pressure port can influence the recorded pressure. This can be checked by the following procedure.

(a) Switch off the suction device and remove the facepiece from the dummy head.

(b) Switch back on and adjust the suction device so that the previously recorded flow is registered on the flowmeter.

(c) Check that the micromanometer reads zero with this flow through the head. If a zero reading is obtained proceed with 6.4.4.4. If the micromanometer fails to read zero adjust it back to zero still with the air flowing through the dummy head.

(d) Switch off the suction device and fit the facepiece to the dummy head. Remeasure the flow of filtered air using the corrected micromanometer setting.

(e) Repeat the operations listed in (a) to (d) so that by a method of successive approximations the true flow of filtered air through the facepiece at zero back pressure is obtained. The error should be less than 5 L/min.

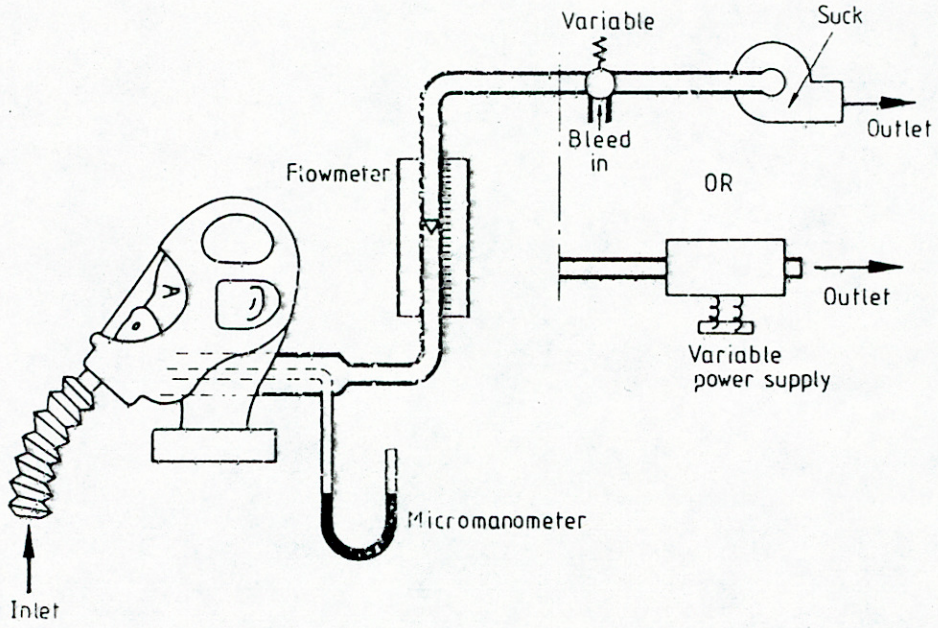


Figure 2. Measurement of air supply rate (full face mask)

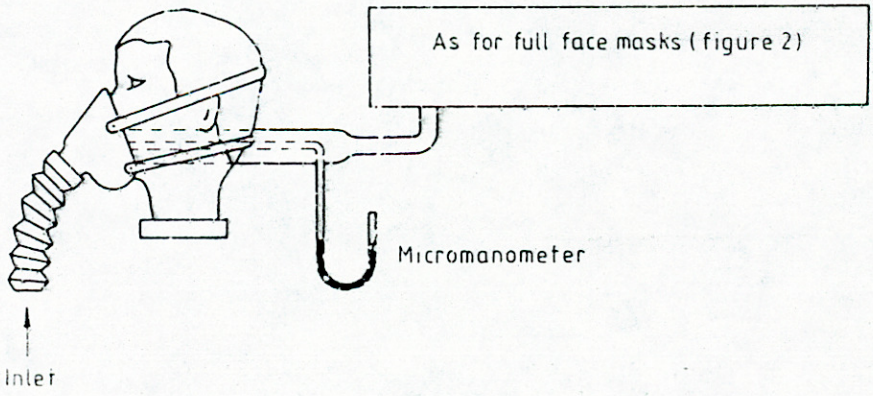


Figure 3. Measurement of air supply rate (half and quarter masks)

6.4.4.4 Continue to ensure zero back pressure and repeat the measurement at intervals of 5 min until a total time of 30 min has elapsed.

6.4.4.5 Calculate the average of the six measurements and report as the initial flow rate.

6.4.5 *Procedure : duration.* After measuring the initial flow rate as described in 6.4.4, disconnect the rubber hose from the dummy head and seal the mouth tube with a rubber bung. All the filtered air now escapes via the exhalation valve.

Allow the device to run for 3 h.

After 3 h reconnect the rubber hose and unseal the mouth tube.

Measure and record the flow rate as described in 6.4.4 at intervals of 10 min up to a total elapsed time (including the first 30 min for initial flow rate measurement) of 4 h 10 min.

Report the flow rate after 4 h running.

