BRITISH STANDARD

BS EN
529:2005

# Respiratory protective devices — Recommendations for selection, use, care and maintenance — Guidance document

The European Standard EN 529:2005 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 529:2005. It supersedes BS 4275:1997 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee PH/4, Respiratory protection, to Subcommittee PH/4/11, Respiratory protection — General, 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 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.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 529

October 2005

ICS 13.340.30

Supersedes CR 529:1993

English Version

# Respiratory protective devices - Recommendations for selection, use, care and maintenance - Guidance document

Appareils de protection respiratoire - Recommandations pour le choix, l'utilisation, l'entretien et la maintenance - Guide

Atemschutzgeräte - Empfehlungen für Auswahl, Einsatz, Pflege und Instandhaltung - Leitfaden

This European Standard was approved by CEN on 22 July 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 529:2005) 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of an identical text or by endorsement, at the latest by March 2006, and conflicting national standards shall be withdrawn at the latest by March 2006.

This European Standard supersedes CR 529:1993.

Users of this European Standard, prepared in the field of application of Article 118A of the EC Treaty, should be aware that European Standards have no formal legal relationship with Directives which may have been made under Article 118A of the Treaty. In addition, national legislation in the Member States may contain more stringent requirements than the minimum requirements of a Directive based on Article 118A. Information on the relationship between the national legislation implementing Directives based on Article 118A and this European Standard may be given in a national foreword of the national standard implementing this European Standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, 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

Hazardous substances such as dusts, fibres, fumes, vapours, gases, micro-organisms and radioactive particulates and gases encountered at work can cause significant damage to health or, in extreme cases, can lead to death. This frequently occurs by the inhalation of harmful levels of hazardous substances that are present in the workplace air. Besides the inhalation exposure dermal exposure to hazardous substances can also lead to local skin damage, and sensitisation, as well as systemic effects.

Similarly exposure to an oxygen deficient atmosphere can lead to death.

Exposure (via all routes - inhalation, dermal and ingestion) to hazardous substances at work should be eliminated or alternative substances which are less hazardous used. Where elimination is not practicable adequate protective measures should be put in place so that exposures are reduced to a minimum.

The use of suitable protective measures at source should be the first choice for minimising the exposure. Such measures protect everyone in the workplace, whereas a respiratory protective device only protects the person who wears it. If adequate protective measures at source or any other administrative measures are not reasonably practicable or found to be inadequate for controlling inhalation exposure then an adequate and suitable respiratory protective device should be used.

Respiratory protective devices are designed to be worn in hazardous environments and should provide wearers with an adequate supply of breathable air or gas. Respiratory protective devices are considered to be at the bottom of the hierarchy of protective measures and should only be used after an acceptable case for their use has been established by way of an appropriate risk assessment.

Fatalities and serious accidents can occur if there is a failure to select and use a respiratory protective device suited to the substances, the wearer, the task and the environment in which the device is used. The failure to maintain the device in good working condition can also lead to similar consequences. These problems should be avoided by implementing a suitably designed respiratory protective device programme.

# 1 Scope

This European Standard provides guidance on the best practice for establishing and implementing a suitable respiratory protective device programme. It is published to provide a Europe-wide baseline for the selection, use, care and maintenance of respiratory protective devices. It provides guidelines for preparing national guidance in this area. The guidance contained in this European Standard is not intended to be exhaustive, but highlights important aspects to which attention should be given. The recommendations in this European Standard will help to comply with national legislation on this subject where it exists, or with European legislation.

Respiratory protective devices used exclusively in diving and at increased or reduced atmospheric pressures are not covered by this guidance.

# 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*

# 3 Terms and definitions

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

**3.1**
**atmosphere immediately dangerous to life or health**
atmosphere in which the concentrations of hazardous substances, including asphyxiants, or the oxygen levels present create one or more of the following conditions:

— immediate threat to life;

— could cause delayed threat to life;

— would cause immediate acute health effects;

— would prevent the respiratory protective device wearer from an unaided escape to safety in case of the device malfunctioning or failing to operate correctly

**3.2**
**assigned protection factor (APF)**
level of respiratory protection that can realistically be expected to be achieved in the workplace by 95 % of adequately trained and supervised wearers using a properly functioning and correctly fitted respiratory protective device and is based on the $5^{th}$ percentile of the Workplace Protection Factor (WPF) data

**3.3**
**breathing zone**
space outside the facepiece extending 0,3 m in radius in front of the respiratory protective device wearer's face and centred on the mid-point of a line joining the ears

**3.4**
**competent person**
person with suitable and sufficient experience and with practical and theoretical knowledge of the elements of respiratory protective device programme for which that person is responsible

**3.5**
**emergency breathing facility**
facility, as specified by the respiratory protective device manufacturer, coming into operation when the normally operating respiratory protective device is not functioning. The facility provides an adequate level of protection for a period to enable the device wearer to exit the work area, unassisted, to a place of safety

**3.6**
**nominal protection factor**
number derived from the maximum percentage of total inward leakage permitted in relevant European Standards for a given class of respiratory protective device. The relationship between nominal protection factor and total inward leakage can be expressed as follows:

$$\text{nominal protection factor} = \frac{100}{\text{permitted maximum percentage total inward leakage}}$$

**3.7**
**maximum allowed occupational exposure limit**
limit of the time weighted average concentration of hazardous substances in the air within the breathing zone of a worker in relationship to a specified reference period

**3.8**
**specified reference period**
specified time for the purposes of time-weighting the exposure concentration as stated for the occupational exposure limit value of hazardous substances. The specified reference period for the long-term limit value is normally 8 h and for the short-term limit value is normally 15 min

**3.9**
**peak inhalation rate**
maximum instantaneous volume flow rate which occurs during an inhalation cycle of a respiratory protective device wearer

**3.10**
**respiratory protective device passport**
document for recording the details of initial and refresher training provided to a respiratory protective device wearer

**3.11**
**workplace protection factor**
ratio between the breathing zone (see 3.3) concentration (outside the facepiece) of a chosen hazardous substance and its concentration inside the facepiece (suitable sampler being placed as near as possible to the mouth of respiratory protective device wearer) of a correctly functioning respiratory protective device when correctly worn and used in the work place. The workplace protection factor may be expressed as:

$$\text{workplace protection factor} = \frac{\text{concentration within the breathing zone (outside the facepiece)}}{\text{concentration inside the facepiece}}$$

**3.12**
**work rate**
physiological load (strain) imposed on an individual respiratory protective device wearer due to his work rate can be defined in terms of the maximal oxygen uptake rate in l/min. The rate of oxygen uptake due to work rate can be categorised into light, moderate, heavy and very heavy metabolic rates (watts)

NOTE Metabolic rate may be calculated using the international standard method (see EN ISO 8996).

# 4 Classification

## 4.1 General classification

There are two distinct types of respiratory protective devices:

a) Filtering devices: These purify the ambient air to be breathed using filters able to remove contaminants in the air.

b) Breathing apparatus: These supply the wearer with breathable air (e.g. compressed air), or breathable gas, (e.g. compressed oxygen) from an uncontaminated source.

Details of different types of devices are given in Annex A.

## 4.2 Main components

### 4.2.1 General

A respiratory protective device consists of two main components, a facepiece and filter(s) or a facepiece and a means of supplying uncontaminated breathable air or gas.

### 4.2.2 Facepieces

The facepiece directs the uncontaminated breathable air or gas to the wearer's nose and mouth area. Filtering devices and breathing apparatus are available with a range of different facepieces but there are some important limitations.

— Tight-fitting facepieces (filtering facepieces, quarter masks, half masks and full face masks) rely heavily on a good seal between the mask and the wearer's face. Full face masks, half masks and quarter masks may be used for both types of devices as described in 4.1.

— Loose-fitting facepieces (e.g. hoods, helmets, visors, blouses, suits) rely on enough air being provided to prevent contaminants leaking into the facepiece as the wearer breathes and moves about. They are only used on powered filtering devices or with suitable breathing apparatus. In other words, loose-fitting facepieces are not suitable for devices which rely on the breathing action of the wearer to draw air. These include unpowered filtering devices and some breathing apparatus.

— Mouthpieces are used with certain devices. They make any form of verbal communication impossible. They are used in conjunction with a nose clip.

### 4.2.3 Filters

Filtering devices should have the correct type of filter(s) matched to the substance(s) from which the wearer needs protection. The filters can only protect against limited concentration ranges of contaminants as specified by the manufacturers. The filter can be for protection against particles (particle filters), gases/vapours (gas filters) and for protection against particles and gases/vapours (combined filters). Further details are given in A.2.

### 4.2.4 Breathable air or gas supply source for breathing apparatus

A source (e.g. chemical oxygen generator or compressed air line) or a vessel (e.g. a gas cylinder) which is capable of supplying uncontaminated breathable air or gas to a breathing apparatus. The quality of the compressed air for breathing apparatus should be in accordance with EN 12021. Further details are given in A.4.5.

# 5 Programme process

## 5.1 Employers and self-employed persons responsibilities

### 5.1.1 Programme policy

The employer and self-employed persons have legal responsibilities for the correct selection, maintenance and issue of respiratory protective devices and the management of their correct use in the workplace. Therefore, they should define and document a suitable policy for a respiratory protective device programme including the objectives for the programme.

The policy should be relevant to the needs of the organisation and adequate for the health and safety risks involved. The policy should be understood at all levels in the organisation.

When developing the policy the employer should involve the device wearers and their representatives.

NOTE The responsibilities of the employer are detailed in the Directive 89/656/EEC.

### 5.1.2 Provision of respiratory protective devices

There is no charge to the employee when a respiratory protective device is provided.

### 5.1.3 Organisation

The people tasked with the responsibility, authority, implementation and running of an effective respiratory protective device programme should be able to demonstrate the relevant competency.

### 5.1.4 Resources

The employer should identify and make available the necessary resources for the implementation and running of an effective programme including the need for supervision, training and developing the relevant competency.

### 5.1.5 Management review

The employer should review the programme at defined intervals or when necessary to ensure the continued effectiveness of the programme and to monitor the progress of improvement objectives.

In any event a review should take place annually. An audit schedule relevant to the programme should also be put in place to review the effectiveness of implementation at all levels within the employer's responsibilities.

### 5.1.6 Training

The employer should ensure that the programme supervisors, the wearers and others involved in the maintenance of the devices receive suitable training. Refresher training should be provided as necessary. In any event this should take place at least annually unless otherwise decided by individual risk assessments.

### 5.1.7 Supervision

The employer should ensure that the devices are used in accordance with the manufacturers instructions and that no respiratory protective device is modified.

