



BSI Standards Publication

Respiratory protective devices - Compressed air line breathing devices with demand valve

Part 1: Devices with a full face mask - Requirements, testing and marking

National foreword

This British Standard is the UK implementation of EN 14593-1:2018. It supersedes BS EN 14593-1:2005, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PH/4, Respiratory protection.

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

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English Version

**Respiratory protective devices - Compressed air
line breathing devices with demand valve - Part
1: Devices with a full face mask - Requirements,
testing and marking**

Appareils de protection respiratoire -
Appareils de protection respiratoire isolants
à adduction d'air comprimé avec soupape à
la demande - Partie 1: Appareil avec masque
complet - Exigences, essais et marquage

Atemschutzgeräte - Druckluft-Schlauchgeräte mit
Lungenautomat - Teil 1: Geräte mit einer Vollmaske
- Anforderungen, Prüfung und Kennzeichnung

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European foreword

This document (EN 14593-1:2018) 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of an identical text or by endorsement, at the latest by November 2018, and conflicting national standards shall be withdrawn at the latest by November 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14593-1:2005.

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association, and supports essential health and safety requirements of EU Regulation(s).

For relationship with EU Regulation(s) see informative Annex ZA, which is an integral part of this document.

The following main technical changes have been made compared to EN 14593-1:2005:

- a) requirements for cleaning and disinfection deleted;
- b) visual inspection changed to inspection and detailed list inserted;
- c) test for leaktightness added;
- d) test for noise level adapted to the test procedure specified in ISO 16900-14;
- e) Annex B deleted;
- f) figures adapted to the changes made in the test procedures, where appropriate.

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

1 Scope

This document specifies minimum requirements for compressed air line breathing devices with demand valve for use with a full face mask as a respiratory protective device (RPD).

Diving RPD are not covered by this document.

RPD used in abrasive blasting operations without additional protective features are not covered by this document.

Escape RPD, although certain requirements addressing the use in conjunction with escape RPD and escape conditions are given, are not covered by this document.

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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 136:1998, *Respiratory protective devices — Full face masks — Requirements, testing, marking*

EN 137:2006, *Respiratory protective devices — Self-contained open-circuit compressed air breathing apparatus with full face mask — 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: Tread connection M 45 x 3*

EN 402:2003, *Respiratory protective devices — Lung governed demand self-contained open-circuit compressed air breathing apparatus with full face mask or mouthpiece assembly for escape — Requirements, testing, marking*

EN 12021, *Respiratory equipment — Compressed gases 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 13274-3:2001, *Respiratory protective devices — Methods of test — Part 3: Determination of breathing resistance*

EN 13274-4:2001, *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 the inhalation air*

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

ISO 16900-14, *Respiratory protective devices — Methods of test and test equipment — Part 14: Measurement of sound level*

3 Terms, description and symbols

For the purposes of this document, the terms, definitions and symbols given in EN 132:1998, EN 134:1998 and the following apply.

3.1 Terms

3.1.1

as received

not pre-conditioned or modified to carry out a test

3.1.2

facepiece

[Respiratory Interface (RI)]

full face mask conforming to EN 136 (Class 2 or Class 3)

3.1.3

mobile high pressure air supply system

supply system that can include a compressor, filters, compressed air cylinders, for use as a mobile source of breathable air

3.1.4

switch over device

device that ensures that in the event of a malfunction or disconnection of the airline, the air supply, when airline is used in conjunction with self-contained breathing devices, automatically switches over to the self contained air supply, without interruption of supplied air to the wearer

3.2 Description

This RPD supplies the wearer with breathable air in accordance with EN 12021, which on inhalation, flows through a lung governed demand valve. The latter can operate at negative pressure or at positive pressure and is connected to a suitable full face mask, possibly via a breathing hose. A compressed air supply tube connects the wearer to a 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.

3.3 Symbols

3.3.1



See information supplied by the RPD manufacturer

4 Requirements

4.1 General

All test samples specified in the related test clauses shall meet the relevant requirements.

Where it is required in a specific clause, the manufacturer shall declare that a risk assessment e.g. a Failure Modes and Effect Analysis (FMEA) concerning these specific requirements has been conducted.

NOTE Further information is given in EN 60812 [3].

If the manufacturer claims that the RPD may be used in potentially explosive atmospheres it shall comply with the appropriate requirements.

4.2 Nominal values and tolerances

Unless otherwise specified, the values stated in this document 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 $\pm 5\%$. Unless otherwise specified, the ambient conditions for testing shall be between $16\text{ }^{\circ}\text{C}$ and $32\text{ }^{\circ}\text{C}$ and $(50 \pm 30)\%$ relative humidity. Any temperature limits specified shall be subject to an accuracy of $\pm 1^{\circ}\text{C}$.

4.3 Ergonomics

The requirements of this document are intended to take account of the interaction between the wearer, the RPD, and where possible the working environment in which the RPD is likely to be used. The RPD shall satisfy [4.4](#) and [4.8](#).

Testing shall be performed accordance with [5.3](#).

4.4 Materials

4.4.1 All materials used in the construction shall have adequate resistance to deterioration by heat and adequate mechanical strength.

After any pre-conditioning according to [5.7](#), testing shall be performed in accordance with [5.3](#).

The manufacturer shall supply a declaration that this was addressed by a risk assessment, e.g. a FMEA.

Check in accordance with [5.2](#).

4.4.2 If the manufacturer claims that the RPD may be used in potentially explosive atmospheres, exposed parts, i.e. those which can be subjected to impact during use of the RPD shall not be made of aluminium, magnesium, titanium or their alloys.

The manufacturer shall supply a declaration that this was addressed by a risk assessment, e.g. a FMEA.

Check in accordance with [5.2](#).

4.4.3 Materials that can come into direct contact with the wearer's skin or that can 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.

The manufacturer shall supply a declaration that this was addressed by a risk assessment, e.g. a FMEA.

Check in accordance with [5.2](#).

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

Check in accordance with [5.2](#) and test in accordance with [5.3](#).

4.5 Practical performance

The complete RPD shall undergo practical performance tests under realistic conditions. These general tests serve the purpose of checking the RPD for imperfections that cannot be determined by the tests specified elsewhere in this document.

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

After completion of the activities the test subjects are asked to answer the questions in EN 13274-2:2001, 6.6.

Testing shall be performed in accordance with [5.3](#).

4.6 Connections

4.6.1 General

Components of the RPD 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.

Check in accordance with [5.2](#) and test in accordance with [5.3](#).

4.6.2 Couplings

The RPD shall be constructed so that any twisting of the hoses and tubes does not affect the fit or performance of the RPD, 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.

Check in accordance with [5.2](#) and test in accordance with [5.3](#).

4.6.3 Strength of connections to full face mask, demand valve, medium pressure connecting tube and breathing hose

Connections of the breathing hose at the full face mask and at the demand valve or between the full face mask connector and the demand valve shall withstand a force of 250 N.

Testing shall be performed in accordance with [5.4](#).

