BRITISH STANDARD

BS EN
14593-2:2005

Respiratory protective devices — Compressed air line breathing apparatus with demand valve —

Part 2: Apparatus with a half mask at positive pressure — Requirements, testing, marking

The European Standard EN 14593-2:2005 has the status of a British Standard

ICS 13.340.30

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 14593-2:2005. Together with BS EN 14593-1:2005 and BS EN 14594:2005, it supersedes BS EN 139:1995 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee PH/4, Respiratory protection, to Subcommittee PH/4/13, Breathing apparatus, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

Cross-references

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Respiratory protective devices - Compressed air line breathing apparatus with demand valve - Part 2: Apparatus with a half mask at positive pressure - Requirements, testing, marking

Appareils de protection respiratoire - Appareils de protection respiratoire isolants à adduction d'air comprimé avec soupape à la demande - Partie 2: Appareil avec demi-masque à pression positive - Exigences, essais, marquage

Atemschutzgeräte - Druckluft-Schlauchgeräte mit Lungenautomat - Teil 2: Geräte mit einer Halbmaske und Überdruck - Anforderungen, Prüfung, Kennzeichnung

This European Standard was approved by CEN on 15 March 2005.

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

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Contents

Foreword

This European Standard (EN 14593-2:2005) has been prepared by Technical Committee CEN/TC 79 “Respiratory protective devices”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2005, and conflicting national standards shall be withdrawn at the latest by October 2005.

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

For relationship with EU Directive, see informative Annex ZA, which is an integral part of this European Standard.

Together with EN 14593-1 and EN 14594, this European Standard supersedes EN 139:1994.

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

Introduction

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

1 Scope

This European Standard specifies minimum requirements for compressed air line breathing apparatus with demand valve for use with a half mask at positive pressure, as a respiratory protective device. Escape and diving apparatus, apparatus for fire fighting and apparatus used in abrasive blasting operations without additional protective features are not covered by this European Standard, although certain requirements addressing the use in conjunction with escape apparatus and escape conditions are noted.

Laboratory and practical performance tests are included for the assessment of conformance to the requirements.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 132:1998, *Respiratory protective devices — Definitions of terms and pictograms*

EN 134:1998, *Respiratory protective devices — Nomenclature of components*

EN 140, *Respiratory protective devices — Half masks and quarter masks — Requirements, testing, marking*

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

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

EN 148-3, *Respiratory protective devices — Threads for facepieces — Part 3: Thread connection M45 x 3*

EN 12021, *Respiratory protective devices — Compressed air for breathing apparatus*

EN 13274-1:2001, *Respiratory protective devices — Methods of test — Part 1: Determination of inward leakage and total inward leakage*

EN 13274-2:2001, *Respiratory protective devices — Methods of test — Part 2: Practical performance tests*

EN 13274-3, *Respiratory protective devices — Methods of test – Part 3: Determination of breathing resistance*

EN 13274-4, *Respiratory protective devices — Methods of test — Part 4: Flame tests*

EN 13274-6, *Respiratory protective devices — Methods of test — Part 6: Determination of carbon dioxide content of inhalation air*

EN ISO 8031, *Rubber and plastics hoses and hose assemblies — Determination of electrical resistance (ISO 8031:1993)*

3 Terms, definitions and pictograms

For the purposes of this European Standard, the terms, definitions and pictograms given in EN 132:1998 and EN 134:1998 and the following apply,

3.1
compressed air line breathing apparatus with a demand valve for use with a half mask at positive pressure
apparatus, which is not self-contained, in which the wearer is supplied with breathable air from a source of compressed air at a maximum pressure of 10 bar

3.2
mobile high pressure air supply system
supply system that may include a compressor, filters, compressed air pressure vessels, for use as a mobile source of breathing air

4 Description

This apparatus enables the wearer to be provided with breathable air, which shall be in accordance with EN 12021, which, on inhalation flows through a lung governed demand valve operating at positive pressure to a suitable facepiece, possibly via a breathing hose. A compressed air supply tube connects the wearer to supply of compressed air. Exhaled air flows into the ambient atmosphere via an exhalation valve.

NOTE Conformance to EN 12021 can be ensured by a breathable air supply system or an additional device such as a compressed air filter system.

5 Requirements

5.1 General

Unless otherwise specified, the values stated in this European Standard are expressed as nominal values. Except for temperature limits, values which are not stated as maxima or minima shall be subject to a tolerance of ± 5 %. Unless otherwise specified, the ambient temperature for testing shall be between 16 °C and 32 °C and the temperature limits shall be subject to an accuracy of ± 1 °C. Where a test clause is referenced, all subclauses of the test clause shall apply, unless otherwise stated.

5.2 Ergonomics

The requirements of this European Standard are intended to take account of the interaction between the wearer, the respiratory protective device, and where possible the working environment in which the respiratory protective device is likely to be used. The device shall satisfy 5.3, 5.9 and 5.10.

Testing shall be done accordance with 6.4.

5.3 Materials

5.3.1 All materials used in the construction shall have adequate resistance to deterioration by heat and adequate mechanical strength. Testing shall be done in accordance with 6.3, after any pre-conditioning according to 6.8, and any safety data sheet, if applicable, and declaration of the manufacturer related to materials used in the construction of the device.

5.3.2 Exposed parts, i.e. those which may be subjected to impact during use of the apparatus shall not be made of aluminium, magnesium, titanium or their alloys.

5.3.3 Materials that may come into direct contact with the wearer's skin or that may affect the quality of the breathed air shall not be known to be likely to cause skin irritation or any other adverse effects to health.

Testing shall be done in accordance with 6.3.

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

Testing shall be done in accordance with 6.3.

5.4 Water immersion

The apparatus shall continue to function satisfactorily after being submerged temporarily in water. Before immersion and after removal from the water the apparatus shall meet the requirements of 5.21.

NOTE The apparatus is not designed for use under water.

Testing shall be done in accordance with 6.2.

5.5 Cleaning and disinfecting

All materials shall be visibly unimpaired after cleaning and disinfection by the agents and procedures specified by the manufacturer.

Testing shall be done in accordance with 6.3.

5.6 Practical performance

The complete apparatus shall undergo practical performance tests under realistic conditions. These general tests serve the purpose of checking the apparatus for imperfections that can not be determined by the tests described elsewhere in this European Standard.