### 5.2 Employees responsibilities

#### 5.2.1 Wearers

Individuals involved in a respiratory protective device programme should always follow procedures and systems laid down by the programme and be responsible for the delegated responsibilities.

Individuals who are provided with and required to wear respiratory protective devices or any other personal protective equipment which includes respiratory devices should use the devices in accordance with the manufacturer's instructions including the pre-use checks and the training provided by the employer. They should make known to their supervisor any problems encountered during wear or use.

#### 5.2.2 Competent persons

Individuals nominated as competent persons should co-operate with their employer to ensure that they have the relevant knowledge, experience and training to undertake respiratory protective device related tasks.

### 5.3 Manufacturers' responsibilities

Manufacturers or their appointed representatives are responsible for CE-marking (see 9.3.5) the respiratory protective devices before the devices are supplied to users.

Respiratory protective device manufacturers and suppliers should ensure that the information they provide with their devices is accurate, reflects the current knowledge and assists the employers/users in making the correct choice. The duty to select and use adequate and suitable respiratory protective devices remains with the employer.

## 6 Risk assessment process

The exposure to hazardous substances at work should be eliminated. If this is not reasonably practicable then the exposure should be minimised by other means at source before using respiratory protective devices.

The employer should carry out an adequate and suitable risk assessment wherever hazardous substances are in use or there are foreseeable risks to health and safety.

The risk assessment should take into account at least the hazard, its nature, the sources contributing to the exposure, the degree of exposure, the working environment, the tasks and the people carrying out the tasks, the effectiveness of preventive measures taken or to be taken as well as other foreseeable consequences of failure of protective measures.

When deciding the protective measures, the steps given in Table 1 should be evaluated in the order given and put in place as appropriate. It should be noted that in many workplace situations a combination of the steps described in Table 1 will be needed to minimise exposure. In addition, administrative, including supervisory, systems should be in place to ensure that the protective measures remain adequate at all times.

The risk assessment should be recorded and be kept up to date through a process of regular review or whenever the assessment is found to be no longer valid. A review should take place at least annually.

**Table 1 — Protective measures**

| | |
|---|---|
| 1 | The use of alternative substances which are less hazardous. |
| 2 | The substitution of a given substance in a form that is less hazardous. |
| 3 | The substitution of a process by an alternative process likely to generate lower airborne concentrations of substances. |
| 4 | Total or partially enclosed process and handling systems. |
| 5 | Partial enclosure with local exhaust ventilation. |
| 6 | Local exhaust ventilation. |
| 7 | General ventilation. |
| 8 | Reducing period of exposure. |
| 9 | The introduction of appropriate working practices and systems of work (e.g. to close and store containers securely when not in use). |
| 10 | Use of monitoring and warning devices to give a clear indication when unsafe airborne concentrations are present. |
| 11 | Good housekeeping. |
| 12 | The use of adequate and suitable personal protective equipment including respiratory protective device. |

## 7 Criteria for using respiratory protective devices

Respiratory protective devices should only be used when one or more of the following conditions are met:

a) other protective measures are in place, yet an unacceptable inhalation exposure risk still exists;

b) exposures exceed the relevant occupational exposure limit value and protective measures are in the process of being installed;

c) emergency work which cannot wait until other protective measures at source are put in place;

d) exposures are infrequent and of short duration and permanent installation of other protective measures are not practicable;

e) respiratory protective device is needed for escape in the event of an emergency;

f) emergency rescue work by trained personnel.

However, there are situations where adequate control measures may be in place and the employer may decide to provide suitable respiratory protective devices as an extra precaution.

## 8 Risk assessment for respiratory protective device use

### 8.1 Elements of respiratory protective device programme

Where a respiratory protective device is needed for minimising the exposure it should only be used when a suitable respiratory protective device programme is in place. The elements of a respiratory protective device programme will include the following:

a) hazard appreciation and identification;

b) risk assessment to comply with legal requirements;

c) selection of adequate and suitable devices;

d) training for users and others involved in the programme;

e) maintenance of the devices in accordance with manufacturer's instructions;

f) record keeping which will include programme policy, management systems implementing the programme, risk assessments, adequacy and suitability assessment, training details and maintenance records;

g) auditing of the programme;

h) management systems for implementing the programme.

### 8.2 Factors to consider in risk assessment

The risk assessment for minimising the inhalation exposure by using respiratory protective device should consider at least the following:

a) Will the atmosphere contain sufficient oxygen during the whole period of work/exposure?

b) Which hazardous substances including asphyxiants are likely to be present? What are their physical and chemical properties?

c) Which forms do the air contaminants take – dust, fibre, mist, fume, micro-organism, gas, vapour or radioactive particulates or gases?

d) What health effects can these substances have on the body?

e) What are the foreseeable worst-case concentrations in the atmosphere?

f) What are the relevant occupational exposure limit values or the safe exposure levels?

g) What other hazards (e.g. potential for splashing, sparks, fire, flammability) are associated with the job/process, which will influence the selection and use of a respiratory protective device?

## 9 Adequacy and suitability

### 9.1 General

The process of selecting a correct device should only be undertaken after an appropriate risk assessment has been carried out. The next step in a selection process should be the determination of adequacy. Once the adequacy has been established suitability should be determined for the correct selection of the device.

### 9.2 Adequacy

#### 9.2.1 General

A respiratory protective device is considered adequate if it has the capacity to reduce the wearer's exposure to a hazard to acceptable levels (e.g. to comply with occupational exposure limit values).

#### 9.2.2 Assessing atmospheres immediately dangerous to life or health

When an environment is considered as an atmosphere immediately dangerous to life and health (see Annex B) a high level of respiratory protection is required, for example, a self-contained breathing apparatus with a full face mask operating in a pressure demand or positive pressure mode; a compressed air line breathing apparatus with a full face mask operating in a pressure demand or positive pressure mode.

The device used in an atmosphere immediately dangerous to life or health may incorporate an emergency breathing facility which would last long enough for the wearer to reach a place of safety. Where an emergency breathing facility is not provided other measures which are equally effective should be put in place.

#### 9.2.3 Assessing the minimum required protection factor

To determine adequacy it is necessary to know the foreseeable worst-case concentration(s) of the airborne contaminant(s), against which the respiratory protective device is to be used. The minimum required protection is then calculated according to:

$$\text{minimum required protection} = \frac{\text{contaminant concentration outside the facepiece}}{\text{allowable concentration inside the facepiece}}$$

NOTE The maximum allowable concentration inside the facepiece is usually the occupational exposure limit value. The air sample outside the facepiece is normally taken within the breathing zone.

The figure obtained for the minimum required protection should then be compared against the nationally applicable assigned protection factors, where defined, for different types of devices. Those devices with assigned protection factors greater than the minimum required protection can be considered as adequate. The next step would involve the selection of suitable devices.

An introduction to protection factors including a table of comparative assigned protection factors from different countries is described in Annex C.

### 9.3 Suitability

#### 9.3.1 General

Respiratory protective devices selected should be suitable for the use intended and be able to provide adequate protection for the duration of wear. The suitability assessment of a device should take into account at least the following issues:

a) be CE-marked (see 9.3.5);

b) be adequate;

c) be compatible with the environment, the task, the wearer and other personal protective equipment used;

d) be in good working order.

#### 9.3.2 Assessing suitability for the workplace environment

The device selected should be suitable to cope with the environmental conditions. The factors that need to be considered include:

a) oxygen deficiency or enrichment;

b) asphyxiants present or potential for sudden release and their likely concentrations;

c) Is the atmosphere immediately dangerous to life or health?

d) Is the atmosphere corrosive or likely to become so?

e) Is the atmosphere explosive or likely to become so?

f) permeation capabilities of air contaminants (e.g. via facepiece and filters);

g) physical state (e.g. gas, mist, dust, fume) of the contaminant;

h) temperature and humidity of the atmosphere.

The description of each factor is given in Annex D.

#### 9.3.3 Assessing suitability for the task

The device selected should be suitable for the task(s) undertaken by the wearer. The factors that need to be considered include:

a) work rates involved;

b) visibility requirements;

c) mobility requirements including spatial conditions of the environment;

d) communication requirements;

e) thermal strain on wearer;

f) other accessory worn in the area in contact with the device;

g) tools to be used;

h) other personal protective equipment to be worn in addition to a respiratory protective device;

i) duration of wear.

The description of each factor is given in Annex D.

#### 9.3.4 Assessing suitability for the wearer

The device selected should be suited to the wearer and the factors needing consideration include:

a) medical fitness of the wearer;

b) facial characteristics of the wearer including facial hair;

c) physical characteristics of the wearer;

d) use of spectacles;

e) use of contact lenses;

f) assessment of the fit of tight-fitting facepiece.

The description of each factor is given in Annex D.

#### 9.3.5 CE-Marking

Respiratory protective devices marketed in the European Union have to be CE-marked to show that they meet the requirements of the European Directive 89/686/EEC. The CE-mark does not make the device adequate and suitable for a given situation and wearer. Assessing adequacy and suitability is part of a respiratory protective device programme process. The requirements for CE-marking are summarised in D.5.

## 10 Use

Respiratory protective devices should be used in accordance with the manufacturers or suppliers instructions for use and they should not be modified. The device wearer should carry out pre-use checks which should include:

a) inspecting the condition of vulnerable parts (e.g. seals, harness, valves, visors);

b) where filters are fitted: checking that they are the right type, fitted correctly, not damaged and they are within the end of shelf life printed on the filters;

c) checking that the correct air flow rate is supplied (e.g. by a blower or a compressed air source);

d) fit-checking to ensure that the facepiece has been donned correctly each time the respiratory protective device is worn. Details on facepiece fit assessment are given in Annex E.

## 11 Operating information, instruction and training

### 11.1 General

The training of all those involved in the programme should be kept up to date through a process of regular refresher training. The refresher training should take place at least annually. The training should be matched to the complexity of the device and the extent of the health/life risks against which the device is used.

### 11.2 Employers

The employer is required (89/656/EEC) to ensure that each wearer and others involved in the programme receive the necessary information, instruction and training.

### 11.3 Wearers

Each wearer should be given both initial and at least annual refresher training in the safe use of the chosen device. The training should include information on:

a) hazards against which the device is to be used and the health effects likely to result from exposure to those hazards;

b) why the device is needed for the job and when to use it?

c) wearer’s responsibilities for the correct use and care of personal protective equipment;

d) reason for selecting a particular type of device and the fit testing of face pieces, where necessary;

e) risks to the wearer if the device is not worn and used correctly and/or not worn all the time in the contaminated area;

f) how the device works, what it can do and cannot do, including limitations;

g) how to recognise faults in the device;

h) pre-use inspection and checks required and how to carry them out;

i) method of donning and doffing the device and fit-checking;

j) practical emergency procedures when wearing the device;

k) doffing, cleaning, disinfection and inspection of the device after use;

l) instruction on correct storage;

m) information on reporting arrangements (e.g. to report faults, need for maintenance, to obtain and fit spare parts where practicable).