4.6.4 Connection between RPD and full face mask

The connection between the RPD and the full face mask can be achieved by a permanent, special or thread type connector. If a thread connector is used, either it shall conform to the requirements of one of the following standards:

- EN 148-1, for RPD without positive pressure,
- EN 148-3, for RPD with positive pressure

or if any other thread type connector is used it shall not be possible to connect it with the above mentioned threads.

The thread in accordance with EN 148-2 shall not be used.

Check in accordance with [5.2](#).

4.6.5 Unacceptable connections

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

Check in accordance with [5.2](#).

4.7 Compressed air line breathing device used with self-contained breathing device - switch over device

4.7.1 General

If a compressed air line breathing device is used in conjunction with self-contained breathing device meeting the requirements of EN 137 or EN 402, a switch over device shall be provided on the airline device to ensure continuous breathable air in the event of malfunction or disconnection of the air line.

After "switch over", the air supply of the self-contained breathing device shall continue to meet the requirements of EN 137 or EN 402, and the switch over shall cause no interruption of supply to the wearer. After disconnecting the compressed air supply tube, the self-contained breathing device shall continue to meet the requirements of EN 137 or EN 402.

Any pressure peak exceeding the limits specified in [4.22](#) caused during the "switch over" measured within one breathing cycle shall be disregarded.

Testing shall be performed in accordance with EN 137:2006, 6.21 or EN 402:2003, 6.24.2 and 6.24.3 as appropriate.

The design of the switch over device shall prevent air loss from the self-contained breathing device.

Check in accordance with [5.2](#).

If the switch over device is connected to the compressed air supply tube, the connection shall withstand a pull force of 1 000 N.

Testing shall be performed in accordance with [5.6](#).

If the switch over device is connected to the breathing hoses or to the medium pressure supply tube, the connection shall withstand a pull force of 250 N.

Testing shall be performed in accordance with [5.4](#).

Couplings (if fitted) shall be self-sealing. When not connected, it shall be possible to protect all connectors from contamination. Disconnecting of the compressed air supply tube shall be possible in case of emergency and shall be operable by the user.

Check in accordance with [5.2](#) and test in accordance with [5.3](#).

4.7.2 Switch over warning device

4.7.2.1 General

Once the switch over has occurred a warning signal shall be activated to give indication to the wearer of the use of breathable air from the self-contained breathing device.

4.7.2.2 Audible switch over warning device

If an audible warning device is incorporated, the signal may be continuous or intermittent. The peak sound pressure level shall be at least 90 dB (A) measured at the ear nearest the device and the frequency range shall be between 2 000 Hz and 4 000 Hz.

Check in accordance with [5.2](#) and test in accordance with [5.16](#).

4.7.2.3 Pneumatic switch over warning device

Where the switch over warning devices operates pneumatically 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

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

Check in accordance with [5.2](#) and test in accordance with [5.15](#).

4.8 Body harness or belt

A body harness or belt shall be provided to which the medium pressure connecting tube or breathing hose, and compressed air supply tube, shall be attached. Buckles shall not slip, and the harness or belt shall not be damaged when subjected to a pull of 1 000 N.

Check in accordance with [5.2](#) and test in accordance with [5.3](#) and [5.6](#).

4.9 Pre-conditioning

At least two samples shall be pre-conditioned in accordance with [5.7](#), and after returning to room temperature, all performance requirements of this document shall be met.

RPD specifically designed for storage beyond the limits of pre-conditioning specified in [5.7](#) shall be conditioned accordingly. After returning to room temperature, all performance requirements of this document shall be met. Those RPD shall be marked accordingly.

Testing shall be performed in accordance with [5.7](#).

4.10 Flammability

4.10.1 The flammability test shall be carried out on two samples, as received, which shall not be used for other tests afterwards.

4.10.2 The requirements of [4.10.3](#) and [4.10.4](#) do not apply to the compressed air source, e.g. mobile compressed air supply systems, but do include the compressed air supply tube. Full face masks shall meet the requirements of EN 136.

4.10.3 No exposed components of the RPD shall continue to burn for more than 5 s after removal from the flame.

Testing shall be performed in accordance with [5.8.1](#).

4.10.4 Wherever the manufacturer designs the RPD to be used in applications with a high flammability risk, the exposed components shall not continue to burn for more than 5 s after removal from the flame and the RPD shall be marked in accordance with [6.3 f](#)).

Testing shall be performed in accordance with [5.8.2](#).

4.11 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.

Check in accordance with [5.2](#).

4.12 RPD with mobile high pressure air supply systems

4.12.1 General

The requirements of [4.20](#) shall apply to each RPD simultaneously connected to a mobile high pressure air supply system. Where multiple wearers are supplied from one pressure reducer, the tests are

conducted with the first wearer outlet attached to a breathing machine and all remaining RPD 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 which can be carried by the wearer.

Check in accordance with [5.2](#).

4.12.2 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 [4.16](#) and [4.20](#) 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 marked to indicate the pressure range.

Check in accordance with [5.2](#) and test in accordance with [5.3](#).

4.12.3 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 performed in accordance with [5.9](#).

4.13 Warning devices for mobile high pressure air supply systems

4.13.1 General

A warning device which draws attention of the assistant and/or the wearer shall be provided which activates at 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.

Check in accordance with [5.2](#).

The warning device shall be activated at the predetermined operating pressure ± 5 bar and shall continue at least until 5 bar remains in the high pressure source.

The warning device shall be activated before the residual air volume drops below 300 l per user at atmospheric pressure or a pressure of 10 bar in the high pressure source is left, whichever occurs first.

Check in accordance with [5.2](#) and test in accordance with [5.15](#).

4.13.2 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.

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

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. Thereafter it shall continue to sound to at least 70 dB(A).

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.

Testing shall be performed in accordance with [5.3](#), [5.15](#) and [5.18](#).

4.14 Compressed air supply tube

4.14.1 Resistance to kinking

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

Testing shall be performed in accordance with [5.10](#).

4.14.2 Resistance to collapse

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

Testing shall be performed in accordance with [5.11](#).

4.14.3 Strength

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

Check in accordance with [5.2](#) and test in accordance with [5.6](#).

4.14.4 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.

Check in accordance with [5.2](#).

4.14.5 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 be free from unsatisfactory odour or taste and shall be marked in accordance with [6.4 d](#)).

NOTE For guidance on measuring odour or taste detection thresholds see ISO 13301. For determination of odour concentration see EN 13725.

Testing shall be performed in accordance with [5.12](#).

4.14.6 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 $10^3 \Omega$ and less than $10^8 \Omega$ and shall be marked in accordance with [6.4 e](#)).

Testing shall be performed in accordance with EN ISO 8031.

4.14.7 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.

Check in accordance with [5.2](#).

4.15 Breathing hose

4.15.1 Resistance to kinking

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

Check in accordance with [5.2](#) and test in accordance with [5.3](#).

4.15.2 Resistance to collapse

The air flow shall not be reduced by more than 50 % at the specified test air flow rate.

Testing shall be performed in accordance with [5.5](#).