If during any activity, by any test subject, the test subject fails to finalise the selected activity due to the apparatus being not fit for the purpose for which it has been designed, the apparatus shall be deemed to have failed.

After completion of the activities the test subjects are asked to answer the questions in 6.6 of EN 13274-2:2001. These answers shall be used by the test house to determine if the apparatus passes or fails. The test house shall provide full details of those parts of the practical performance tests which revealed these imperfections.

NOTE This will enable other test houses to duplicate the tests and assess the results thereof.

The testing shall be done in accordance with 6.4.

5.7 Connections

5.7.1 General

Components of the apparatus shall be readily separated for cleaning, examining and testing. 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 joints and couplings are disconnected during normal use and maintenance.

Testing shall be done in accordance with 6.3 and 6.4.

5.7.2 Couplings

The apparatus shall be constructed so that any twisting of the hoses and tubes does not affect the fit or performance of the apparatus, or cause the hoses or tubes to become disconnected. At least one swivelling coupling shall be fitted to the compressed air supply tube adjacent to the wearer. The design of the couplings shall be such as to prevent unintentional interruption of the air supply.

Testing shall be done in accordance with 6.3 and 6.4.

5.7.3 Strength of connections to half mask, demand valve, medium pressure hose and breathing hose

Connections of the breathing hose at the half mask connector and at the demand valve or between the half mask connector and the demand valve shall withstand a force of 50 N.

Testing shall be done in accordance with 6.5.

5.7.4 Connection between apparatus and half mask

The connection between the breathing apparatus and the half mask may be achieved by a permanent, special or thread type connector.

Threads in accordance with EN 148-1, -2 and -3 shall not be used with equipment covered by this European Standard.

Testing shall be done in accordance with 6.3.

5.7.5 Unacceptable connections

It shall not be possible to connect the compressed air supply tube directly to the breathing hose, medium pressure connecting tube or half mask.

Testing shall be done in accordance with 6.3.

5.8 Body harness or belt

A body harness or belt shall be provided to which the medium pressure connecting tube and compressed air supply tube shall be attached. Buckles shall not slip, and the harness or belt shall not be damaged.

Testing shall be done in accordance with 6.3, 6.4 and 6.7.

5.9 Performance requirements after storage

After conditioning in accordance with 6.8.1 and 6.8.2, and returning to room temperature, all performance requirements of this European Standard shall be met, except for 5.10.

Apparatus specifically designed for storage in temperatures beyond the limits of storage conditioning given in 6.8.1 shall be tested and marked accordingly.

Testing shall be done in accordance with 6.8.

5.10 Flammability

5.10.1 The requirements of 5.10.2 and 5.10.3 do not apply to the compressed air source, e.g. mobile high pressure air supply systems, but do include the compressed air supply tube.

5.10.2 No exposed components of the apparatus shall continue to burn for more than 5 s after removal from the flame. Testing shall be done in accordance with 6.9.1.

5.10.3 Wherever the manufacturer designs the apparatus to be used in applications with a high flammability risk, the exposed components shall be tested in accordance with 6.9.2. The exposed components shall not continue to burn for more than 5 s after removal from the flame and the apparatus shall be marked in accordance with Clause 7.

Testing shall be done in accordance with 6.9.2.

5.11 Resistance to pressure

The compressed air supply tube and the medium pressure connecting tube and their couplings shall be capable of withstanding a pressure of 30 bar for 15 min without damage.

Testing shall be done in accordance with 6.1 and 6.3.

5.12 Mobile high pressure air supply systems

5.12.1 General

The requirements of 5.21 shall apply simultaneously to each apparatus connected to a mobile high pressure air supply system.

Where multiple wearers are supplied from one pressure reducer, a tests are conducted with the first wearer outlet attached to a breathing machine and all remaining apparatus operating at a continuous flow of 160 l/min.

The mobile high pressure air supply system shall supply breathable air in accordance with EN 12021, and shall be fitted with a pressure reducer, a high pressure gauge, medium pressure gauge, relief valve and a warning device.

Testing shall be done in accordance with 6.3.

5.12.2 Pressure reducer

The pressure reducer and the characteristics of the compressed air supply system incorporating the compressed air supply tube(s) shall be such that the requirements of 5.16 and 5.21 are met.

If the outlet pressure is variable, the pressure reducer shall not be adjustable without the use of special tools and the pressure gauge shall be suitably marked to indicate the pressure range.

Testing shall be done in accordance with 6.3 and 6.4.

5.12.3 Pressure reducer relief valve

A pressure reducer relief valve shall be provided. The pressure reducer relief valve shall be designed to pass an air flow of 400 l/min at a medium pressure not exceeding 30 bar. With the pressure reducer relief valve operational, the inhalation and exhalation breathing resistances shall not exceed 25 mbar.

Testing shall be done in accordance with 6.10.

5.13 Warning devices for mobile high pressure air supply systems

5.13.1 General

A warning device shall be provided which activates at the minimum operating conditions specified by the manufacturer.

If the equipment is intended by the manufacturer to be operated without an assistant at the air supply control, then the warning device shall be worn by the wearer.

If the equipment is intended by the manufacturer to be operated with an assistant at the air supply control, then the warning device shall warn the assistant and/or the wearer.

At the predetermined operating pressure of the warning device ± 5 bar the duration of the warning shall be at least 15 s for a continuous signal and at least 60 s for an intermittent signal and thereafter shall continue. The warning device shall activate when the residual air volume per user is no less than 300 litres per user at atmospheric pressure.

Testing shall be done in accordance with 6.3 and 6.17.

5.13.2 Audible warning device

If an audible warning device is incorporated, the sound pressure level shall be at least 90 dB(A) measured at the ear nearest the device in the case of the wearer, or within 1 m of the mobile high pressure air supply system in the case of an assistant.

The signal may be continuous or intermittent.

At the predetermined operating pressure of the warning device ± 5 bar the duration of the warning at 90 dB(A) shall be at least 15 s for a continuous signal and at least 60 s for an intermittent signal and thereafter shall continue to sound down to 10 bar.

In the case of an intermittent warning device the peak sound pressure shall be at least 90 dB(A). The frequency range shall be between 2 000 and 4 000 Hz.

The warning device shall continue to operate in a temperature range of 0 ºC to 10 ºC at a relative humidity of 90 %.

The air loss that might be caused by the warning signal shall not exceed an average of 5 l/min from response of signal to a pressure of 10 bar. During and after response of the warning device the wearer shall be able to continue breathing without added difficulty.