### 11.4 Supervisors

Supervisors should be trained to monitor the correct use of respiratory protective devices. The training curriculum should include items listed in 11.3 and on general management duties which should include procedures for issuing the correct device, enforcing correct use, dealing with complaints relating to the device used including the recording of complaints; dealing with accidents and incidents involving the device; auditing the effectiveness of the device programme and acting as role models.

## 12 Maintenance

Except for single use disposable devices the maintenance of respiratory protective devices is required (89/656/EEC) to be carried out by competent persons and in accordance with the manufacturer's instructions.

A thorough maintenance programme should include:

a) fault finding routines;

b) replacement of parts, as necessary;

c) performance checking.

Where a device is not issued on a personal basis the employer should ensure that the device is adequately cleaned and disinfected.

## 13 Storage

### 13.1 Employers duties

The employer is required (89/656/EEC) to provide suitable storage accommodation for respiratory protective devices as recommended in the user instructions supplied by the manufacturer.

The employer should provide facilities/administrative systems for segregating dirty and clean respiratory protective devices for safely disposing of contaminated respiratory protective devices or their components.

### 13.2 Employees' duties

The individual wearers involved in the programme should store the devices safely in the accommodation provided.

## 14 Record keeping

The employer should keep records of risk assessment, the respiratory protective device programme policy, assessment of adequacy and the suitability of the device, repair and maintenance undertaken on the device and details of the training provided to the wearers, supervisors and maintainers.

These records should be maintained for a period appropriate to the toxicity and latency of diseases associated with the contaminants concerned and at least to the minimum period required by any national regulations.

Appropriate records should be made available to the relevant wearers and their safety representatives. The details of the training provided should be recorded. For this purpose a respiratory protective device passport may be used. The details of the passport are given in Annex F.

# Annex A
(informative)

# Types and components of respiratory protective devices

## A.1 Facepieces

### A.1.1 Half mask without inhalation valves and with separable filters to protect against gases or gases and particles and particles only (EN 1827)

This device is a lightweight half mask without inhalation valves covering the nose, mouth and the chin. The mask may or may not have exhalation valves. The filter(s) is separable from the mask and replaceable. Filters are intended to be used for a maximum of a single shift. The half mask itself is intended for replacement after a relatively small number of uses.

The filter/mask combination is 'dedicated'. This means that the mask should only be used with filters specified by the manufacturer. Since the mask has no inhalation valve and reduced strength requirements it should not be confused with half masks meeting EN 140. Complete devices are designated according to the filter type and class used and will have the prefix FM.

### A.1.2 Half masks and quarter masks (EN 140)

A half mask is a facepiece which covers the nose, mouth and the chin of the wearer and is held in place with adjustable straps. Similarly, a quarter mask is a facepiece which covers the nose and mouth. When used with a filtering device air is drawn through an appropriate filter(s) by the wearer's lung-power or from a power assisted filtering device (see A.1.3). The exhaled air is discharged through an exhalation valve(s), or by other appropriate means. Filters are available for particulates, gases/vapours or as a combined filter (see A.2). Half masks may also be used with breathing apparatus.

### A.1.3 Full face Masks (EN 136)

A full face mask covers the eyes, nose, mouth and the chin. It seals against the face of the wearer and is held in place with adjustable straps. When used in a filtering device air is drawn into the mask either through an appropriate filter(s) by the wearer's lung-power or from a power assisted filtering device. This mask may also be used with breathing apparatus. Exhaled air is discharged through an exhalation valve(s). Most masks have an inner mask which can reduce the re-inhalation of exhaled carbon dioxide, reduce visor misting and assist comfort. Some devices are fitted with a speech diaphragm to improve the clarity of communication and others may have facilities for fitting special spectacles within the mask. The visor provides protection against particulates and gases. In some cases special grade visors are needed for protection against chemical splashes or impact.

Particle filters or gas/vapour filters or combined filters can be used with this mask. See A.2.3.

There are three classes of masks. Class 1 is of light-duty construction intended in the main for filtering devices and (light-duty) continuous flow compressed air line breathing apparatus. Class 2 is more robust and offers greater resistance to flammability. Class 3 offers greater resistance to radiant heat and flame, and this type of mask may be suitable for fire fighting.

## A.2 Filters

### A.2.1 General

A filtering device should have the correct type of filter(s) matched to the substance(s) from which the wearer needs protection. Employers should follow the manufacturer's recommendations on where to use them and when to replace them. The maximum mass of filter(s) designated to be used directly connected to a half mask is 300 g. The maximum mass of filter(s) designated to be used directly connected to a full face mask is 500 g. Filters to be used with power assisted devices have to be specifically approved with the device.

Filters are classified and colour-coded as described in Table A.1. However, the manufacturer's information should specify their application and the marking on the filters will include:

— CE-mark;

— type and class;

— colour code;

— identification of manufacturer, e.g. name and trademark;

— European Standard (EN) number(s), as appropriate;

— shelf life, if appropriate;

— 'see instructions for use' or equivalent pictograms;

any additional markings relevant to particular types.

Filters should not be shared between wearers.

If a device is designed to be used with more than one filter of the same type and class then all filters should be changed at the same time.

### A.2.2 Particle filters (EN 143, EN 12941 and EN 12942)

These are marked 'P' and are generally colour-coded white. For negative pressure devices the European Standard is EN 143 and the filters are available in three classes based on their filtering efficiency; P1-low efficiency, P2-medium efficiency and P3-high efficiency. For powered and power assisted filtering devices the P marking will be present together with an indication S or SL. S means the filter is suitable only for solid aerosols, SL means for solid and liquid aerosols.

The breathing resistance of a particle filter can increase substantially as it becomes loaded. This may become evident to the wearer of negative pressure devices. For powered and power assisted filtering devices the pre-use check should indicate problems with clogged filters and some classes of device have alarms which warn the wearer during use if the minimum airflow or pressure performance is not being maintained.

### A.2.3 Gas filters and combined filters (EN 14387, EN 12941 and EN 12942)

Gas filters are available for use against different types of gaseous (to include vapours) contaminants as specified by the manufacturer or as 'multi-type' filters which can be used against more than one type of gas as specified by the manufacturer. Most gas filters are further divided into three classes in terms of capacity (Classes 1, 2 and 3). The classification is based on how much of the gas or vapour the filter can hold. Class 1 filters have the lowest capacity and Class 3 filters the highest. The relationship between capacity and how long the filter could be used in the workplace is not tested. Therefore, users should seek directions from the manufacturers about the service life of the filters (for more detail see A.2.4, below). It is vital to note that the capacity Classes 1, 2 and 3 for negative pressure devices in EN 14387 are different from those for powered devices. Combined filters consist of a gas filter(s) and a particle filter. A gas filter can be combined with any

particle filter, as in A.2.2 above, except for those filters made for use against mercury and oxides of nitrogen which are always combined with P3 or high efficiency filters for powered or assisted devices of Class 3.

**Table A.1 — Types of particle, gas and vapour filters**

| Substance | Filter type | Colour |
|---|---|---|
| Particles | P | white |
| Organic gases and vapours (BP > 65 °C) as specified by the manufacturer | A | brown |
| Inorganic gases and vapours as specified by the manufacturer (excluding carbon monoxide – CO) | B | grey |
| Sulphur dioxide and other acid gases and vapours as specified by the manufacturer | E | yellow |
| Ammonia and organic ammonia derivatives as specified by the manufacturer | K | green |
| Mercury | Hg<br>incorporates P3 filter and maximum use is limited to 50 h | red-white |
| Oxides of nitrogen | NO<br>incorporates P3 filter and for single use only | blue-white |
| Organic gases and vapours (B ≤ 65 °C) substance as specified by the manufacturer | AX<br>single use only | brown |
| Filters against specific substances as specified by the manufacturer | SX<br>marked with the name of the chemical | violet<br>violet-white if combined with particle filter |
| NOTE Many of these filters can be used with filtering devices relying on the breathing action of the wearer (negative pressure devices) and also with powered devices. Filters may carry two sets of classification, one for negative pressure devices and the other for the powered devices. The powered device marking is not relevant when used with negative pressure devices and vice versa. | | |

## A.2.4 Service life of filters

### A.2.4.1 General

There is no simple rule on when filters should be changed. The service life (sometimes referred to as ”end-of-service-life”) of a filter(s) will be affected by a number of variables including the type of filter used, its capacity; the ambient conditions such as the temperature and humidity; the nature and the concentration(s) of the substance(s); how strongly it is held by the filter sorbent medium, any potential interaction between different substances and how fast or slow the wearer is breathing and the airflow rate in the case of assisted filtering devices. It is clear that the service life assessment is a complicated process. It will also be affected by the storage conditions.

NOTE The term "service life" and “end of service life” should not be confused with the term “end-of-shelf-life”. The latter is determined by the filter manufacturer and is determined for the specified conditions of storage. A filter beyond the “end-of-shelf-life” should not be used for providing protection.

### A.2.4.2 Particle filters

Some particle filters or filtering half mask devices are designed for single use only. These should be replaced after a single shift. The breathing resistance of a particle filter will progressively increase with loading. It may be considerably increased if the filters are used in damp conditions. When filters are used with negative pressure

devices, as a general rule, the service life is reached when there is a perceived increase in resistance to breathing. Many filtering facepiece type devices are susceptible to deformation (e.g. when kept in a trouser pocket). If the facepiece is deformed it should be discarded.

In general, particle filters are not designed (or tested) for cleaning or disinfection. If there is an intention of cleaning or disinfection manufacturer's advice should be sought.

#### A.2.4.3 Gas filters

It is difficult to give a "general rule of thumb" advice for the safe duration of use (service life) for a gas filter. Users of such filters should obtain the maximum possible information about the type of air contaminants to be present in the work environment, their likely concentrations, humidity levels and temperature and work rate. Armed with this information, they should seek guidance from the filter manufacturer about the type and class of filter to be used and the likely safe duration of use. Many manufacturers are using algorithms for assessing the "end-of-service-life" for a given substance under specified use conditions.

Some users may rely on the smell or taste of hazardous substances to detect breakthrough and thereby the safe duration of use. This practice may not be suitable because wearer's senses may be affected or nullified for a variety of reasons. This in turn can lead to potential over exposure.