4.16 Lung governed demand valve

4.16.1 Without positive pressure

The negative pressure for opening the lung governed demand valve shall be between 0,5 mbar and 3,5 mbar when tested using a continuous flow of 10 l/min.

A self-opening of the demand valve at negative pressures of less than 0,5 mbar shall not occur.

At a flow rate of 300 l/min the negative pressure shall not exceed 10 mbar.

These requirements shall be met over the pressure range of the air supplied to the RPD as specified by the manufacturer.

Check in accordance with [5.2](#) and test in accordance with [5.13](#).

4.16.2 With positive pressure

The RPD shall conform to the requirements of [4.20](#).

Testing shall be performed in accordance with [5.13](#).

4.16.3 Supplementary air supply

RPD without positive pressure shall be provided with a manually operated means of providing a supply of air at a flow rate of at least 60 l/min at the manufacturer's minimum stated compressed air supply conditions.

Check in accordance with [5.2](#) and test in accordance with [5.3](#) and [5.13.3](#).

NOTE RPD with positive pressure can also be provided with such a device.

4.16.4 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.

Check in accordance with [5.2](#) and test in accordance with [5.3](#).

4.17 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.

Check in accordance with [5.2](#) and test in accordance with [5.3](#).

4.18 Full face masks

Full face masks shall conform to EN 136:1998, Class 2 or Class 3.

Check in accordance with [5.2](#).

4.19 Total inward leakage

The total inward leakage of the complete RPD, including the facepiece, shall not exceed 0,05 %.

Testing shall be performed in accordance with EN 13274-1:2001 with respect to the following prerequisites:

- 2 samples;
- ten test subjects;
- pre-conditioning according to [5.7](#);
- using EN 13274-1:2001, method 1 or method 2A.

4.20 Breathing resistance

4.20.1 General

The requirements of [4.20.2](#) and [4.20.3](#) apply at the extremes of the pressure range of the air supply to the RPD as specified by the manufacturer.

4.20.2 Inhalation resistance

4.20.2.1 RPD without positive pressure

At a sinusoidal flow of 25×2 l/min, the inhalation resistance of a RPD without facepiece shall not exceed 4,5 mbar. The negative pressure shall not exceed 7 mbar when fitted with a facepiece.

Testing shall be performed in accordance with [5.13](#).

4.20.2.2 RPD with positive pressure

The RPD shall be designed so that at a sinusoidal flow of $40 \times 2,5$ l/min, the positive pressure is maintained in the cavity of the mask adjacent to the face seal and shall not exceed 5 mbar.

Testing shall be performed in accordance with [5.13](#).

4.20.3 Exhalation resistance

4.20.3.1 RPD without positive pressure

The exhalation resistance shall not exceed 3 mbar, when tested using a breathing machine at a flow rate of 50 l/min ($25 \times 2,0$ l/min).

Testing shall be performed in accordance with [5.13](#).

4.20.3.2 RPD with positive pressure

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

Testing shall be performed in accordance with [5.13](#).

4.21 Carbon dioxide content of inhalation air

The complete RPD 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 performed in accordance with [5.14](#).

4.22 Leaktightness

With the maximum designed working pressure applied to the RPD, 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. Components of the RPD which are designed to lose air on purpose are excluded from this requirement, e.g. heater or cooler.

The demand valve shall be activated, and the RPD sealed at its facepiece connection.

The test shall be applied immediately before and after the tests in [5.6](#) and shall subsequently be applied after all laboratory testing is completed with the exception of that for flammability.

Those components submerged during the test shall not leak at a rate of more than one bubble per second.

Check in accordance with [5.2](#) and test in accordance with [5.17](#).

5 Testing

5.1 General

In addition to the laboratory tests described, the RPD shall also undergo practical performance tests under realistic conditions. These general tests serve the purpose to check the RPD for imperfections that cannot be determined by the tests specified elsewhere in this document.

Practical performance tests shall only be performed following satisfactory results during the laboratory tests.

Before performing tests involving human test 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 shall be carried out on two samples, which shall not be used for other tests afterwards.

Positive pressure complete RPD, including the facepiece, shall be tested as supplied by the manufacturer.

[Table 1](#) gives the test and requirement clause numbers.

Table 1 — Test schedule

Requirement	Title	Conditioning	Test clause	Associated requirements
4.3	Ergonomics	5.7	5.3	4.4 and 4.8
4.5	Practical performance		5.3	EN 13274-2:2001, 5.6
4.6	Connections		5.2, 5.3, 5.4	
4.7	Compressed air line breathing device used with self-contained breathing device - switch over device		5.2, 5.3, 5.6, 5.15 and 5.16	EN 137:2006, 6.21 or EN 402:2003, 6.24.2 and 6.24.3
4.8	Body harness or belt		5.2, 5.3 and 5.6	
4.10	Flammability	Two as received	5.8	EN 136 for full face masks
4.11	Resistance to pressure	5.7	5.2	
4.12	Mobile high pressure air supply systems, if applicable		5.2, 5.3, 5.9	4.16, 4.20
4.13	Warning devices for mobile high pressure air supply systems		5.2, 5.3, 5.15 and 5.18	
4.14	Compressed air supply tube		5.2, 5.6, 5.10, 5.11 and 5.12 EN ISO 8031	
4.15	Breathing hose		5.2, 5.3 and 5.5	
4.16	Lung governed demand valve		5.2, 5.3 and 5.13	4.20
4.17	Adjustable parts		5.2 and 5.3	
4.18	Full face masks		5.2	EN 136:1998, Class 2 or Class 3
4.19	Total inward leakage	Two according 5.7	EN 13274-1:2001	
4.20	Breathing resistance	5.7	5.13	4.5
4.21	Carbon dioxide content of inhalation air		5.14	
4.22	Leak tightness	5.6 and 5.7	5.2 and 5.17	

5.2 Inspection

The inspection shall be made prior to laboratory or practical performance tests or as specified in this document.

This can entail a certain amount of assembly, dismantling or adjustment of the RPD.

The inspection shall include a report of the findings and assessments.

Inspection shall include, where applicable:

- an assessment of visible damage, deformation, corrosion;
- an assessment of operation of switches, connections, control means, etc.;
- an assessment of the need for special tools;
- an assessment if connections can be disconnected inadvertently;
- an assessment if means for sealing, such as O-rings or gaskets, will be retained in position, unless deliberately removed for maintenance;

- f) an assessment if incorrect combinations are prevented by design solutions;
- g) an assessment of warning devices, monitoring devices, checking devices and indicators, whether or not signals intended to give different information can be distinguished from one or the other. This can require certain adjustments on the RPD, e.g. replacing a battery with a controllable power supply, relieving pressure, etc.;
- h) a documentation, e.g. safety data sheets and a declaration that a risk assessment, e.g. a FMEA has been conducted in relation to the materials used in its design;
- i) an assessment of gas flow;
- j) an assessment of compatibilities with other PPE or equipment specified by the manufacturer;
- k) an assessment of marking;
- l) an assessment of information supplied by the manufacturer.