5.14 Compressed air supply tube

5.14.1 Resistance to kinking

When tested, the compressed air supply tube shall maintain a uniform near-circular loop and spiral from this loop. It shall not deform during the test to an extent that decreases the flow of air through it by more than 10 %, when compared with that measured when the tube is straight and unstressed.

Testing shall be done in accordance with 6.11.

5.14.2 Resistance to collapse

The reduction in air flow when tested shall not be greater than 10 %.

Testing shall be done in accordance with 6.12.

5.14.3 Strength

The compressed air supply tube, couplings and demand valve shall not separate from the couplings, belt or harness as appropriate.

Testing shall be done in accordance with 6.3 and 6.7.

5.14.4 Flexibility

When pressurized to the maximum working pressure the compressed air supply tube shall be capable of being wound once around a drum 300 mm in diameter.

Testing shall be done in accordance with 6.3.

5.14.5 Heat resistance

Compressed air supply tubes claimed to be resistant to damage from contact with hot surfaces and boiling water shall show no signs of damage or indications of failure when tested, and the air quality shall not be significantly affected.

Testing shall be done in accordance with 6.13.

5.14.6 Electrostatic properties

Compressed air supply tubes claimed to be anti-static when measured by making connections to the couplings, shall have an electrical resistance that is greater than 10^3 Ω and less than 10^8 Ω.

Testing shall be done in accordance with EN ISO 8031.

5.14.7 Couplings

Where a hand operated connection is fitted to the outlet of the compressed air supply tube it shall incorporate a self-sealing coupling to seal the air supply when disconnected.

Testing shall be done in accordance with 6.3.

5.15 Breathing hose

5.15.1 Resistance to kinking

Breathing hoses (if fitted) shall be flexible and non-kinking.

Testing shall be done in accordance with 6.3 and 6.4.

5.15.2 Resistance to collapse

The air flow shall not be reduced by more than 10 % at the specified test air flow rate. There shall be no visible distortion 5 min after completion of the test.

Testing shall be done in accordance with 6.6.

5.16 Lung governed demand valve

5.16.1 General

The apparatus shall conform to the requirements of 5.21. These requirements shall be met over the pressure range of the air supplied to the apparatus as specified by the manufacturer.

Testing shall be done in accordance with 6.3 and 6.15.

5.16.2 Couplings

Where a hand operated coupling is fitted between the demand valve and a connector at the waist belt or body harness it shall incorporate a self-sealing device to prevent loss of air from the compressed air supply tube.

Testing shall be done in accordance with 6.3 and 6.4.

5.16.3 Supplementary air supply

Apparatus may be provided with a manually operated means of providing a supply of air. If provided, the air flow from such a device shall be at least 60 l/min at the minimum stated air supply conditions.

Testing shall be done in accordance with 6.3 and 6.15.

5.17 Adjustable parts

All parts requiring manipulation by the wearer shall be readily accessible and easily distinguishable from one another by touch. All adjustable parts and controls shall be constructed so that their adjustment is not liable to accidental alteration during use. Parts that are not intended for adjustment by a wearer shall require the use of tools for their adjustment.

Testing shall be done in accordance with 6.3 and 6.4.

5.18 Half masks

Half masks shall conform to EN 140:1998, with the exception of 6.12, 6.14, 6.15 and 6.16 of that standard.

Testing shall be done in accordance with 6.3.

5.19 Inward leakage

The mean inward leakage of the complete device, including the facepiece, shall not exceed 0,5 %.

Testing shall be done in accordance with 6.14.

Testing shall be done in accordance with EN 13274-1 with respect to:

— number of samples;

— device preparation;

— selection and number of test subjects;

— any prior conditioning or testing;

— test method (1, 2a, 2b);

— any deviations from the method;

— use of supplementary fans if applicable;

— characteristics to be assessed subjectively;

— pass/fail criteria.

5.20 Inhalation and exhalation valves

All complete apparatus shall be provided with one or more exhalation valves and may have one or more inhalation valves. Valve assemblies shall be such that they can be readily maintained and correctly replaced. It shall not be possible to fit an inhalation assembly in the expiratory circuit.

Testing shall be done in accordance with 6.3.

5.21 Breathing resistance

5.21.1 General

The requirements of 5.21.2 and 5.21.3 apply both before and after the water immersion in accordance with 5.4 and at the extremes of the pressure range of the air supply to the apparatus as specified by the manufacturer.

5.21.2 Inhalation resistance

The apparatus shall be designed such that at a sinusoidal flow of 40 x 2,5 l/min a positive pressure is maintained in the half mask and shall not exceed 5 mbar during inhalation.

Testing shall be done in accordance with 6.15.

5.21.3 Exhalation resistance

The exhalation resistance shall not exceed 6 mbar at a continuous flow of 10 l/min, 7 mbar at a sinusoidal flow of 25 $\times$ 2 l/min, and 10 mbar at a sinusoidal flow of 40 $\times$ 2,5 l/min.

Testing shall be done in accordance with 6.15.

5.22 Carbon dioxide content of inhalation air

The complete apparatus including the face mask shall be tested, and the carbon dioxide content of the inhaled air shall be not greater than an average of 1 % by volume.

Testing shall be done in accordance with 6.16.

5.23 Leaktightness

With the maximum designed working pressure applied to the apparatus, the compressed air supply tube, medium pressure connecting tube, couplings, demand valve and breathing hose (if fitted), shall be tested for leaktightness by immersion in water for 1 min. The demand valve shall be activated, and the apparatus sealed at its facepiece connection. The test shall be applied immediately before and after the tests in 6.7 and shall subsequently be applied after all laboratory testing is completed with the exception of that for flammability.

No bubbles shall be observed escaping from the apparatus.

Testing shall be done in accordance with 6.3 and 6.7.

6 Testing

6.1 General

Table 1 details the test and requirement clause numbers.