Organic substances with boiling point at or below 65 °C are very volatile and therefore less readily held by "A" type filters. For these substances AX filter (as specified by the manufacturer) should be used. These filters are for single use only and should be replaced latest after each shift. If there is an intention to reuse pre-used gas/vapour filters they should be stored in accordance with the manufacturers recommendations. Most importantly in the case of A-type filters spontaneous breakthrough can take place after a certain period of storage. The probability for spontaneous breakthrough increases with the amount of loading, the length of storage and with decreasing boiling point of the substance trapped in the filter.

SX-filters may only be used against gases whose name they are marked with by the filter manufacturer. Manufacturer's guidance should be sought on safe duration of use.

#### A.2.4.4 Combined filters

The recommendations in A.2.4.1 to A.2.4.3 will apply.

## A.3 Filtering devices

### A.3.1 General

Filtering devices purify the ambient air to be breathed by the wearer using filters able to remove contaminants in the air. They incorporate two major components – a filter for purifying the air and a facepiece to direct the purified air to the wearer's nose and mouth area. A filtering device relying solely on the breathing action of the wearer is termed unassisted, also known as negative pressure devices. Filtering devices employing a mechanical method for pulling the air through the filter and to deliver the air to the breathing zone of the wearer are termed powered and power assisted filtering devices.

### A.3.2 Negative pressure devices

#### A.3.2.1 Filtering half masks to protect against particles (EN 149)

These masks are designed for particle filtration. Filtering half masks cover the nose, mouth and the chin. The mask consists entirely or substantially of filter material or comprises a facepiece in which the main filter(s) form an inseparable part of the device. Air enters the particle filtering half mask and passes directly to the nose and mouth area of the wearer or via, an inhalation valve(s) if fitted. The exhaled air flows through the filter material and/or an exhalation valve (if fitted) directly to the ambient atmosphere.

These devices are designed to protect against both solid and liquid aerosols and are classified according to their filtering efficiency and their maximum total inward leakage. There are three classes of devices: FFP1, FFP2 and FFP3. These devices are normally intended to be used for a single shift.

Particle filters used against micro-organisms and enzymes should be discarded after the first use and disposed according to national regulations or work practices. These organisms may grow and pass through the material of particle filters.

#### A.3.2.2 Valved filtering half masks to protect against gases or gases and particles (EN 405)

A valved filtering half mask covers the nose, mouth and the chin. The device consists either entirely or substantially of filter material. These devices are for use essentially against gases and vapours. In addition these devices can be designed to protect against solid and liquid aerosols. Any gas/vapour filter forms an inseparable part of the device. The particle filter, if present, may be integral or separable. These devices should have both inhalation and exhalation valves. According to the design specification and protection capacity, gas and combined filters are classified into types and classes (for further details about types and classes of filters (see A.2.3).

Complete devices are designated according to filter type and class used and will carry the prefix FF. Types of filters include A, B, E, K, AX and SX. Combined filters will include particle filter(s) of a given filtration efficiency. However, special filters NO-P3 (oxides of nitrogen) and Hg-P3 (mercury) are excluded. Capacity of the gas filters may be Class 1 or Class 2.

### A.3.3 Assisted filtering devices

#### A.3.3.1 General

There are two types of assisted filtering devices: power assisted filtering devices using a full face mask or a half mask as a facepiece and powered filtering devices using a hood or similar type of facepieces. The paragraphs below provide detailed information on devices belonging to these types.

#### A.3.3.2 Power assisted filtering devices incorporating full face masks or half masks (EN 12942)

A complete power assisted filtering device consists at least of a turbo unit, a battery as a power supply for the turbo unit, one or more particle-, gas- or combination filter(s) and a full face mask or a half mask. The power operated turbo unit pulls the ambient air through the filter(s) and then directs the purified air to the facepiece directly or by means of a breathing hose. The turbo unit usually is worn on a waist belt or attached to the mask. The battery power supply for the turbo unit may also be attached to a waist belt carried by the device wearer or held elsewhere.

Since the air is pulled through the filters by the turbo unit power assisted filtering devices have the advantage of a reduced inhalation resistance. Depending on the performance characteristics of the device and the wearers demand for air the pressure inside the facepiece may remain above the ambient air pressure. However, at higher breathing rates pressure inside the facepiece can go negative. The exhalation resistance may be increased because in addition to the exhalation air the device still supplies air to the facepiece which needs to be exhausted through the exhalation valve. With so called “breath-responsive devices” the amount of air supplied to the wearer is controlled by the wearers breathing rate so that the supply rate is increased during inhalation while at exhalation the air supply rate is reduced.

The performance of these devices is defined at the so called “manufacturer’s minimum design condition”. At this condition the requirements for the total inward leakage, the re-breathed $CO_2$ content (“dead space”) and the breathing resistances still need to be fulfilled. Equipment meeting EN 12942 is provided with a means for the user to check that the manufacturer’s minimum design condition is exceeded prior to use. Some devices give a warning to the user when the minimum design condition is not fulfilled during use.

Because of the nature of the face seal (i.e. a right fitting facepiece) in these devices and the design requirements some protection will be provided even if, for example, the air supply fails allowing the wearer to use the device in negative pressure mode and to leave the contaminated area without removing the device.

Depending on the filters which are dedicated to the complete device these devices may be used against gases and vapours, or particles, or a combination of both. Depending on the protection level devices are designated into one of three classes (TM1x, TM2x or TM3x; x refers to filter type and class), with TM3 offering the highest protection level.

#### A.3.3.3 Powered filtering devices incorporating a helmet or a hood (EN 12941)

A complete powered filtering device consists at least of a turbo unit, a battery as a power supply for the turbo unit, one or more particle, gas, or combination filter(s) and a facepiece having no tight fit to the wearers face, e.g. a hood, visor, helmet, blouse or even a full suit. The power operated turbo unit pulls the ambient air through the filter(s) and then directs the purified air to the facepiece directly or by means of a breathing hose. The turbo unit usually is worn on a waist belt or attached to the facepiece. The battery power supply for the turbo unit may also be attached to a waist belt carried by the device wearer or held elsewhere.

Due to the “loose fitting” design of the facepiece these devices have low inhalation- or exhalation resistance. For the same reason at very high breathing rates the user may inhale unfiltered ambient air.

For correct performance these devices rely on a minimum air flow being supplied to the facepiece. This minimum air flow is defined by the “manufacturer’s minimum design flow rate”, and below it there is a possibility of higher inward leakage and high levels of re-breathed $CO_2$. Equipment in accordance with EN 12941 is provided with a means for the user to check that the manufacturer’s minimum design flow rate is exceeded. Apart from the lowest class (TH1x; x refers to filter type and class) the devices should have a warning device to indicate to the wearer during use that a further check of the manufacturer’s minimum design flow rate is necessary. These devices provide no protection when the air supply fails (so called “power off” situation). In this situation the user will be exposed to contaminants contained in the ambient air and increased levels of carbon dioxide ($CO_2$.) due to the rebreathed air in the facepiece.

Depending on the filters, which are dedicated to the complete device, these devices may be used against gases and vapours, or particles, or a combination of both. Depending on the protection level devices are designated into one of three classes (TH1x, TH2x or TH3x; x refers to filter type and class), with TH3 offering the highest protection level.

## A.4 Breathing apparatus

### A.4.1 Fresh air hose breathing apparatus

#### A.4.1.1 General

This equipment has a facepiece connected to an air supply hose, the upstream end of which should be anchored outside the contaminated atmosphere. Breathable air is supplied to the facepiece either by the wearer’s lung power (unassisted) or by a hand or electrically operated blower (assisted). Normally, to take the strain off the facepiece, the supply hose is connected to a manifold on a waist belt and a breathing hose of lighter construction feeds air to the facepiece. The supply hose can be dislodged from its anchor point damaged and become tangled. It can restrict the mobility of the wearer. These effects can reduce the effectiveness of the equipment which can affect the wearer’s safety. Therefore, precautions should be put in place to reduce the risks.

#### A.4.1.2 Fresh air hose breathing apparatus for use with full face mask, half mask or a mouthpiece assembly (EN 138)

##### A.4.1.2.1 Unassisted Fresh air hose breathing apparatus

This apparatus enables the wearer to be provided with breathable air supplied by his own breathing action. Only a full face mask or a mouthpiece assembly is allowed with unassisted equipment. The air supply hose is only available in heavy-duty construction (Class 2).

#### A.4.1.2.2 Manually assisted fresh air hose breathing apparatus

This apparatus enables the wearer to be provided with breathable air which is forced through an air hose by a manually operated blower. This equipment can be used with a full face mask, half mask or a mouthpiece assembly. In an emergency the wearer is able to inhale whether or not the blower is operating. Therefore, the length of the hose should be maintained in accordance with the device manufacturer's recommendations. No attempt should be made to use any hood due to the problem of $CO_2$ build-up. Some equipment may incorporate a breathing bag or a similar device. Hoses are available in either light-duty (Class 1) or heavy-duty (Class 2) construction.

#### A.4.1.2.3 Power operated fresh air hose breathing apparatus

The air supply is provided with the assistance of a motor driven blower or a device such as a compressed air injector. This equipment can be used with a full face mask, half mask or mouth piece assembly. Hoses are available in either light-duty (Class 1) or heavy-duty (Class 2) construction.

#### A.4.1.3 Powered fresh air hose breathing apparatus incorporating a hood (EN 269)

The construction is similar to a power-operated device described above.

The apparatus will give no protection if the power supply fails. In addition, asphyxiation may occur due to $CO_2$ buildup within the hood.

#### A.4.1.4 Compressed air line or powered fresh air hose breathing apparatus incorporating a hood for use in abrasive blasting operations (EN 14594)

This European Standard describes the use of a blasting helmet as a facepiece.

### A.4.2 Compressed air line breathing apparatus (EN 14593-1, EN 14593-2, EN 14594, EN 1835 and EN 12419)

#### A.4.2.1 General

This category of equipment covers a wide range of devices and includes different types of facepieces. It contains devices intended for heavy industrial use at one end of the scale and simpler equipment intended to do the same job as a powered filtering device with hood at the other. It is necessary to carefully match the needs of a job with the capability of the device.

All compressed air line breathing apparatus rely on a source of clean breathable compressed air at a maximum delivery pressure of 10 bar. Sufficient volume of air should be available at source to supply all the devices connected when working at their maximum demand. Some air supply systems also supply air tools such as spray guns. Their consumption should also be taken into consideration.

The air is supplied to the user via a compressed air supply tube. This tube should have good kink and crush resistance with a maximum length determined by the manufacturer. Again supply tubes can be damaged, become tangled and restrict mobility. There are different types of equipment which depends on how the air is supplied to the wearer.