5.3 Practical performance

5.3.1 General

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

- Test subjects 1 and 2 shall use RPD 1.
- Test subjects 3 and 4 shall use RPD 2.

5.3.2 Preparation of RPD to be tested

Before each test check the RPD for leaktightness in accordance with [5.17](#). 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.

5.3.3 Test conditions

All tests shall be performed in accordance with the requirements specified in [4.2](#) and shall be recorded.

5.3.4 Work simulation test

The following activities shall be performed in simulation of the practical use of the RPD. The test shall be completed within a total working time of 30 min. The test shall be continuous without removal of the RPD.

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 in EN 13274-2:2001;
- activity number 4 in EN 13274-2:2001;
- activity number 3 in EN 13274-2:2001;
- activity number 10 in EN 13274-2:2001;
- activity number 12 in EN 13274-2:2001;
- activity number 16 in 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

5.3.5 Information to be recorded

During the tests the RPD shall be subjectively assessed by each wearer, and after the test, the answers to the questions (as applicable) in EN 13274-2:2001, 6.6, shall be recorded individually and in private. The test house shall provide full details of those parts of the practical performance tests which revealed imperfections, if any.

5.3.6 Practical performance tests at low temperature

5.3.6.1 Temperature of cold chamber

The temperature of cold chamber for these tests shall be between - 6 °C and - 9 °C in accordance with EN 13274-2:2001, 6.5.

5.3.6.2 Test with pre-cooled RPD

Two RPD are cleaned according to the information supplied by the manufacturer and any excess liquid removed by shaking. The RPD are then made ready for use and pre-cooled for at least 2 h in the cold chamber.

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

5.4 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 250 N for (10 ± 1) s. The connections shall withstand the test with no visible signs of damage. See [Figure 1](#).

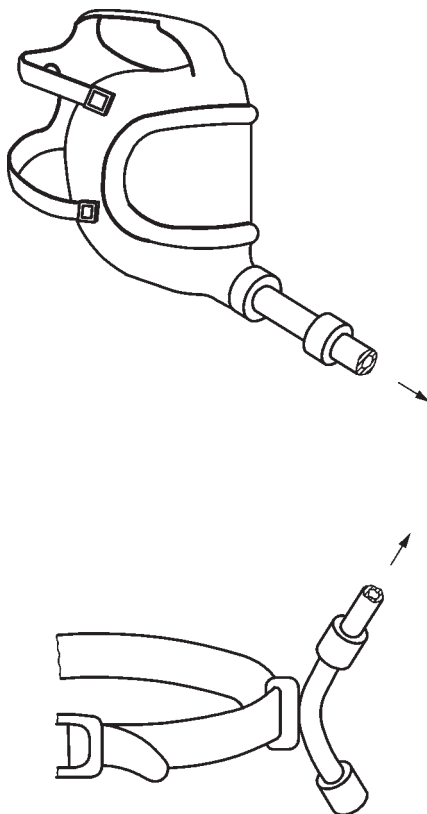


Figure 1 — Arrangement for testing strength of breathing hose connections

5.5 Resistance to collapse of breathing hose

5.5.1 Principle

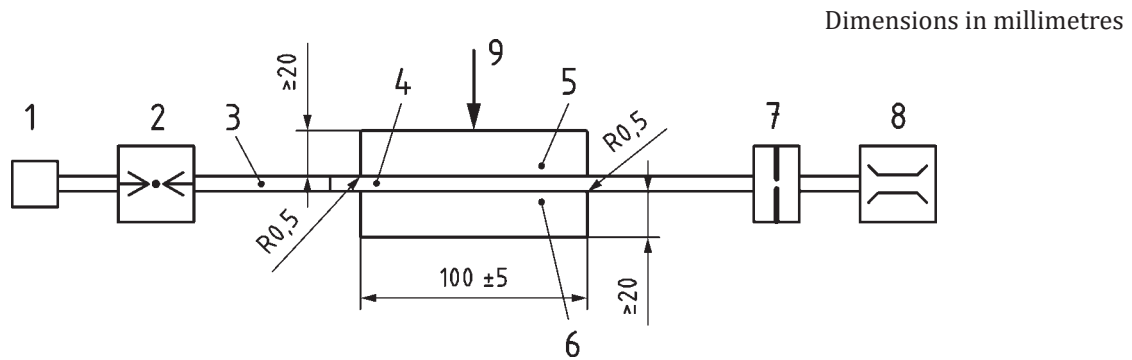
A specified air flow is passed through the breathing hose which is subjected to a specified load. The change in air flow is measured.

5.5.2 Apparatus

Two circular plates with a diameter of 100 mm in a thickness of at least 20 mm shall be used. 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 2](#)).

5.5.3 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.



Key

- | | | | |
|---|--|---|---|
| 1 | source of breathable gas | 6 | fixed lower metal disk (corners radiused to R0,5) |
| 2 | pressure controlling and measuring device | 7 | flow restrictor |
| 3 | straight | 8 | flow meter |
| 4 | hose sample | 9 | test force |
| 5 | moveable upper metal disk (corners radiused to R0,5) | | |

Figure 2 — Typical arrangement for testing collapse of compressed air supply tube

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

The belt or body harness with couplings and demand valve (if present) is secured to a test torso in an upright position. A steady pull of 1 000 N is applied to the compressed air supply tube for 5 min. [Figure 3](#) shows suitable test details.

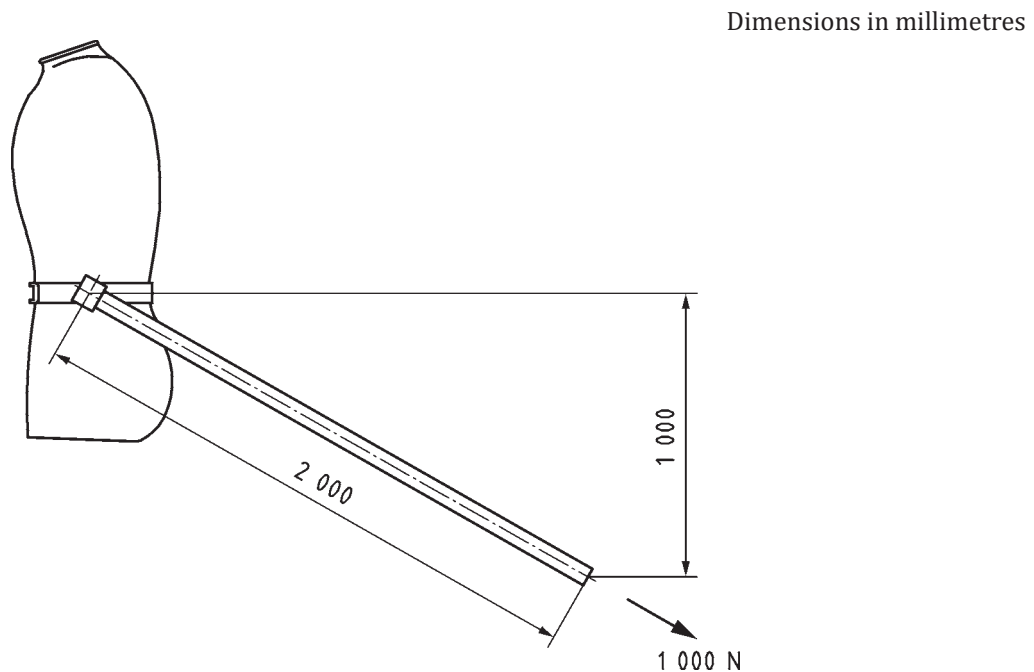


Figure 3 — Arrangement for testing strength of body harness or belt, compressed air supply tube and couplings