Table 1 — Testing schedule

Test clause	Title	Storage conditioning to 6.8	Requirement clause
6.2	Water immersion	Yes	5.4
6.3	Visual inspection	Yes	5.3, 5.5, 5.7, 5.8, 5.12, 5.11, 5.13, 5.15, 5.14, 5.16, 5.17, 5.23
6.4	Practical performance	Yes	5.6, 5.7, 5.8, 5.9, 5.12, 5.17,5.15
6.5	Strength of breathing hose connections (if present)	Yes	5.7
6.6	Resistance to collapse of breathing hose (if present)	Yes	5.15
6.7	Strength of compressed air supply tube, body harness and couplings	Yes	5.14, 5.23
6.8	Resistance to temperature	Yes	5.9
6.9	Flammability	No	5.10, 5.14
6.10	Pressure reducer relief valve	Yes	5.12
6.11	Resistance to kinking of compressed air supply tube	Yes	5.14
6.12	Resistance to collapse of compressed air supply tube	Yes	5.14
6.13	Heat resistance of compressed air supply tube	Yes	5.14
6.14	Exhalation valve leakage	Yes	5.20
6.15	Tests for lung-governed demand valve	Yes	5.16, 5.21
6.16	Carbon dioxide content of inhalation air	Yes	5.22
6.17	Audible warning device	Yes	5.13

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

If no special measuring devices or measuring methods are specified, commonly used methods and devices should be applied.

The flammability test in 6.9 shall be carried out on two unconditioned samples which are not then used for other tests.

The conditioning procedure described in 6.8 shall be completed on two test samples prior to the remaining tests being carried out. In all tests, both test samples need to meet the requirements.

The leaktightness test shall be carried out on the conditioned samples after all other tests except the practical performance test have been completed. The practical performance test shall be carried out using the two conditioned samples after all other tests, with the exception of flammability, have been completed.

Apparatus shall be tested as complete apparatus including the facepiece, as supplied by the manufacturer.

6.2 Water immersion

The facepiece of the complete apparatus is fitted to a dummy head which, in turn, is connected to a breathing machine by a flexible hose. The facepiece of the complete apparatus is fitted to a dummy head. The test is conducted with the breathing machine adjusted to 25 cycles/min and 2 l/stroke. The complete apparatus as worn is immersed in water to a depth of between 0,25 m and 0,80 m for a period of not less than 3 and not more than 5 full breathing cycles. A series of tests is carried out with the apparatus immersed and with the dummy head in two orientations, which represent respectively the maximum and minimum differential pressures between the lung governed demand valve and the exhalation valve.

The apparatus and dummy head are removed from the water after each test at each orientation. Measure the breathing resistance at the appropriate pressure sample points using a precision gauge. The breathing resistance is recorded prior to and immediately after each immersion. The presence of water in the facepiece after the test does not constitute a reason for failure and any water present may be removed prior to measurement of breathing resistance.

6.3 Visual inspection

A visual inspection shall be made by the test house prior to laboratory or practical performance tests. This may entail a certain amount of dismantling in accordance with the manufacturer's instructions for maintenance. The visual inspection shall include the assessment of the device marking and information supplied by the manufacturer ands any safety data sheets (if applicable) or declarations relevant to the materials used in its construction.

6.4 Practical performance

6.4.1 General

Practical performance tests shall be carried out in accordance with EN 13274-2, using two sets of apparatus and four test subjects. Apparatus which has satisfied the laboratory tests shall be used. The test plan shall be as shown below.

Test subjects 1 and 2 shall use apparatus 1. Test subjects 3 and 4 shall use apparatus 2.

6.4.2 Preparation of apparatus to be tested

Before each test check the apparatus for leaktightness. Ensure that air supplies from compressed air systems or from compressed air cylinders are within the specified pressures. The length of the compressed air supply tube shall be the maximum specified by the manufacturer, including the maximum number of permitted connections.

The test shall be completed within a total time of 30 min.

6.4.3 Test conditions

All tests shall be carried out at ambient conditions which shall be recorded.

6.4.4 Work simulation 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 30 min. The test shall be continuous without removal of the apparatus.

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

— activity number 15 of EN 13274-2:2001;

— activity number 4 of EN 13274-2:2001;

— activity number 3 of EN 13274-2:2001;

— activity number 10 of EN 13274-2:2001;

— activity number 12 of EN 13274-2:2001;

— activity number 16 of EN 13274-2:2001.

If the exercises have been completed within less than 30 min the remaining time is used by the subject to walk at 6 km/h.

6.4.5 Information to be recorded

The assessments in accordance with EN 13274-2 shall be recorded. During the tests the device shall be subjectively assessed by each wearer, and after the test, the answers to the questions (as applicable) in 6.6 of EN 13274-2:2001 shall be recorded individually and in private. If during any activity, by any test subject the test subject fails to finalise the selected activity due to the apparatus being not fit for the purpose for which it has been designed, the apparatus shall be deemed to have failed.

6.4.6 Practical performance tests at low temperature

6.4.6.1 Temperature of cold chamber

Temperature of cold chamber for these tests shall be between - 6 °C and - 9 °C according to 6.5 of EN 13274-2:2001.

6.4.6.2 Test with pre-cooled apparatus

Two apparatus shall be cleaned according to the information supplied by the manufacturer and any excess liquid removed by shaking. The apparatus are shall then be made ready for use and pre-cooled for not less than 2 h but no more than 3 h in the cold chamber.

Two warmly clothed subjects shall each don an apparatus in the cold chamber and carry out the test in accordance with activity 17 in EN 13274-2:2001, items a, b, and c.

6.4.6.3 Test with apparatus at ambient temperature

Two apparatus shall be prepared ready for use and conditioned at ambient temperature

Two test subjects shall carry out the test in accordance with activity 17 of EN 13274-2:2001, items a, b, and c.

6.5 Strength of connections to facepiece, demand valve, medium pressure connecting tube and breathing hose

For each of the connections of components between the waist belt/harness to the facepiece, apply an axial force of 50 N for (10 ± 1) s. The connections shall withstand the test with no visible signs of damage. See Figure 1.

6.6 Resistance to collapse of breathing hose

6.6.1 Principle

A specified air flow is passed through the breathing hose which is subjected to a specified load. The change in air flow is measured.

6.6.2 Apparatus

Two metal plates 100 mm square, or circular with diameter 100 mm., and thickness at least 10 mm. One plate is fixed and the other is capable of moving at right angles to the plane of the plates. The moving plate is capable of being loaded to ensure a total force of 50 N can be applied between the plates. See Figure 5.

6.6.3 Procedure

Place the breathing hose centrally between the two plates and pass air at a rate of 120 l/min through the hose. Apply the test force of 50 N (which includes that due to the moveable plate itself) to the hose and measure the air flow again. Calculate the reduction in flow.