6.5 Determination of noise level generated by the device

6.5.1 *Principle.* The device is worn by a test subject and the noise level (in dB(A)) is measured at the subject's ears.

6.5.2 *Apparatus*

6.5.2.1 *Microphones* with a diameter of not greater than 7 mm capable of being fitted at the wearer's ears.

6.5.2.2 *Sound level meter* of type 1 or type 2 as specified in BS 5969.

6.5.3 *Procedure*

6.5.3.1 Calibrate the sound level meter in accordance with the manufacturer's instructions.

6.5.3.2 Ensure that the device to be tested is equipped with a fully charged battery and one of the filters designed to be used with the device.

6.5.3.3 Fix the microphones to the test subject at the centres of each of the external ears and level with the tragions.

6.5.3.4 Have the test subject don the device.

6.5.3.5 Switch on the power supply on the device and measure, in succession, the sound pressure level at each of the two ears with the sound level meter set to indicate frequency weighting characteristics A.

6.5.3.6 Average the readings from the two ears on an energy equivalent basis.

6.5.3.7 Check that the background noise level in the test room is not less than 10 dB(A) lower than that measured for the device and adjust the background level as necessary to meet this condition.

6.5.3.8 If the condition in 6.5.3.7 is satisfied repeat 6.5.3.2 to 6.5.3.6 for another device. If not, after adjusting the background level, repeat 6.5.3.2 to 6.5.3.6 for the two devices.

6.5.3.9 Report the average of the results from the two devices (found from 6.5.3.6) as the noise generated by the device.

6.5.3.10 Repeat the procedure for the complete set of filters designed to be used with the device.

6.6 Determination of carbon dioxide content of the inhalation air

The device is fitted on a dummy head with the power switched off. Breathing air is supplied from a breathing machine adjusted to 25 strokes/min and 2 L/stroke, and the exhaled air shall have a carbon dioxide content of 5 % by volume. A typical test arrangement is shown in figure 4.

The test shall be performed until the carbon dioxide in the inhaled air reaches a steady value.

6.7 Determination of resistance to flame

6.7.1 *Principle.* The device is mounted on a dummy head, passed through a flame and the effects of the flame on the device observed.

6.7.2 *Apparatus*

6.7.2.1 *A dummy head* mounted on a support which enables it to be rotated by motor to describe a horizontal circle (see figure 5).

6.7.2.2 *Gas supply rig* consisting of a propane storage tank with flow control valve and fine pressure gauge, flash back arrestor and a propane burner*. The burner shall be adjustable in height.

6.7.3 *Procedure.* Fit the device to the dummy head and ensure that a speed of 60 mm/s, measured at the point where the device passes the burner, can be obtained.

Rotate the head and device so that it is over the burner.

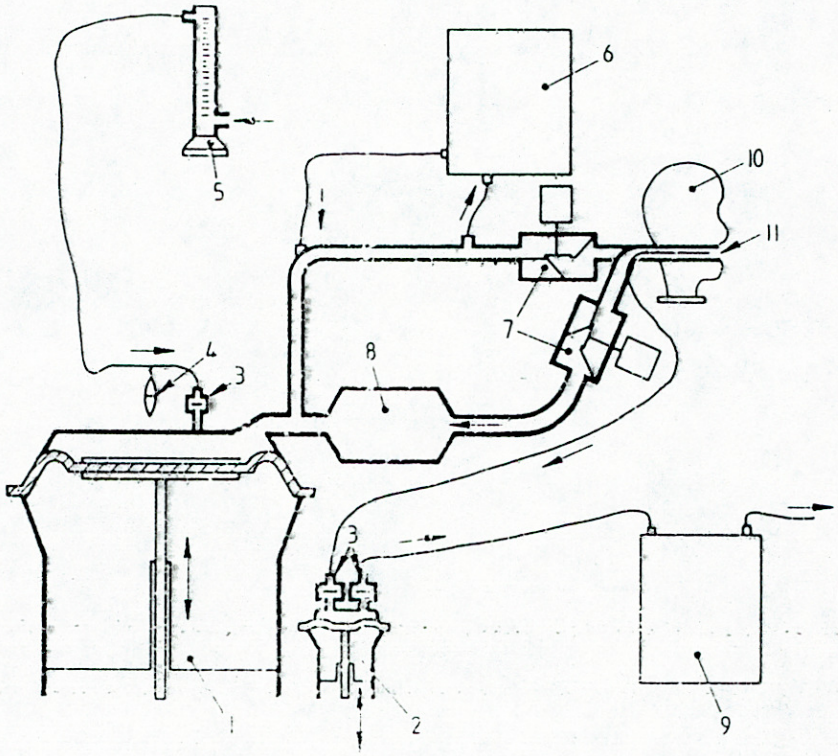
Adjust the position of the burner such that the distance between the top of the burner and the lowest part of the device which is to pass through the flame is 20 mm. Rotate the head away from the burner.