5.7 Pre-conditioning

In order to ensure that there is no thermal shock during the pre-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 RPD shall be pre-conditioned according to the following order:

- a) 4 h to 16 h at (60 ± 3) °C and at least 95 % relative humidity or the manufacturer's stated maximum temperature and humidity, whichever is the higher.
- b) 4 h to 16 h at (-30 ± 3) °C or the manufacturer's stated minimum, whichever is the lower.

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

5.8 Flammability

5.8.1 Carry out the flammability tests in accordance with EN 13274-4:2001, Method 3.

5.8.2 Carry out the flammability tests in accordance with EN 13274-4:2001, Method 2.

5.9 Pressure relief valve

Connect the RPD, including the full face mask, to a breathing machine and to a test head. Adjust the breathing machine to operate at 25 x 2,0 l/min.

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 relief valve. When this condition has been established, switch the breathing machine on and measure the breathing resistance at the appropriate pressure sample point.

5.10 Resistance to kinking of compressed air supply tube

[Figure 4](#) and [Figure 5](#) show the principle of the test. 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.

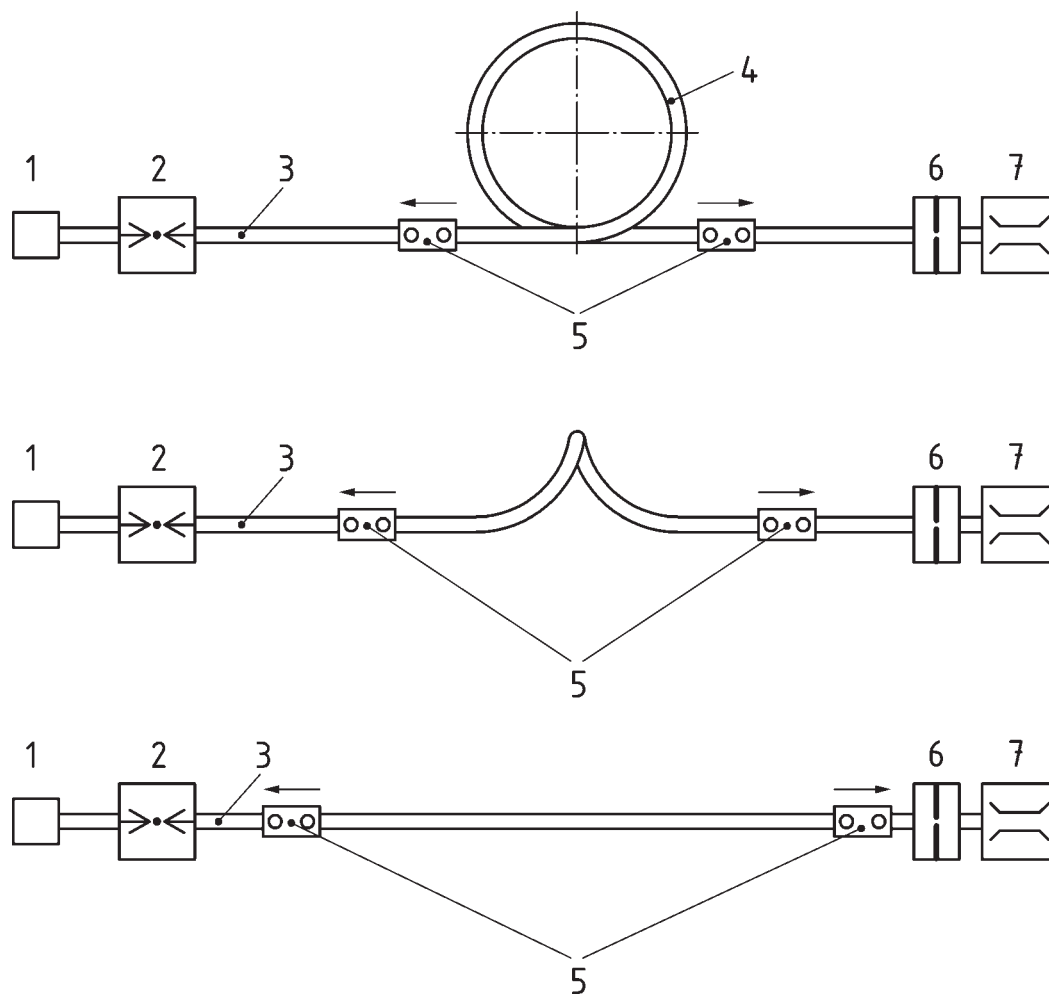
Place a length of the tube on a horizontal surface and shape into a one-loop coil of (300 ± 10) mm diameter. Pull the ends of the loop tangentially to the loop and in the plane of the loop until the tube takes the form of a straight line. It can be convenient to fix one clamp at one end of the loop and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

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

Repeat the test on the same test sample with the hose looped in the opposite direction to ensure that the hose is tested in both, clockwise and anti-clockwise directions. See [Figure 4](#) and [5](#).

Calculate the percentage reduction in air flow.