6.7 Strength of compressed air supply tube, body harness and couplings

The belt or body harness with couplings and demand valve is secured to a dummy torso in an upright position. A steady pull of 1 000 N is applied to the compressed air supply tube 5 min. Figure 2 shows suitable test details.

6.8 Storage conditioning

6.8.1 Conditioning

In order to ensure that there is no thermal shock during the conditioning of the specimens, the temperature gradient shall be less than 2 °C/min between phases at different temperatures, or between the beginning and the end of a thermal cycle.

The apparatus shall be conditioned according to the following order:

a) 4 h to 16 h at (60 ± 3) ºC and at least 95 % relative humidity or the manufacturer's stated maximum conditions, whichever are the higher;

b) 4 h to 16 h at (-30 ± 3) ºC or the manufacturer's stated minimum condition, whichever is the lower.

The apparatus shall then be allowed to return to ambient conditions (at least 4 h) before further testing.

6.8.2 Laboratory test after conditioning

After conditioning in accordance with 6.8.1, the apparatus is operated for at least 30 min using a breathing machine operating at 25 cycles/min, 2 l/stroke.

6.9 Flammability

6.9.1 Carry out flammability tests in accordance with EN 13274-4, using Method 3.

6.9.2 Carry out flammability tests in accordance with EN 13274-4, using Method 2.

6.10 Pressure reducer relief valve

Connect the apparatus, including the facepiece, to a breathing machine and to a "Sheffield" dummy head. Adjust the breathing machine to operate at 25 cycles/min and 2 l/stroke.

With the breathing machine not operating, connect a flow measuring device to the outlet of the pressure reducer relief valve and supply air to the medium pressure side of the pressure reducer. Increase the air supply pressure slowly until an air flow of 400 l/min passes through the pressure reducer relief valve. When this condition has been established switch the breathing machine on and measure the breathing resistance at the appropriate pressure sample point.

6.11 Resistance to kinking of compressed air supply tube

Apply the minimum supply pressure specified by the manufacturer to the supply end of the tube. Connect a means of measuring air flow to the tube.

Figures 3 and 4 show the principle of the test and an outline of an apparatus that has proved satisfactory for this test.

Place a length of the tube on a horizontal surface and shape into a one loop coil of (300 ± 10) mm diameter. Pull the ends of the loop tangentially to the loop and in the plane of the loop until the tube takes the form of a straight line. It may be convenient to clamp one end of the loop and pull the other.

Observe the manner in which the tube unfolds and measure the air flow as it is unfolded.

6.12 Resistance to collapse of compressed air supply tube

6.12.1 Principle

A specified air flow is passed through the compressed air supply tube, a specified load is applied to the tube and the change in air flow measured.

6.12.2 Apparatus

a) Two metal plates 100 mm square, or circular with a diameter of 100 mm and a thickness of at least 10 mm. One plate is fixed and the other capable of moving at right angles to the plane of the plates. The moving plate is capable of being loaded to provide a total force of 1 000 N applied between the plates (see Figure 5).

b) Flowmeter.

6.12.3 Procedure

Place the compressed air supply tube centrally between the two plates and pass an air flow of 120 l/min, through the tube. Record the flow.

Apply a force of 1 000 N (which includes that due to the moveable plate itself) to the moveable plate and measure the air flow again.

6.13 Heat resistance of compressed air supply tube

With the compressed air supply tube at the manufacturer's maximum stated supply pressure apparatus is tested on a breathing machine at 25 cycles/min and 2 l/stroke. Approximately 100 mm of the compressed air supply tube is placed in contact with a hot plate maintained at (130 ± 15) °C and a further part immersed in boiling water.

After 15 min remove the compressed air supply tube from the hot plate and the boiling water, examine for signs of damage and check that the quality of the air passing through the tube has not been significantly affected.

6.14 Inward leakage

Measure the inward leakage of the complete device, including the half mask, in accordance with EN 13274-1. Two specimens shall be used for the tests, one in the as received condition and one conditioned in accordance with 6.8.1European Standard.

Preparation of the device shall be as described in EN 13274-1:2001, 8.1 and 8.4. Ten, clean shaven, test subjects shall be used, selected as described in EN 13274-1:2001, 9.1.

Test methods 1 (sulfur hexafluoride) and 2A (sodium chloride, pulsed sampling) are equally acceptable.

6.15 Tests for lung-governed demand valve

This test uses as a basis method 2 of EN 13274-3.

Operate the equipment at the extremes of pressure as specified in the manufacturer's instructions, and test in accordance with method 2 of EN 13274-3, except that the manometer is connected to a pressure probe in the cavity of the face mask adjacent to the face seal, and the output of the manometer is connected to the recording device.

6.16 Determination of carbon dioxide content of the inhalation air

Measure the carbon dioxide content of the inhalation air in accordance with EN 13274-6.

6.17 Testing of audible warning device

The performance of the warning device is measured during a breathing machine test at 25 cycles/min $\times$ 2 l/stroke. To test the warning device at temperatures between 0 °C and 10 °C air shall be passed through the apparatus in a climatic test chamber using a breathing machine (adjusted to 25 cycles/min $\times$ 2 l/stroke).

During the test the environment of the apparatus shall have a temperature of (3 ± 1) °C and a relative humidity of > 90 %. Every 5 min water shall be sprayed on for 3 s using a spray gun directed at the warning device from a distance of 200 mm.

NOTE Information on the spray gun can be obtained from the secretariat of CEN/TC 79.

7 Marking

7.1 All units of the same model shall be provided with a type identifying marking. The marking shall be clearly visible and as durable as possible.

Components which can be changed by the user and sub-assemblies with considerable bearing on safety shall be readily identifiable.

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

NOTE For marking of components, see Annex A.

7.2 Where the reliable performance of piece parts may be affected by ageing, 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 operating instructions.

7.3 The apparatus, excluding the compressed air supply tube, shall be marked with:

— the number of this European Standard;

— the storage temperatures the apparatus is designed to withstand, or the appropriate pictogram from EN 132, if different from this European Standard;

— the year of manufacture (4 digits);

— the manufacturer's name, trade mark or other means of identification;

— the phrase "see information supplied by the manufacturer" or the appropriate pictogram;

— if appropriate, the marking ‘F’ to show that the apparatus meets the additional requirements of 5.10.3.