Compressed air line breathing apparatus normally use full face masks but it is possible to use half masks. One advantage of using demand flow rather than continuous flow is that overall air consumption is reduced. The masks for positive pressure devices have a special exhalation valve and cannot be interchanged with those for continuous flow or negative demand devices. Loose-fitting facepieces cannot be used with demand valves.

#### A.4.2.2 Continuous flow equipment

The usual arrangement for this equipment is to connect the compressed air supply tube to a waist belt-mounted control valve or regulator. This supplies air at a continuous flow to the facepiece via a breathing hose. It is vital

that sufficient air is available at all times for correct operation. This is fixed by the manufacturer because the supply flow rate depends on whether a mask or hood etc. is to be used. If the wearer is able to adjust this flow in use, then it is important that the air supply is increased during periods of heavy work. Sometimes in light work, when wearing a full face mask, there can be a feeling of too much air perhaps causing drying or cooling. It is therefore important to choose the right facepiece for the job.

Facepieces, visors, hoods, full suits, etc. can all be used with continuous flow devices but only as specified by the manufacturer.

#### A.4.2.3 Demand valve equipment

In devices incorporating a demand valve, the compressed air to the facepiece is supplied via the demand valve. This opens as the user breathes in and closes on breathing out. Demand valves can deliver within certain limits enough air for a user who is working very hard. The valves come in two versions:

a) Negative demand: This operates as the wearer's breathing makes the pressure in the mask fall below that outside, opening and allowing air to enter until a certain pressure level is reached.

b) Positive demand: Where the facepiece cavity stays at a pressure above normal. As the wearer begins to inhale, the mask pressure falls and the demand valve opens before the pressure falls below that outside the mask. This means the devices incorporating a positive demand valve can offer a better degree of protection than negative demand sets, all other things being equal. Also, there can be less effort involved in breathing.

### A.4.3 Self-contained breathing apparatus

#### A.4.3.1 General

A self-contained breathing apparatus consists of a full face mask or half mask fitted with a demand valve and supplied with breathable gas from a pressure vessel(s) (e.g. a cylinder). Both negative and positive demand valve versions are available. Of the breathing apparatus described this is the most complex, requiring a high degree of training for wearing, using and maintenance. It offers more freedom of movement than a compressed air line breathing apparatus but wearers should have a good level of physical fitness to use it. Duration of use is governed by the amount of breathable gas stored in the pressure vessel(s). Like other equipment the manufacturer's instructions regarding spares have to be carefully followed.

#### A.4.3.2 Self-contained open-circuit compressed air breathing apparatus with half mask designed to be used with positive pressure only (EN 14435)

Self-contained open circuit compressed air breathing apparatus are designed and constructed to enable the wearer to breathe air on demand from compressed air pressure vessels via a pressure reducer and/or lung governed demand valve connected to a half mask. The exhaled air passes without re-circulation from the facepiece via the exhalation valve to the ambient atmosphere.

These apparatus are for industrial use. The duration of use of an open-circuit compressed air self-contained breathing apparatus typically lasts about 30 min.

#### A.4.3.3 Self-contained open-circuit compressed air breathing apparatus with full face mask (EN 137)

Self-contained open circuit compressed air breathing apparatus are designed and constructed to enable the wearer to breathe air on demand from compressed air pressure vessels via a pressure reducer and/or lung governed demand valve connected to a full face mask. The exhaled air passes without re-circulation from the facepiece via the exhalation valve to the ambient atmosphere. Self-contained open circuit compressed air breathing apparatus are classified in types as follows:

— Type 1: apparatus for industrial use;

— Type 2: apparatus for fire fighting.

The duration of use of an open-circuit compressed air self-contained breathing apparatus typically lasts about 30 min. Positive pressure demand valve type devices are widely used by industry and the emergency services.

#### A.4.3.4 Self-contained closed-circuit breathing apparatus compressed oxygen or compressed oxygen-nitrogen type (EN 145)

Self-contained closed-circuit breathing apparatus compressed oxygen or compressed oxygen-nitrogen type, designed and constructed so that exhaled breathing gas is ducted from the facepiece into a circuit which contains a carbon dioxide absorption cartridge and breathing bag where it is available for re-breathing. The carbon dioxide absorption cartridge contains chemicals which absorb exhaled carbon dioxide. Oxygen or oxygen-nitrogen is fed into the apparatus at a suitable point by means of a constant flow device or by a lung governed flow or by a suitable combination of both. The gas flow may be of the pendulum or loop type and excess gas is ejected from the breathing circuit via a relief valve.

The use of closed-circuit compressed-oxygen self-contained breathing apparatus demands special precautions for the safety of the wearers and others working in close proximity. These special precautions should be applied even during training exercises in non-hazardous atmospheres. During maintenance and handling, precautions are needed to avoid dangers associated with pure oxygen.

### A.4.4 Ventilated protective suits (EN 943-1 and EN 1073-1)

The ventilated protective suit is designed for use in environments where the protection for the whole body is needed. This situation is encountered in the chemical, petrochemical, nuclear, biological and related industries.

### A.4.5 Compressed air for breathing apparatus (EN 12021)

#### A.4.5.1 General

A compressor system will have produced the compressed air supplied to a breathing apparatus. The compressor system may be used for filling individual high-pressure pressure vessels or those on a mobile trolley or to supply air direct to breathing apparatus and other air-tools used in the workplace.

Contaminants can mix with the compressed air at various stages of its production and supply. Any presence of contaminants in unacceptable quantities will render the air unsuitable as “breathable air” and can threaten the health and safety of the respiratory protective device wearer. For this reason quality assured compressed air should be supplied to a breathing apparatus. EN 12021 stipulates the minimum quality standards for breathable compressed air and includes the levels for oxygen, carbon monoxide, carbon dioxide, lubricants, water, other types of contaminants and odour.

#### A.4.5.2 Compressor system

##### A.4.5.2.1 General

A competent person should be consulted when planning or installing a compressed air system for producing breathable air. This will help to minimise problems associated with compressors and the down stream effects on the quality of the air supplied. Table A.2 provides a summary of the main elements associated with a compressor system for producing breathable air. In addition to the careful planning and installation of the system it should be maintained by a competent person to ensure the safe operation of the system.

The compressor should be installed in an area providing sufficient space on all sides to ensure good ventilation. The area should be cool as possible but avoid places where freezing is possible. The air intake point should be located in open air and away from potential contaminant release points (e.g. not close to ventilation outlets or in the down stream of the outlets or near vehicle exhaust emission points).

#### A.4.5.2.2 Air purification elements

The air purification elements should be placed in the correct sequence to ensure the delivery of acceptable quality breathable air. These purification elements should be replaced in accordance with the advice provided by the competent person and the manufacturers of these elements.

#### A.4.5.2.3 Testing and inspection

The volume flow and quality of the supplied air should be thoroughly tested at intervals as specified by a competent person after risk assessment.

**Table A.2 — Summary of main elements associated with a compressor system for producing breathable air**

| | | |
|---|---|---|
| 1 | Atmospheric air | Typical composition of natural air is given in Table A.1 of EN 12021:1998. |
| 2 | Air intake filter | The intake should be located in fresh air, upwind and as far away as possible, both vertically and horizontally from sources of contamination. The filter is to remove coarse particles to protect the compressor. |
| 3 | Main compressor | With system controls and alarms or monitoring for pressure, temperature and oil level – with standby compressor when necessary. |
| 4 | Aftercooler | With condensate drain facility. |
| 5 | Separator | To remove large water and oil droplets – with condensate drain facility. |
| 6 | Air receiver | For pressure stabilisation and compressor load control – with condensate drain facility. Typical position in system. See also reserve air storage [13] below. |
| 7 | Coalescing filter | To remove small water droplets, oil mist and particles – with condensate drain facility. Elements become blocked and should be monitored for pressure drop. |
| 8 | Dryer stage | To remove water vapour to ensure the pressure dew point is below ambient temperature:<br>a) Desiccant type with carbon pre-filter and outlet dust filter. Essential for sub-zero temperatures and/or –11 °C when ambient temperature is not known. Also for protection to following gas and catalyst stages. Fitted with minimum pressure valve when necessary. Self-reactivating or throw-away cartridges. Should be monitored for dryness. Carbon dioxide can also be removed by some types of desiccant dryer filled with molecular sieve.<br>b) Refrigerant type with outlet coalescing filter/carbon filter – with condensate drain facility – for ambient temperatures above zero, heated factory spaces, and when gas filters and catalyst stages are not used. |
| 9 | Gas filter stage(s) | To remove carbon dioxide and other gaseous contaminants including odour and taste. Either throw-away elements or self-reactivating. Should be monitored for effectiveness. |
| 10 | Catalyst stage | To remove carbon monoxide and ozone. Either throw-away elements or self-reactivating. Should be monitored for effectiveness. |
| 11 | Particle filter stage | To remove dust particles generated by previous stages. Often forming an integral part of the gas filter and catalyst filter. |
| 12 | non-return valve | To prevent reserve air storage from leaking back through the compressor system. |
| 13 | Reserve air storage | To provide enough air for enough time for all users to escape to a place of safety in the event of compressor failure. This is not an EBF (Emergency Breathing Facility). No protection is provided if the hose breaks. Optional position. See air receiver [6] above. |
| 14 | Breathable air | Flow control units, monitoring facilities, couplings and distribution tubes. |
| NOTE 1 Components should be sized for maximum air flow for the total number of breathing apparatus connected to the system at one time.<br>NOTE 2 Depending on the size of the system, items 7 to 11 can be large units at source or subdivided into smaller units and wall mounted at the take off point or portable to provide personal protection at the point of use. | | |

## A.4.6 Escape devices

### A.4.6.1 Self-contained breathing apparatus for escape purposes

#### A.4.6.1.1 General

This equipment is available with compressed air, compressed oxygen and chemical oxygen types and is intended for short-duration use for emergency escape from hazardous areas.

#### A.4.6.1.2 Self-contained closed-circuit breathing apparatus for escape (EN 13794)

An oxygen escape apparatus is designed and constructed so that exhaled breathing gas is ducted from the facepiece into a circuit which contains a cartridge and a breathing bag where it is available for re-breathing. The cartridge contains chemicals which absorb exhaled carbon dioxide and - in case of a $KO_2$ apparatus - humidity and generates also oxygen.

In case of a $NaClO_3$ apparatus a chemical oxygen source ($NaClO_3$ candle) generates the oxygen to be needed.

In case of a compressed oxygen apparatus oxygen is fed into the circuit at a suitable point by means of a constant flow device or by a lung governed demand valve or by a suitable combination of both. The breathing gas flow may be of the pendulum or loop type and excess gas is ejected via a relief valve.

Oxygen escape apparatus are classified according to their oxygen source and rated working duration in types, classes and marked accordingly.