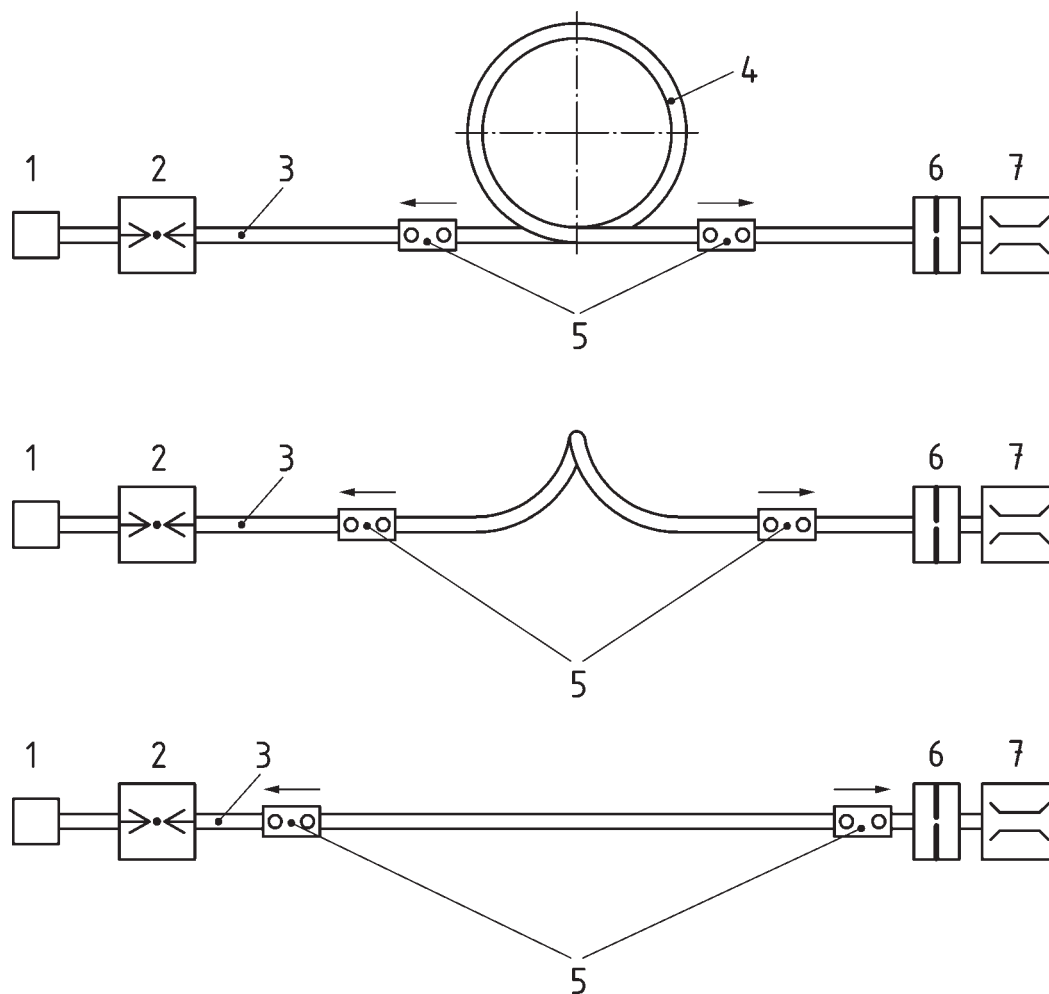
[Figure 6](#) shows an example of a test apparatus to perform the test in the clockwise direction and will need to be adapted for performing the anti-clockwise test.



Key

- 1 source of compressed gas
- 2 pressure controlling and measuring device
- 3 hose sample
- 4 loop having an inside diameter of approximately (300 ± 10) mm
- 5 suitable clamping arrangements for securing hose sample. These shall prevent sample from rotating
- 6 flow restrictor
- 7 flow meter

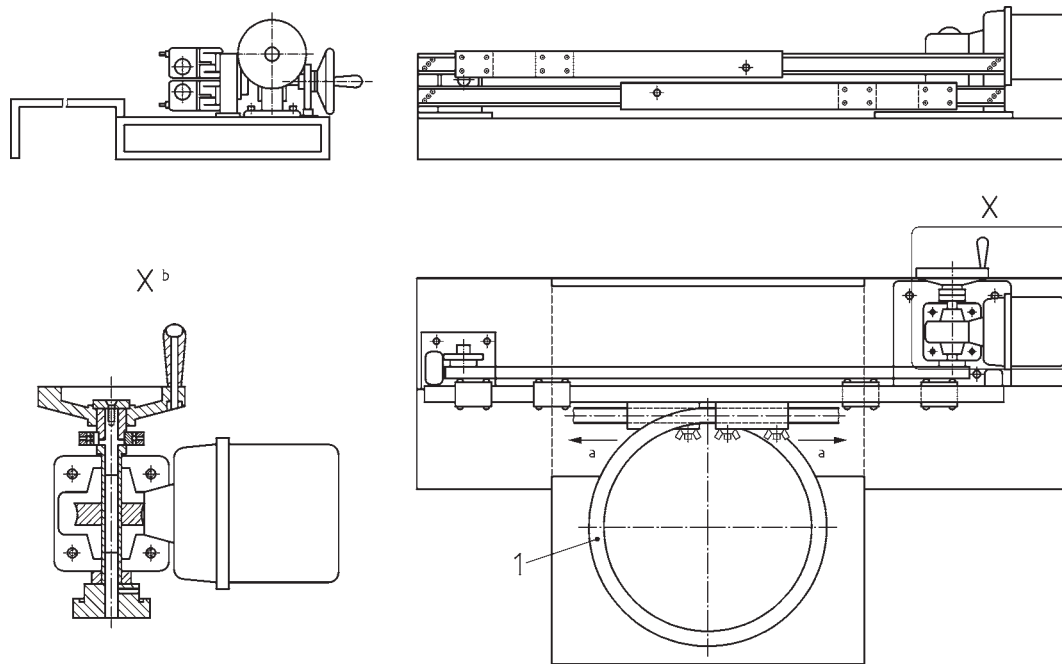
Figure 4 — Diagram demonstrating straightening of hose when looped in clockwise direction



Key

- 1 source of compressed gas
- 2 pressure controlling and measuring device
- 3 hose sample
- 4 loop having an inside diameter of approximately (300 ± 10) mm
- 5 suitable clamping arrangements for securing hose sample. These shall prevent sample from rotating
- 6 flow restrictor
- 7 flow meter

Figure 5 — Diagram demonstrating straightening of hose when looped in anti-clockwise direction



Key

- 1 tube
- a direction of travel
- b section detail X

Figure 6 — Typical arrangement for coil kinking of compressed air supply tube

5.11 Resistance to collapse of compressed air supply tube

5.11.1 Principle

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

5.11.2 Apparatus

Two circular plates with a diameter of 100 mm in a thickness of at least 20 mm shall be used. 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 1 000 N applied between the plates (see [Figure 2](#)).

5.11.3 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.

5.12 Heat resistance of compressed air supply tube

With the compressed air supply tube at the manufacturer's maximum stated supply pressure the RPD is tested on a breathing machine at 25 x 2,0 l/min. Approximately 100 mm of the compressed air supply tube is placed in contact with a hot plate maintained at $(130 \pm 15) ^\circ\text{C}$ 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 hose has not been significantly affected.

5.13 Tests for lung-governed demand valve

5.13.1 Without positive pressure

This test uses as a basis EN 13274-3:2001, method 1.

For devices employing EN 148-1 threads, connect the equipment to the test device shown in [Figure 7](#) and replace the test head in the apparatus specified in EN 13274-3:2001, method 1 by the test device.

Follow the procedure for the measurement of inhalation resistance given in EN 13274-3:2001, method 1, while operating the RPD (e.g. air line, demand valve) at the extremes of supply pressure as specified in the manufacturer's instructions, and applying the appropriate constant flow to the test device or test head as appropriate.

Record the pressure at which the lung-governed demand valve opens and the pressure at a flow of 300 l/min.