7.4 The compressed air supply tube shall be marked at least with:

— the manufacturer's part number and/or the number of this European Standard;

— the year of manufacture (4 digits);

— the manufacturer’s trade name, trademark or other means of identification;

— if appropriate, the marking ‘H’ for 'heat resistant', to show that the tube meets the requirements of 5.14.5;

— if appropriate, the marking ‘S’ for 'anti-static', to show that the tube meets the requirements of 5.14.6;

— if appropriate, the marking ‘F’ to show that the tube meets the additional requirements of 5.10.3.

8 Information supplied by the manufacturer

8.1 Information supplied by the manufacturer for use in the official language(s) of the country of destination shall accompany every apparatus on delivery enabling trained and qualified persons to use it. This information shall comprise the range of application and instructions necessary for correct fitting, care, maintenance and storage.

It is recommended that maintenance instructions be provided separately to the information supplied by the manufacturer.

8.2 Other information shall comprise:

— correct selection and fitting of the facepiece;

— whether or not designed to withstand storage in low or high temperature;

— the maximum length of compressed air supply tube, and the maximum number of compressed air supply tubes that may be joined together to give that length;

— the pressure range of the air supply to the apparatus;

— the maximum working pressure of the compressed air supply tube;

— a warning that adequate protection may not be provided by the apparatus in certain highly toxic atmospheres;

— a warning that at very high work rates the pressure in the half mask may become negative at peak inhalation flow;

— a warning concerning the need to ensure breathable air in accordance with EN 12021;

— a warning that the moisture content of the breathable air should be controlled within the limits in accordance with EN 12021, to avoid it freezing the apparatus;

— a warning against the use of oxygen or oxygen enriched air;

— a recommendation that the user checks that the capacity of the air supply system is sufficient for every user connected to it, in accordance with the manufacturer's instructions;

— the statement: 'Where appropriate, the marking ‘F’ indicates that the apparatus can be used in situations where flammability may be a risk;

— where appropriate, a statement that the compressed air supply tube is heat-resistant (H) and/or anti-static (S);

— information on spare parts (if appropriate);

— information on cleaning and disinfecting procedures;

— a warning against other possible connections to couplings connected to pipe systems that supply other gasses than breathable air; risk assessment by the user against possible perilous connections possible at the workplace, e.g. Nitrox;

— a warning with devices connected to a mobile high pressure air supply system as to whether or not the manufacturer intends the device to be operated with an assistant, together with appropriate instructions concerning the warning device;

— any other information the supplier may care to provide;

— the maximum number of users that can be connected simultaneously to a mobile high pressure air supply system.