**Types of oxygen escape apparatus**

— Type C $NaClO_3$ apparatus;

— Type D Compressed oxygen apparatus;

— Type K $KO_2$ apparatus.

**Classes of oxygen escape apparatus**

Oxygen escape apparatus are classified according to the rated working duration which is defined by performing a breathing machine test with a minute volume of 35 l/min.

Rated working duration will be defined in increments of 5 min up to and including a duration of 30 min and thereafter in steps of 10 min.

#### A.4.6.1.3 Self-contained open-circuit compressed air breathing apparatus with full face mask or mouth piece assembly (EN 402)<br>Self-contained open-circuit compressed air breathing apparatus incorporating a hood for escape (EN 1146)

A self-contained open-circuit compressed air escape apparatus is a respiratory protective device that is independent of the ambient atmosphere and has a portable supply of compressed air.

Compressed air escape apparatus are designed and constructed to enable the wearer to breathe air on demand from a high pressure air container(s) either via a pressure reducer and a lung governed demand valve or a lung governed demand valve connected to the facepiece. The exhaled air passes without recirculation from the facepiece via the exhalation valve to the ambient atmosphere.

Compressed air escape apparatus are classified according to the nominal duration. Rated duration will be defined in steps of 5 min.

#### A.4.6.2 Filtering devices for escape

##### A.4.6.2.1 Filtering respiratory protective devices with hood for self-rescue from fire (EN 403)

A filtering respiratory device with hood for escape from fire (smoke hood) is a respiratory protective device dependent on the ambient atmosphere and is used for escaped from fire. It protects the wearer against particulate matter, carbon monoxide and other toxic gases produced by fire for a minimum period of 15 min. The device consists of a facepiece with combined filter and a suitable packaging. The facepiece of a filtering smoke hood can be a hood itself or a full face mask, half mask, quarter mask or mouthpiece assembly connected to the hood. The combined filter is attached to the facepiece.

It is dependent on ambient atmosphere and does not provide protection against oxygen deficient atmospheres.

Devices designed to be carried on the person are classified as ‘M’’ and those for storage ‘S’.

##### A.4.6.2.2 Filter self-rescuer (EN 404)

A filter self-rescuer is a respiratory protective filtering device in a suitable packing for personal escape designed to protect the wearer against carbon monoxide. It is dependent on ambient atmosphere and does not provide protection against oxygen deficient atmospheres.

The filtering device consists of a mouthpiece assembly with a filter. The mouthpiece assembly of the filtering device is connected directly or indirectly to the filter(s).

Filter self-rescuers are classified according to the minimum test duration, see Table A.3.

NOTE The duration achieved in use may be different from the minimum test duration measured under laboratory conditions.

**Table A.3 — Classes of filter self-rescuers classified according to minimum test duration**

| Classes of filter self-rescuers | |
|---|---|
| **Class** | **Minimum test duration** |
| FSR 1 A, FSR 1 B | 60 min |
| FSR 2 A, FSR 2 B | 75 min |
| FSR 3 A, FSR 3 B | 90 min |
| FSR 4 A, FSR 4 B | 120 min |

# Annex B
(informative)

# Atmospheres immediately dangerous to life or health

## B.1 General

Fatalities and accidents have taken place as a consequence of entering or performing work in atmospheres immediately dangerous to life or health. Some of these events can be attributed to the wrong selection or inappropriate use of respiratory protective devices. Although a vast majority of these events have taken place in confined spaces this can also happen in normal work areas. This annex is aimed at providing guidance on the application of these conditions for the selection and use of respiratory protective devices.

## B.2 Conditions

An atmosphere in which the concentration of hazardous substances including asphyxiants or the oxygen levels present create one or more of the following conditions:

An immediate threat to life if exposed to that atmosphere; exposure to the atmosphere would cause immediate acute health effects and/or would prevent the respiratory protective device wearer from unaided escape to safety in the case of the device malfunctioning or failing to operate correctly.

## B.3 Situations likely to present atmospheres immediately dangerous to life or health

### B.3.1 Confined spaces

A confined space is a place which is substantially (though not always entirely) enclosed and where there will be a foreseeable risk of serious injury or death from exposure to oxygen deficiency or hazardous substances.

### B.3.2 Oxygen deficiency

Oxygen deficiency may result from, for example:

— purging of the confined space with an inert gas to remove flammable or toxic gas, fume, vapour or aerosols;

— naturally occurring biological processes consuming oxygen which can occur in sewers, storage tanks, storm water drains, wells etc. Similarly gases can be produced as a result of fermentation in sealed silos where crops have been or are being stored; in fermentation vessels, in brewing or in cargo holds caused by the carriage of timber or timber products, steel turnings or swarf, vegetable products, grain, coal etc.;

— leaving a vessel completely closed for some time (particularly one constructed of steel) since the process of rust formation on the inside surface consumes oxygen. Newly fabricated or shot blasted carbon steel vessels are especially vulnerable to rusting particularly those with a large surface area, for example, heat exchangers, separators, filters etc;

— risk of increased levels of carbon dioxide from limestone chippings associated with drainage operations when they get wet;

— burning operations and work such as welding and grinding which consume oxygen;

— displacement of air during pipe freezing, for example, with liquid nitrogen;

— gradual depletion of oxygen as workers breathe in confined spaces and where provision of replacement air is inadequate.

### B.3.3 Emergency situations created by hazardous substances

Normally when work involving hazardous substances is undertaken in areas that are not confined spaces or deficient in oxygen may be considered as non-emergency situations. In these situations, repeated exposure to unacceptable levels of hazardous substances (e.g. above occupational exposure limit values) may produce discomfort, sickness, permanent harm (e.g. sensitisation, neurotoxic effects, damage to kidneys, birth deformity) or death due to ill health such as cancer.

Emergency situations created by hazardous substances are those that involve actual or potential exposure to dangerous levels of these substances. These can lead to situations described in B.2 above.

NOTE None of the European agencies involved in health and safety have established dangerous concentration levels for hazardous substances at which they can be considered as immediately dangerous to life or health. The United States National Institute of Occupational Safety and Health (NIOSH) has established concentration levels for over 400 substances. The compendium established by the National Institute of Occupational Safety and Health will not cater for many more substances encountered in the workplace. In addition, substances such as hydrogen fluoride gas, cadmium fume may not produce immediate acute effects and may pass without an immediate medical emergency. However, delayed medical emergency may occur or possibly fatal collapse.

# Annex C
(informative)

# Protection factors

## C.1 General

The term protection factor can be expressed in many ways and this can lead to confusion and the potential for incorrect selection of respiratory protective devices. Some may incorrectly refer this term to the result obtained during a facepiece fit testing. Others may refer to the extent of the protection an individual is experiencing when wearing a respiratory protective device. In other instances it can allude to the level of protection likely to be achieved in laboratory by a particular type of respiratory protective device.

This annex provides additional information to further explain the definitions provided in 3.2, 3.6 and 3.11.

## C.2 Using protection factors

The performance of respiratory protective devices could be assessed in a number of ways.

European Standards specify “inward leakage” requirements. A device designed to meet the requirements of a given European Standard should perform, when tested in an approved testing laboratory, at or below the maximum inward leakage specified in the standard. This inward leakage figure could be converted in to “nominal protection factor” as defined in 3.6. As the term implies, it is a protection level that is “supposed” to be achieved by any respiratory protective device wearer. There are many reasons for not using nominal protection factors for assessing the likely protection at the workplace. The laboratory tests do not represent the activities covered in workplace situations; the laboratory tests only involve a small number of individuals, who cannot represent a significant portion of the population of respiratory protective device wearers in the workplace; the individuals selected for the test panel are likely to be well-trained and are familiar with the test procedures; the standards allow for disallowing people who do not pass the initial screening test needed before the total inward leakage test is carried out.

Therefore the users should ensure that the protection factors used in the selection of appropriate RPD take account of the variability described in the previous paragraph and any nationally applicable regulatory requirements.

Table C1 lists nominal protection factors (NPF) and examples of assigned protection factors (APF) used in different countries for different types of RPD’s.

**Table C.1 — Nominal protection factors and assigned protection factors used in different countries**

| Standard | Description | Class | NPF | Assigned Protection Factors used in some countries | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | FIN | D | I | S | UK |
| EN 149 | Filtering half mask | FF P1 | 4 | 4 | 4 | 4 | 4 | 4 |
| | | FF P2 | 12 | 10 | 10 | 10 | 10 | 10 |
| | | FF P3 | 50 | 20 | 30 | 30 | 20 | 20 |
| EN 405 | Valved filtering half mask | FFGasX P1 | 4 | | 4 | - - | | 4 |
| | | FFGasX | 50 | | 30 | - - | | 10 |
| | | FFGasX P2 | 12 | | 10 | - - | | 10 |
| | | FFGasX P3 | 33 | | 30 | - - | | 10 |
| EN 140 (Mask) | Half mask and quarter mask with filter | P1 | 4 | 4 | 4 | 4 | 4 | 4 |
| | | P2 | 12 | 10 | 10 | 10 | 10 | 10 |
| Filters EN 141 *) EN 143 EN 371 *) EN 372 *) EN 14387 EN 12083 | | P3 | 48 | | 30 | 30 | | 20 |
| | | GasX | 50 | 20 | 30 | 30 | 20 | 10 |
| | | GasX P1 | 4 | | | | | |
| | | GasX P2 | 12 | | | | | |
| | | GasX P3 | 48 | | 30 | -.- | | 10 |
| EN 1827 | Filtering half mask without inhalation valves | FM P1 | 4 | | 4 | - - | | 4 |
| | | FM P2 | 12 | | 10 | - - | | 10 |
| | | FM P3 | 48 | | 30 | - - | | 20 |
| | | FM GasX | 50 | | 30 | - - | | 10 |
| | | FM GasX P1 | 4 | | | | | |
| | | FM GasX P2 | 12 | | | | | |
| | | FM GasX P3 | 48 | | | | | |
| EN 136 (Mask) | Full face mask (all classes) | P1 | 5 | 4 | 4 | 4 | 4 | 4 |
| | | P2 | 16 | 15 | 15 | 15 | 15 | 10 |
| Filters EN 141 *) EN 143 EN 371 *) EN 372 *) EN 14387 EN 12083 | | P3 | 1000 | 500 | 400 | 400 | 500 | 40 |
| | | GasX | 2 000 | 500 | 400 | 400 | 500 | 20 |
| | | GasX P1 | 5 | | | | | |
| | | GasX P2 | 16 | | | | | |
| | | GasX P3 | 1 000 | | 400 | -.- | | 20 |