5.13.2 With positive pressure

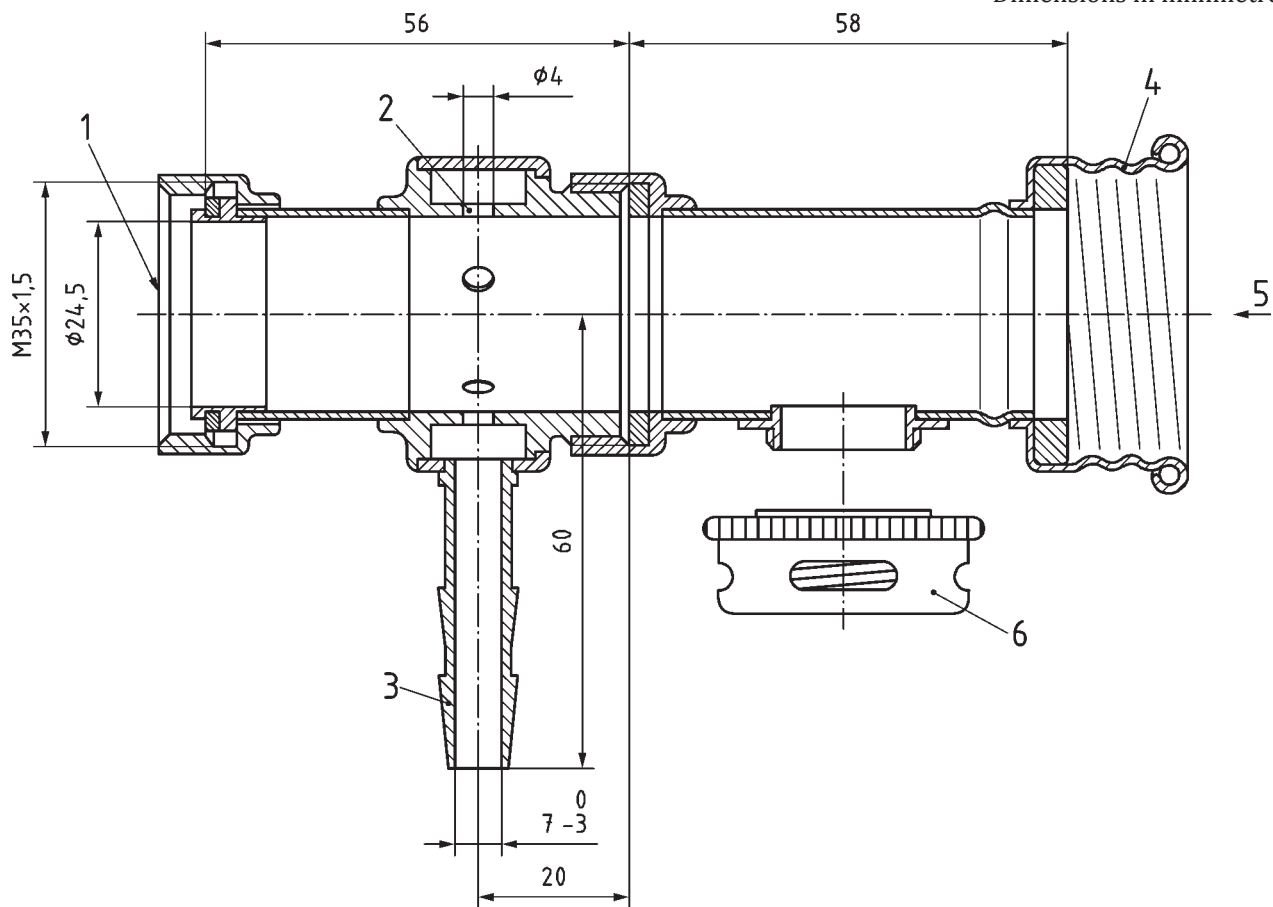
This test uses as a basis EN 13274-3:2001, method 2.

Operate the RPD at the extremes of pressure as specified in the manufacturer's instructions, and test in accordance with EN 13274-3:2001, method 2, 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.

5.13.3 Supplementary air supply

Connect the RPD as specified in [5.13.1](#) and operate at the minimum stated compressed air supply conditions. Whilst operating the supplementary supply, withdraw a steady air flow of 60 l/min from the test device or test head as appropriate. Record whether the pressure is positive or negative. If the pressure is negative, report fails.

Dimensions in millimetres



Key

- 1 connection for breathing machine
- 2 five holes
- 3 measurement point for breathing resistance
- 4 connector (EN 148-1)
- 5 connection for device
- 6 exhalation valve having a resistance of 3 mbar at 25×2 l/min sinusoidal flow or max 160 l continuous flow

Figure 7 — Test device used in the measurement of breathing resistance

5.14 Determination of carbon dioxide content of the inhalation air

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

5.15 Testing of audible warning device

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

During the test the environment of the RPD shall have a temperature of (3 ± 1) °C and a relative humidity of > 90 %. Each 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.

5.16 Switch over device

The switch over (and warning) device shall be tested whilst the airline supply is connected and the main cylinder valve of the self-contained breathing device is open. The airline supply will be closed whilst maintaining the connection to the self-contained breathing apparatus (SCBA). The performance of the switch over (and warning) device is measured during a breathing machine test at 25 x 2,0 l/min.

Once the device has actuated and the warning device operated the test will continue observing three cycles of warning after which the airline supply will be reopened and the warning observed.

To test the switch over device at temperatures between 0 °C and 10 °C air shall be passed through the RPD in a climatic test chamber using a breathing machine (adjusted to 25 x 2,0 l/min).

During the test the environment of the RPD shall have a temperature of $(3 \pm 1) ^\circ\text{C}$ and a relative humidity of $> 90 \%$. Each 5 min, water shall be sprayed on for 3 s using a spray gun directed at the switch over device from a distance of 200 mm.

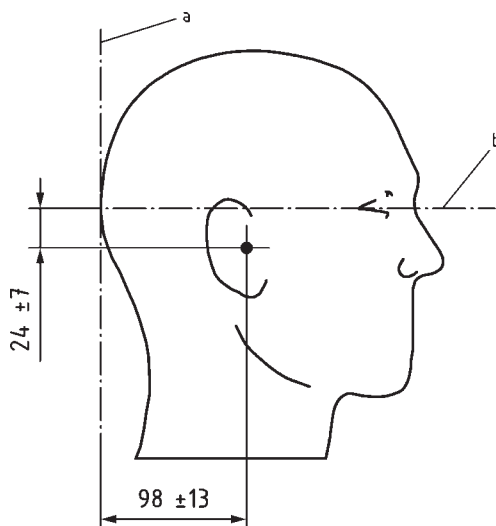
5.17 Leaktightness

The components shall be immersed in water to a depth of between 0,2 m and 0,3 m for 2 min. After the first minute it shall be observed if bubbles are emerging. If bubbles are observed, the rate shall be measured.

5.18 Sound level measurement

Testing shall be performed in accordance with ISO 16900-14 using a test head using the dimensions given in [Figure 8](#).

Dimensions in millimetres



Key

- a vertical reference line -back of the test head
- b horizontal reference line through the centre of the eyes

Figure 8 — Position of microphone in test head

6 Marking

6.1 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.