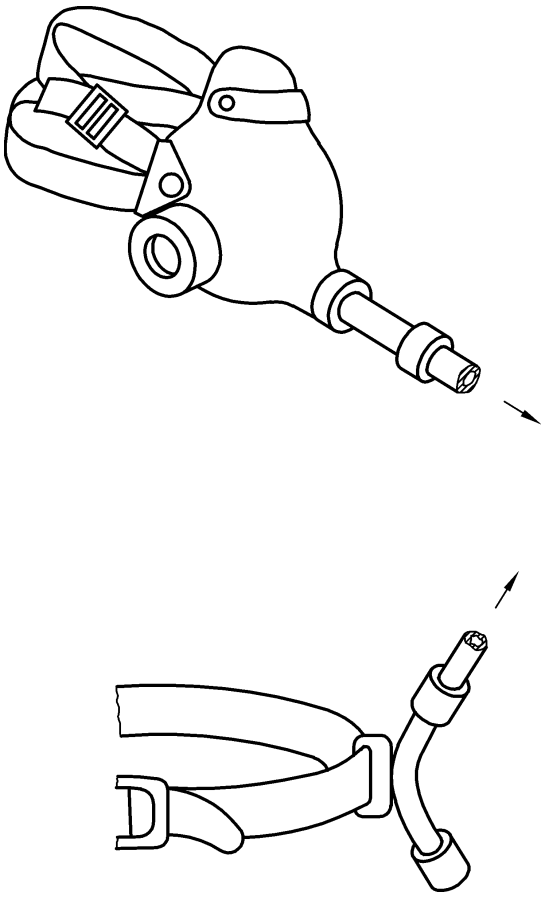


Figure 1 — Measurement of strength of breathing hose connections

Dimensions in millimetres

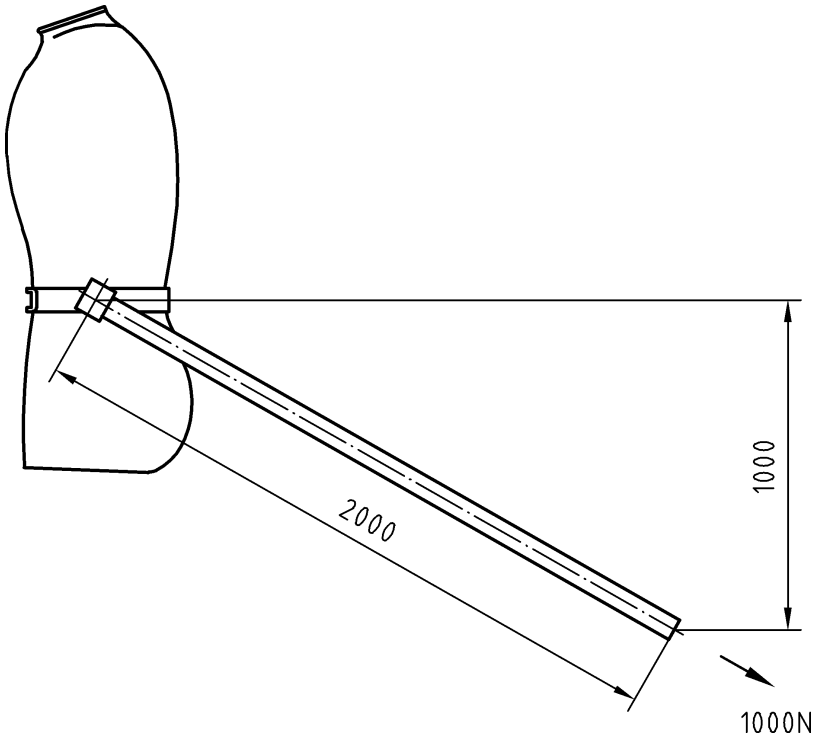
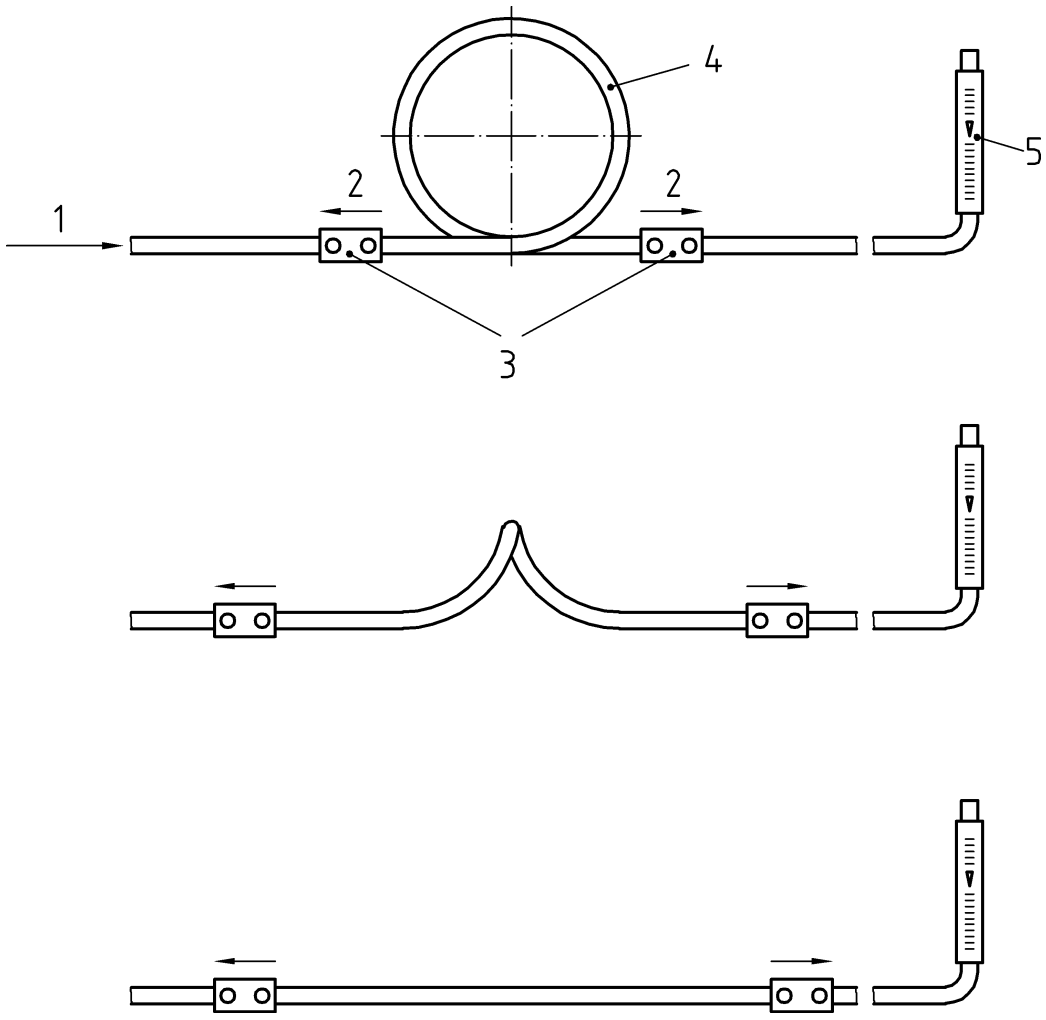


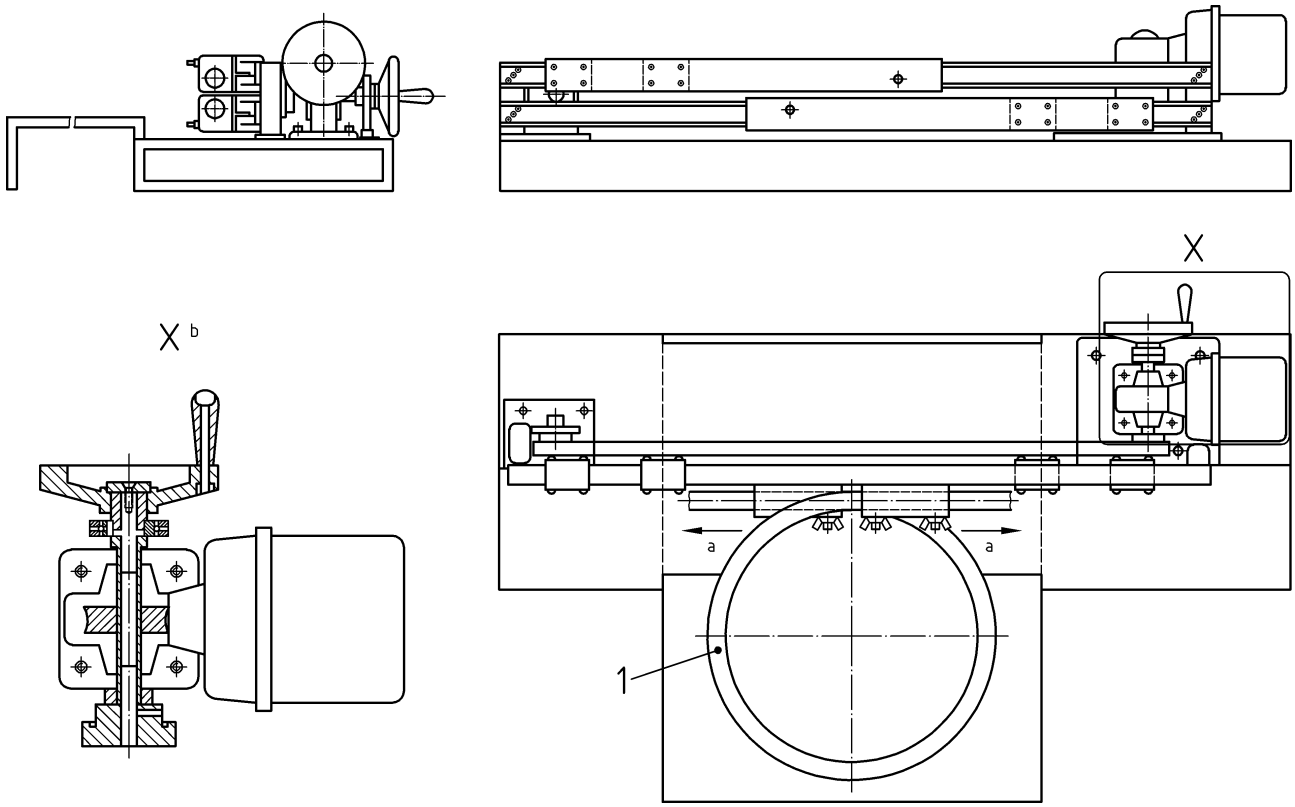
Figure 2 — Arrangement for testing strength of body harness or belt, compressed air supply tube and couplings