Ignite the gas at the burner and adjust the pressure to be 0.5 bar. Ensure that the burner air vent is fully closed and adjust the flow control valve to give a flame height of 40 mm above the burner top.

NOTE. These settings should give a flame temperature of 800 ± 50 °C at a point 20 mm above the burner top.

Pass the device mounted on the dummy head once through the flame at the set speed of 60 mm/s.

*For information on the availability of a suitable burner apply to Enquiry Section, BSI, Linford Wood, Milton Keynes MK14 6LE enclosing a stamped addressed envelope for reply.



Key

1 Breathing machine
2 Auxiliary lung
3 Non-return valves
4 Compensator
5 Flow meter
6 Carbon dioxide measuring device
7 Magnetic valves
8 Carbon dioxide absorber
9 Carbon dioxide measuring device
10 Dummy head/torso
11 Sampling tube

Figure 4. Test rig for determination of carbon dioxide content of inhalation air

Using two further samples, repeat the test to enable an assessment to be made of all materials on the exterior of the device. Any one sample shall be passed through the flame once only.

6.7.4 *Assessment and test report.* Examine the device after it has passed through the flame and report whether it has grossly deformed or decomposed or whether it continues to burn.

7 Marking

7.1 On the facepiece

The facepiece shall be marked with the following information:

(a) the name, trademark or other means of identification of the manufacturer;

(b) the size, if more than one is available;

(c) type identifying mark;

(d) date of manufacture.

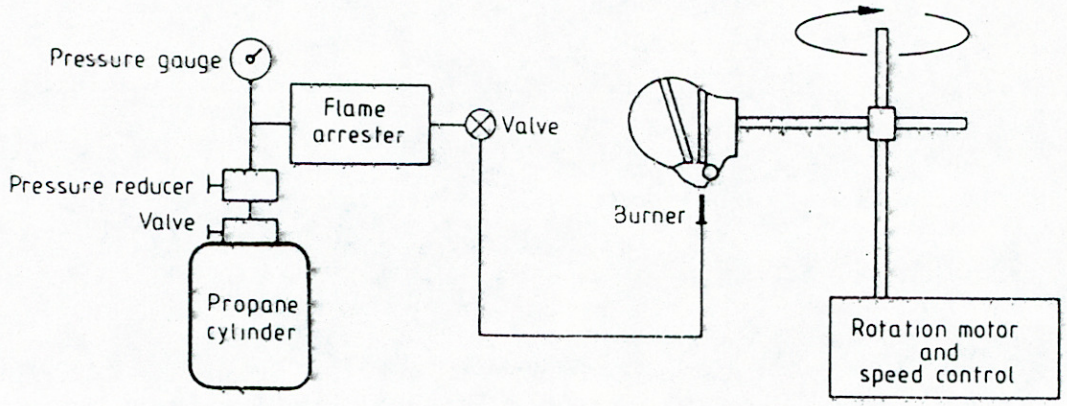


Figure 5. Schematic diagram of apparatus for assessment of flammability

7.2 On the blower, and battery casing

Each blower and, if separate, each battery casing shall be marked with the following information:

(a) the name, trademark or other means of identification of the manufacturer;

(b) type identifying mark;

(c) if appropriate, a statement that the device is intrinsically safe for use in explosive atmospheres and reference to BS 5501 : Part 7;

(d) date of manufacture.

7.3 On the filters

7.3.1 Particle filters (except unencapsulated) shall be either:

(a) white; or

(b) silver with a white band, clearly superimposed.

7.3.2 All filters, shall be clearly marked with the following:

(a) their correct classification;

(b) type identifying mark.

7.3.3 All filters, including unencapsulated, which do not pass the paraffin oil test shall be clearly marked 'For use against solid and water based aerosols only', or information to this effect shall be given on the smallest package unit.

8 Instructions for use, maintenance and storage

8.1 On delivery, instructions shall accompany the device enabling trained and qualified persons to use it.

8.2 The instructions shall comprise the range of application, instructions concerning correct fitting, care, maintenance and storage and whether or not the facepiece can be used without the blower. Furthermore, attention shall be drawn to incorrect use. This shall include the range of operating and storage temperatures and conditions.

8.3 The instructions shall clearly describe which filter has to be used for a specific type and class of device.

8.4 It shall be stated that the power-off condition is considered to be an abnormal condition.

8.5 It shall be stated whether or not the device can be used in an explosive atmosphere.

8.6 The instructions shall state the minimum design flow rate, and include details of how the flow rate should be checked prior to each use.

This Draft for Development, having been prepared under the direction of the Personal Safety Equipment Standards Committee, was published under the authority of the Board of BSI and comes into effect on 27 February 1987.

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Committees responsible for this Draft for Development

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British Occupational Hygiene Society
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