6.2 Where the reliable performance of piece parts can be affected by ageing, the date (month and year) of manufacture shall be marked.

For parts which cannot be marked the relevant information shall be included in the operating instructions.

6.3 The RPD, excluding the compressed air supply tube, shall be marked with:

- a) the number and the year of this European Standard, e.g. EN 14593-1:YYYY;
- b) the storage temperatures the RPD is designed to withstand, or the appropriate pictogram from EN 132, if different from this European Standard;
- c) the month and year of manufacture (MM-YYYY);
- d) the manufacturer's name, trade mark or other means of identification;
- e) the phrase "See information supplied by the manufacturer" or the appropriate pictogram;
- f) if appropriate, the marking 'F' to show that the RPD meets the additional requirements of [4.10.4](#).

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

- a) the manufacturer's part number or the manufacturer's type identification;
- b) the month and year of manufacture (MM-YYYY);
- c) the manufacturer's trade name, trademark or other means of identification;
- d) the marking 'H' for 'heat resistant', to show that the tube meets the requirements of [4.14.5](#), if appropriate;
- e) the marking 'S' for 'anti-static', to show that the tube meets the requirements of [4.14.6](#), if appropriate;
- f) the marking 'F' to show that the tube meets the additional requirements of [4.10.4](#), if appropriate.

7 Information supplied by the manufacturer

7.1 Information supplied by the manufacturer shall accompany each RPD on delivery enabling trained and qualified user to handle 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.

7.2 Other information shall comprise:

- a) the correct selection and fitting of the facepiece;

- b) whether or not designed to withstand storage in low or high temperature;
- c) 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;
- d) the pressure range of the air supply to the RPD;
- e) the maximum working pressure of the compressed air supply tube;
- f) a warning that adequate protection cannot be provided by the RPD in certain highly toxic atmospheres, where appropriate;
- g) a warning that at very high work rates the pressure in the full face mask can become negative at peak inhalation flow;
- h) a warning concerning the need to ensure that the breathable air is in accordance with EN 12021;
- i) a warning that the moisture content of the breathable air should be controlled within the limits in accordance with EN 12021, to avoid freezing of the RPD;
- j) a warning against the use of oxygen or oxygen enriched air;
- k) a warning that every user connected to the air supply system shall check that the capacity of the air supply system is sufficient for himself in accordance with information supplied by the manufacture;
- l) that the donning procedure shall be carried out strictly in accordance with the information supplied by the manufacturer
- m) the statement: 'Where appropriate, the marking 'F' on the RPD and the compressed air supply tube indicates that both can be used in situations where exposure to flame can be a risk;
- n) where appropriate, a statement that the compressed air supply tube is heat-resistant (H) and/or anti-static (S);
- o) the information for cleaning and disinfection agents and procedures;
- p) 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;
- q) the instructions for a switch-over device, where appropriate;
- r) the information on spare parts (if appropriate);
- s) a warning against other possible connections to couplings connected to pipe systems that supply other gases than breathable air;
- t) risk assessment by the user against possible perilous connections possible at the workplace, e.g. Nitrogen;
- u) the explanation of the markings specified in [Clause 6](#);
- v) any other information the manufacturer would like to give;
- w) the maximum number of users that can be connected simultaneously to a mobile high pressure compressed air system.

Annex ZA (informative)

Annex ZA Relationship between this European Standard and the essential health and safety requirements of Regulation 2016/425/EU [2016 OJ L81] aimed to be covered

This European Standard has been prepared under a Commission's standardization request to provide one voluntary means of conforming to essential requirements of Regulation 2016/425/EU of the European Parliament and of the Council of 9 March 2016 on personal protective equipment and repealing Council Directive 89/686/EEC [2016 OJ L81].

Once this standard is cited in the Official Journal of the European Union under that Regulation, compliance with the normative clauses of this standard given in [Table ZA.1](#) confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential health and safety requirements of that Regulation, and associated EFTA regulations.

Table ZA.1 — Correspondence between this European standard and [Article 3](#) of Regulation 2016/425/EU [2016 OJ L81]

Essential health and safety requirements of Regulation 2016/425/EU	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.1.1 Ergonomics	4.5 , 4.6.2 , 4.8 , 4.20 , 4.21	
1.1.2.1 Optimum level of protection	4.5	
1.2.1 Absence of risks and other 'inherent' nuisance factors	4.4.1 , 4.4.2 , 4.6.5 , 4.7.1 , 4.7.2.3 , 4.10 , 4.11 , 4.12.3 , 4.14.1 , 4.14.2 , 4.14.5 , 4.14.7 , 4.15 , 4.16.4 , 4.17	
1.2.1.1 Suitable constituent materials	4.4.3	
1.2.1.2 Satisfactory surface condition of all PPE parts in contact with the user	4.4.4	
1.2.1.3 Maximum permissible user impediment	4.5	
1.3.1 Adaptation of PPE to user morphology	4.5 , 4.8	
1.3.2 Lightness and design strength	4.6.3 , 4.7.1 , 4.8 , 4.11 , 4.14.3 , 4.14.4 , 4.15	EN 136:1998, EN 402:2003
1.4. Manufacturer's instructions and information	Clause 7	EHSR 1.4, items i,j,k,l are not covered by this standard
2.1 PPE incorporating adjustment systems	4.8 , 4.17	
2.2 PPE "enclosing" the parts of the body to be protected	4.18	By reference to EN 136
2.3 PPE for the face, eyes and respiratory system	4.18	
2.4 PPE subject to ageing	6.2	
2.6 PPE for use in potentially explosive atmospheres	4.4.2 , 4.14.6	
2.8 PPE for intervention in very dangerous situations	4.7.2.2 , 4.7.2.3 , 4.13.2 , 7	
2.9 PPE incorporating components which can be adjusted or removed by the user	4.6.1 , 4.17	

Essential health and safety requirements of Regulation 2016/425/EU	Clause(s)/subclause(s) of this EN	Remarks/Notes
2.10 PPE for connection to, complementary equipment external to the PPE	4.12.1 , Clause 7	
2.12 PPE bearing one or more identification markings or indicators directly or indirectly relating to health and safety	Clause 6	
3.10.1 Respiratory protection	4.16.1 , 4.16.2 , 4.16.3 , 4.18 , 4.19 , 4.20 , 4.21 , 4.22 , 7.2	
3.10.2 Protection against cutaneous and ocular contact	4.18	EN 136:1998

WARNING 1 Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

Bibliography

- [1] EN 13725, *Air quality — Determination of odour concentration by dynamic olfactometry*
- [2] EN 60079-32-2, *Explosive atmospheres — Part 32-2: Electrostatics hazards — Tests (IEC 60079-32-2)*
- [3] EN 60812:2006, *Analysis techniques for system reliability — Procedure for failure mode and effects analysis (FMEA) (IEC 60812)*
- [4] ISO 13301, *Sensory analysis — Methodology — General guidance for measuring odour, flavour and taste detection thresholds by a three-alternative forced-choice (3-AFC) procedure*

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