Key
1 Air supply
2 Direction of travel
3 Clamps
4 Tube
5 Flow meter

Figure 3 — Arrangement for testing kinking of compressed air supply tube

Dimensions in millimetres



Key
1 Tube
[a] Direction of travel
[b] Section detail X

Figure 4 — Arrangement for testing kinking of compressed air supply tube

Dimensions in millimetres

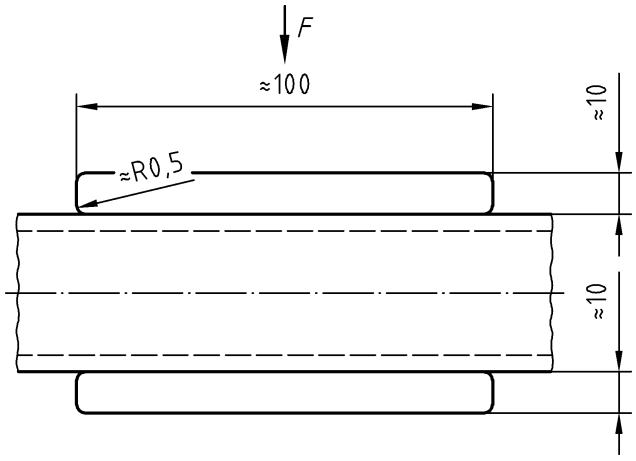


Figure 5 — Arrangement for testing collapse of compressed air supply tube

Annex A
(informative)

Marking

It is recommended that consideration be given to marking the following components and sub-assemblies - if applicable - to be identifiable.

Table A.1 — Marking

Components/ subassemblies	Part-marking	Date of manufacture	Remarks
Pressure reducer	+	+	
Demand valve	+	+	
Breathing hose (if fitted)	+	+	
Inhalation valve disc	+	+	1
Exhalation valve disc	+	+	1
Half mask			according to EN 140
Body harness/Belt	-	-	1
Medium pressure connecting tube (if fitted)	-	+	
Compressed air supply tube	+	+	
Compressed air container			according to the relevant standards
Compressed air container valve			according to the relevant standards

Key

+ The marking is necessary.

- The marking is not necessary.

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

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

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 89/686/EEC (PPE)

This European Standard has been prepared under a mandate given to CEN/CENELEC by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 89/686/EEC on the Approximation of the laws of the Member States relating to Personal Protective Equipment.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in table ZA confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA — Correspondence between this European Standard and Directive 89/686/EEC

Clause(s)/ subclause(s) of this EN	Essential Requirements (ERs) of Directive 89/686/EEC		Qualifying remarks/ Notes
5.2	1.1.1	Ergonomics	
5.2	1.1.2.1	Highest level of protection possible	
5.2	1.2.1.3	Maximum permissible user impediment	
5.2	1.3.1	Adaptation of PPE to user morphology	
5.2	2.3	PPE for the face, eyes and respiratory tracts	
5.3.2	2.6	PPE for use in explosive atmospheres	
5.3.3	1.2.1.1	Suitable constituent materials	
5.3.4	1.2.1.2	Satisfactory surface condition of all PPE parts in contact with the user	
5.4	1.2.1	Absence of risks and other inherent nuisance factors	
5.6	1.1.1	Ergonomics	
5.6	1.1.2.1	Highest level of protection possible	
5.6	1.2.1.3	Maximum permissible user impediment	
5.6	1.3.1	Adaptation of PPE to user morphology	
5.7.1	2.9	PPE incorporating components which can be adjusted or removed by the user	
5.7.2	1.2.1	Absence of risks and other inherent nuisance factors	
5.7.3	1.3.2	Lightness and design strength	
5.7.4	2.10	PPE for connection to another, external complementary device	
5.7.5	1.2.1	Absence of risks and other inherent nuisance factors	
5.8	1.3.2	Lightness and design strength	
5.8	2.1	PPE incorporating adjustment systems	
5.9	1.3.2	Lightness and design strength	
5.10.2	1.2.1	Absence of risks and other inherent nuisance factors	

5.10.3	1.2.1	Absence of risks and other inherent nuisance factors	
5.11	1.3.2	Lightness and design strength	
5.13.2	2.8	PPE for use in very dangerous situations	
5.14.1	1.2.1	Absence of risks and other inherent nuisance factors	
5.14.2	1.2.1	Absence of risks and other inherent nuisance factors	
5.14.3	1.3.2	Lightness and design strength	
5.14.4	1.3.2	Lightness and design strength	
5.14.5	1.2.1	Absence of risks and other inherent nuisance factors	
5.14.6	2.6	PPE for use in explosive atmospheres	
5.14.7	1.2.1	Absence of risks and other inherent nuisance factors	
5.15	1.2.1	Absence of risks and other inherent nuisance factors	
5.16.1	3.10.1	Respiratory protection	
5.16.2	1.2.1	Absence of risks and other inherent nuisance factors	
5.16.3	3.10.1	Respiratory protection	
5.17	1.2.1	Absence of risks and other inherent nuisance factors	
5.17	2.1	PPE incorporating adjustment systems	
5.18	3.10.1	Respiratory protection	
5.19	3.10.1	Respiratory protection	
5.20	1.2.1	Absence of risks and other inherent nuisance factors	
5.20	2.10	PPE for connection to another, external complementary device	
5.21.2	3.10.1	Respiratory protection	
5.21.3	3.10.1	Respiratory protection	
5.22	3.10.1	Respiratory protection	
5.23	3.10.1	Respiratory protection	
7	2.12	PPE bearing identification marks related to health and safety	
7	3.10.1	Respiratory protection	
8	1.4	Information supplied by the manufacturer	
8	2.8	PPE for use in very dangerous situations	
8	2.12	PPE bearing identification marks related to health and safety	

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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