Table C.C.2 *(continued)*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| EN 12941 | Powered filtering device incorporating a hood or a helmet | TH1<br>TH2<br>TH3 | 10<br>50<br>500 | 5<br>20<br>200 | 5<br>20<br>100 | 5 [b]<br>20 [b]<br>200 [b] | 5<br>20<br>200 | 10<br>20<br>40 |
| EN 12942 | Powered assisted filtering device incorporating full face mask, half mask or quarter mask | TM1<br>TM2<br>TM3 | 20<br>200<br>2 000 | 10<br>100<br>1 000 | 10<br>100<br>500 | 10 [b]<br>100 [b]<br>400 [b] | 10<br>100<br>1 000 | 10<br>20<br>40 |
| EN 14593-1 | Compressed air line breathing apparatus with demand valve - Part 1: Apparatus with a full face mask | | 2 000 | 1 000 | 1 000 | 400 | 1 000 | 40 |
| EN 14593-2 | Compressed air line breathing apparatus with demand valve – Part 2: Apparatus with half mask at positive pressure | | 200 | | | | | |
| EN 14594 | Continuous flow compressed airline breathing apparatus | 1A / 1B<br>2A / 2B<br>3A / 3B<br>4A / 4B | 10<br>50<br>200<br>2000 | | | | | |
| EN 138 | Fresh air hose breathing apparatus | Half mask<br>Full face mask | 50<br>2 000 | <br>500 | 100<br>1 000 | - -<br>400 | <br>500 | 10<br>40 |
| EN 269 | Powered fresh air hose breathing apparatus incorporating a hood | Hood | 200 | | 100 | | | |
| EN 137 | Self-contained open circuit compressed air breathing apparatus | Negative pressure demand<br>Positive pressure demand | 2 000<br>2000 | | > 1000[a]<br>> 1000[a] | 400<br>1 000 | | 40<br>2 000 |
| EN 145 | Self-contained closed-circuit compressed oxygen/nitrogen breathing apparatus | | 2 000 | 500 | > 1000[a] | 400 | 500 | |
| EN 402 | Self-contained open circuit compressed air breathing apparatus with full face mask or mouth piece assembly for escape | | 2000 | | > 1000[a] | - - | | |

*) superseded by EN 14387.

[a] Comment from BGR 190 (2004) “Rules for the use of respiratory protective devices”:
These devices can be used generally, particularly when filtering devices cannot provide sufficient protection. A restriction of the field of use due to high concentrations of harmful substances cannot be derived from the use of these types of devices as far is known until now. This applies to devices with normal and positive pressure.

[b] Value based on old EN 146 for apparatus THP1/THP2/THP3 and TMP1/TMP2/TMP3.

# Annex D
(informative)

# Suitability factors

## D.1 General

This annex is intended to provide best practice advice in complying with the suitability assessment in 9.3. Assessment of the suitability of a given respiratory protective device can be a complex task. Consideration of environmental, wearer, task and legal factors will all be required and the following gives examples of best practice in these areas.

## D.2 Environmental factors

### D.2.1 Oxygen deficiency

Where the risk assessment (see Clause 6) indicates oxygen deficiency according to national regulations is possible or likely, it should be assumed that filtering devices will not be suitable. They are incapable of supplying oxygen or enriching the atmosphere. In general, breathing apparatus will be required and consideration should also be given to the provision of an emergency breathing facility if the assessment shows the possibility of main device failure necessitating immediate escape from the work area. In any event rescue and first aid plans will be required.

The following devices are not suitable for work and escape in oxygen deficient atmospheres: All filtering devices, e.g. filtering facepieces, masks (half and full face masks) fitted with filters or assisted filtering devices.

The following devices may be suitable depending on the precise situation, the specification of the device, and the manufacturer's recommendation: continuous flow air line breathing apparatus, self-contained breathing apparatus for escape purposes (for escape only), air line breathing apparatus with demand valve, and half mask and, fresh air hose breathing apparatus with full face mask.

The following devices are considered to be suitable: self-contained breathing apparatus with full face mask, air line breathing apparatus with demand valve and a full face mask and an emergency breathing facility.

### D.2.2 Oxygen enrichment

Oxygen enrichment is unusual, but where it is present, there is a very significantly increased risk of fire or explosion. For this reason RPD should be carefully selected giving consideration to specifying antistatic, non-sparking, non-flammable materials. Lubricants used in maintenance of these devices should also be carefully selected.

### D.2.3 Asphyxiants

Presence of asphyxiants, above normal levels, will normally require the use of breathing apparatus of an appropriate type even if the levels are relatively low since performance of filtering devices is likely to be inadequate. The asphyxiant may penetrate filters rendering them ineffective against other contaminants.

Asphyxiants may be present at levels which exceed national exposure limits or which displace sufficient oxygen to render the atmosphere deficient. In this case, selection of suitable devices should follow D.2.1 above.

### D.2.4 Contaminant levels immediately dangerous to life or health

The risk assessment may indicate that levels of contaminant are such that there would be an immediate threat to life or health of the wearer such that they may be unable to escape unaided. This may be because of respiratory distress, narcosis, extreme eye irritation or other immediate poisoning causing permanent or long term ill health.

Selection of devices in this situation will need to consider the method of escape in the event of main protection failure including how protection will be maintained to an adequate level during the escape.

The following devices are unsuitable for use in IDLH:

a) all filtering devices except those for escape;

b) air line BA with hood or helmet, except those with emergency breathing facility.

The following devices may be suitable depending on the precise situation, the specification of the device and the manufacturer's recommendation: continuous flow air line fitted with full and half masks, continuous flow full suits fitted with suitable emergency breathing facilities, self-contained compressed air escape devices (for escape only), air line breathing apparatus with demand valve, fresh air hose breathing apparatus.

The following devices may be considered the most likely to be suitable: self-contained breathing apparatus with full face mask, air line breathing apparatus with demand valve, full face mask and emergency breathing facility.

### D.2.5 Potentially corrosive atmospheres

Respiratory protective devices may be required for protection against contaminants which are corrosive in nature. These contaminants may come into contact with the skin, eyes, or the respiratory protective device either as gaseous or aerosol contaminants or by splashing of liquids from the work process. Selection of suitable devices will need to include consideration of the interaction of the device with adequate and suitable chemical protective clothing. The materials of construction of the device may need to be checked to ensure they have adequate resistance against the contaminants in question. An alternative approach may be to select devices where affected components can be disposed and replaced at suitable intervals.

Certain organic solvents are capable of weakening plastic or rubber components of respiratory protective devices. This may lead to a reduction in robustness of components over time. This would be of concern if the performance of the device is reduced, e.g. by damage to valves or if other protective elements of the device, e.g. helmets or eye protectors were significantly weakened or rendered opaque. Advice from the device manufacturer should be sought and the selection modified if appropriate. In addition an enhanced maintenance programme may be required for the device.

It is likely that respiratory protective device suitable for use in corrosive atmospheres will either include a full facemask which can be integrated with special chemical clothing or be of a type which substantially encloses the head and neck, e.g. powered or air line hoods, helmets or suits. Devices should include suitable eye protection.

### D.2.6 Potentially explosive atmospheres

Where respiratory protective devices are used in potentially explosive atmospheres, selection will need to include an assessment of the device itself as a possible ignition source. Any personal protective equipment or other clothing or equipment worn by a worker can form an ignition source by sparking from impact onto metallic parts or by build up of static electricity. Consideration should be given to earthing the worker in the event that static is assessed as a significant risk. Cleaning and maintenance of the device may need to be planned to ensure that build up of static electricity is not increased by cleaning processes, or that any inherent antistatic properties are not reduced.

In addition to the consideration of sparking, portable devices such as powered and power assisted filtering devices and electrical components fitted to other types of respiratory protective devices can form an ignition source in the event of a fault developing. In this case devices will need to be approved and marked EX, denoting that they have been certified as safe in certain defined explosive atmospheres. The EX classification of the device selected should match the assessment of the zone classification (0, 1 or 2 for gases), the gas or dust types present and the assessed ambient conditions. If in any doubt advice should be sought from the respiratory protective device manufacturer.

### D.2.7 Potentially permeating contaminants

Certain contaminants, most notably many organic solvents and tritium, are capable of permeating through materials of construction of respiratory protective devices in the event that the contaminant comes into contact with the device. This can result in re-evaporation of the contaminant into the device potentially over-exposing the wearer. Selection of devices may need to include consideration of use of more permeation resistant materials. This is particularly of concern if components such as facepieces, breathing hoses or compressed air connecting tubes may be immersed in liquid contaminant. It should be noted that permeation could occur even against a positive air pressure differential.

### D.2.8 Particulate contaminants (aerosols)

Where adequate filtering devices are selected for protection against particulates an assessment should be made to determine that the filter element selected is effective against the particulate contaminant of concern. Certain filters may have relatively poor performance against very penetrating particulates such as metal fume. This aspect should be checked against the manufacturer's advice.

Filters require regular replacement in order to maintain protective performance and the manufacturer's information should be used together with the hazard/risk assessment, in order to determine correct intervals.

Workers can easily spread particulate contamination outside defined areas whether wearing a respiratory protective device or not. Plans should be made for appropriate decontamination of the wearer and the device before leaving the defined work area. Device selection may therefore need to include consideration of ease of decontamination. Where contaminants are toxic in nature, e.g. bacteria, virus, radioactive dust, enzymes, carcinogens such as asbestos, arrangements will need to be made for safe disposal of contaminated filters, prefilters and other parts which cannot be safely decontaminated. Relevant national regulations should be followed.

Particulate filters offer no protection against gas or vapour contaminants. If particulate and gas/vapour contaminants are encountered simultaneously, adequate and suitable filtering devices with combination filters or breathing apparatus should be selected.

### D.2.9 Gas and vapour contaminants

For protection against gas or vapour contaminants, adequate and suitable filtering devices fitted with gas/vapour filters or breathing apparatus should be selected.

Where filtering devices are selected, it is essential that the filter is of the appropriate classification (type and class) for the contaminants and concentrations present. Selection of the correct filter should follow the manufacturer's published advice or alternatively advice should be sought directly from the manufacturer or their appointed representative. It should be assumed that filters of an incorrect classification will not provide sufficient protection.

Where filtering devices are selected, plans should be made for setting up a filter replacement programme. This is because gas/vapour filters readily become saturated with contaminants and thereafter offer no protection. Manufacturer's advice, together with the hazard/risk assessment, should be used to calculate safe filter replacement intervals. Where contaminant concentrations are unknown or unpredictable, it will not be possible to calculate replacement intervals and adequate and suitable breathing apparatus should be used. It is unlikely that filtering devices will be suitable where the contaminant is difficult to taste or smell at levels at or above the exposure limit unless the contaminant is very precisely defined and filters are replaced well before they are saturated.

Where filtering devices are to be used for escape from accidentally contaminated atmospheres, it is essential that the filter selected is of the correct type and class for the contaminants envisaged and the assessed maximum possible concentration. If these parameters are unknown, suitable breathing apparatus should be used.

There are many gas/vapour contaminants for which no suitable filter is commercially available. In this case adequate and suitable breathing apparatus should be selected.

Gas or vapour filters offer no protection against particulate contaminants. If particulate and gas/vapour contaminants are encountered simultaneously, adequate and suitable filtering devices with combination filters or breathing apparatus should be selected.

### D.2.10 Climatic extremes

Effects of climatic extremes on wearers of respiratory protective devices are considered in D.3.5, however the selection process may also need to include an assessment of the likely effects on the device itself.

In general, manufacturers will advise limiting conditions of use in accompanying information for users. Limits of temperature and humidity will normally be set for both storage and use of the device. Devices should not be used outside these limits without the agreement of the manufacturer.

Extreme cold (less than 0 °C) can affect devices in a number of ways. Face seals and hoods can become more brittle and crack or less flexible potentially causing fit or comfort problems. Hoses and connecting tubes can also become more brittle and crack or be less flexible, become unwieldy causing comfort and fitting problems. Any moisture in compressed breathing air or exhaled breath can condense causing flow restrictions or other defects. In particularly extreme cold moisture in exhaled air can freeze in valve assemblies rendering them ineffective.

Performance of electrochemical batteries used in powered and power assisted filtering devices and other equipment falls off rapidly with decreasing temperature, potentially affecting airflow and duration.

High temperatures can have a number of adverse effects on devices. At the extreme, for example in foundry applications, radiant heat may be sufficient to melt or soften plastics commonly used in standard devices, so specialist materials may be required.

High heat and humidity will tend to degrade the performance of gas and vapour filters in particular, necessitating more frequent replacement or selection of other suitable devices.

Winds in excess of 2 m/s velocity can have an adverse effect on the protection of powered and air line hoods and helmets since contamination can be blown into the breathing zone against the device air flow. Selection of devices for use in windy areas should therefore consider this possibility.

## D.3 Task/job factors impacting on the wearer

### D.3.1 Work rate

All respiratory protective devices impose a physiological and sometimes psychological burden on the wearer. This is due to ergonomic factors and most particularly mass and breathing resistance. For both of these factors the impact is increased with increasing work rate. Therefore, the higher the expected work rate during the assessed task, the more consideration should be given to minimising the effective mass and imposed breathing resistance of the device. The two factors may require trading off against each other since for example a positive pressure demand breathing apparatus imposes very little breathing resistance even at very high work rates, nevertheless its high mass could impose a greater burden depending on the precise task. Conversely a filtering facepiece for particulates has negligible effective mass but may impose a significant breathing resistance at high work rate.

At high work rates preference should generally be given to devices which supply adequate breathable air to the wearer, e.g. powered filtering devices, compressed air line devices. Where self-contained breathing apparatus is required its mass should be kept to a minimum.

If negative pressure devices such as unassisted filtering devices or negative pressure demand breathing apparatus are used at high work rates, frequent rest periods may be required.

An additional factor to be considered at high work rates is that the leakage may be increased owing to higher negative pressures inside the facepiece. Powered and power assisted filtering devices or air line devices should be selected such that the manufacturer's minimum flow is sufficient to prevent negative pressure.

### D.3.2 Visibility

Most respiratory protective devices impede vision to some degree either through a reduced effective field of vision or through imperfect optical quality of the eye covering/visor. Devices have to meet minimum requirements in this regard but certain tasks may require special consideration of visibility needs. Where workers need to see fine detail, e.g. surface finishing, warning lights, reading text, etc. good optical quality eye covering may be required. Where there is no eye hazard present it may be possible to select half or quarter masks so that vision is unimpeded.

Where a wide field of vision is required, e.g. climbing or descending ladders or where vehicle or plant movement is likely, respiratory protective device offering the minimum possible reduction in field of view is required.

### D.3.3 Mobility

The mobility required to perform the task should be assessed to see how the respiratory protective device selection may be affected. In general, compressed air line or fresh air hose devices may not be suitable if the job requires movement over several metres (certainly no more than the length of the compressed air supply tube or air hose), movement between floors or levels within a building or transit through very small openings or tunnels/ducts. Where significant body movement, e.g. bending, stretching, crawling, manual handling tasks are envisaged the impact of these movements should be assessed. It may be necessary to consider both, the possibility of discomfort or musculoskeletal injury to the worker due to the device and the possibility that movements may affect the fit and protection of the device.

Where tasks involve repeated or frequent head movement, e.g. driving of vehicles, the respiratory protective device selected should have as low effective mass on the head as possible so as to avoid neck strain.

Certain tasks may involve access to awkward areas such as ducts, tunnels or small voids or involve working in awkward positions. The respiratory protective device may need to be very carefully selected so that it does not get damaged by the activity and does not unduly impede movement. Bulky backpacks or pressure vessels could cause problems if the worker needs to work on their back or pass through a small opening. In some cases it may be necessary to take backpacks off temporarily. In this case protection has to be maintained. The risk of hoses and tubes becoming snagged should be assessed so the most appropriate device can be selected to minimise the risk of protection failure or damage.

### D.3.4 Communication

Many tasks involve verbal or visual communication between co-workers. Since respiratory protective devices will in general impede communication an assessment of the additional risks involved may be required. Devices such as half and full masks cover the nose and mouth completely and talking can reduce the protection by breaking the face seal and increasing the peak air demand. Sound may be so muffled that effective verbal communication over distance is impossible. In addition, recognition of co-workers may be difficult. Communication can be improved by selecting devices with effective speech transmitters and models incorporating microphones and radios are generally available. These should be considered where effective verbal communication is required in order to ensure safety of workers and others.

Some devices, particularly some powered filtering devices with hood or helmet, or compressed air line BA with hood, helmet or suit inhibit communication less since the whole face may be visible. Their protection may not be so compromised by facial movement and the nose and mouth are not confined. Care should be taken, however, if selecting devices which enclose the ears. Where verbal communication proves difficult, a system of visual signals may be required, see D.4.1.

It should be recognised that when workers find communication difficult, there will be a temptation to remove devices in work areas resulting in exposure to contaminants. This possibility should be avoided as a priority.

### D.3.5 Thermal stress

Since respiratory protective devices enclose the head and potentially other parts of the body, natural heat loss from the body is reduced possibly by a significant amount. Particularly in high ambient heat or humidity conditions and/or at high work rates or where insulating or impervious clothing is worn, heat loss may be so impeded that the body core temperature can rise to uncomfortable or dangerous levels relatively quickly. Increasing core body temperature can lead progressively to discomfort, dizziness, fatigue, disorientation, sickness, unconsciousness, coma and death unless intervention is rapid and effective.

Where thermal stress is assessed as a possibility, the device selected should ideally contribute to the heat loss of the wearer, e.g. compressed air line breathing apparatus and powered filtering devices may have a cooling effect on the body. In addition, assessment of safe work/break regimes should be made, provision for increased water uptake made (cool, still drinking water, possibly with added essential electrolytes) and escape/rescue/first aid plans enhanced.

Cooling jackets are commercially available and may need to be considered and some compressed air line devices are available with certified coolers fitted to reduce the breathing air temperature. These may be useful in reducing the effects of heat strain, but care is required because of the additional demands these devices place on compressed air supplies.

In cold climate or refrigerated work areas cold strain may become an issue. This may be particularly true if powered filtering devices or constant flow breathing apparatus are worn as the cold air flow could increase heat loss from the body and cause localised frostbite. Some compressed air line breathing apparatus are available with certified heaters fitted to warm the breathing air, alternatively the compressed air can be preheated before it is delivered to the device. Unassisted or demand valve devices may be preferred otherwise.

Since compressed air for breathing is dry use of breathing apparatus at high flow rates and for long periods can lead to dehydration even at normal ambient conditions. Provision should be made for regular breaks and increased liquid uptake.

### D.3.6 Duration of wear

Devices should be selected so that they are comfortable and offer consistent protection for the intended duration of wear. Generally, unassisted devices become less comfortable as the level of protection provided by the device increases and so the comfortable time of use may reduce from a full shift. In this case to increase the duration of wear maintain protection and a good level of comfort or where the task duration is long or work load is high, then powered filtering devices and breathing apparatus should also be considered.

All respiratory protective devices whatever their type should be used within their operating conditions and take into account the ambient environmental conditions that will affect comfort and duration of wear.

### D.3.7 Tools used

Tools used during the course of a task can influence the performance of the respiratory protective device radically. These influences should be considered as part of the selection process. Some examples are:

Electrical devices such as powered and power assisted filtering devices used during welding and certain smelting processes may be subjected to extreme electrical and magnetic fields. This can cause problems with the operation of the respiratory protective device. This may occur even when devices meet the requirement of the EMC Directives (89/336/EEC and 92/31/EEC), since such extreme emissions are not considered. Many older welding machines do not meet these directives. Where this occurs alternative devices may need to be considered.

Devices used during welding and other processes may be subjected to impact by hot or molten particles. This can cause damage to the device and may cause ignition of components such as filters. Selection of devices for these operations should ensure that the devices are sufficiently robust or that damaged parts can be easily disposed and replaced on a regular planned basis. Where a flammability risk has been identified an alternative device should be selected with higher heat and flame resistance.

Sometimes compressed air is used by the respiratory protective devices and air tool from the same supply. This is not good practice but where it does occur the selection of the device should include consideration of how the air

supply to the device can be maintained at correct levels at all times when the air tool is used and how the wearer will be warned if air supply is reduced.

For spraying operations with paints, coatings, adhesives, insecticides, etc. consideration of possible damage to and contamination of the device from back spray should be considered. Cleaning of the device may be difficult and it may be appropriate to consider the use of adequate and suitable disposable filtering devices, or disposable visor covers or other protective covers. Cleaning of devices with solvents is likely to lead to damage unless the manufacturer allows it and advice should be sought as to the best cleaning agent to use. Adhesives and other sprays can render valves ineffective very quickly if they are not cleaned or replaced very regularly. Devices with well-protected valves would be preferred in this case.

Many power tools can adversely affect respiratory protective device performance. This may be through transmitted vibration, impact of air jets emanating from tools, or particles impacting on the device. This is a significant problem if the air jet or particles impact in the area of face seals or valves. An assessment should be made to ensure that any air jets or high velocity particles do not interact with the device in these sensitive areas.

## D.4 Wearer factors

### D.4.1 Medical fitness

Medical problems that may affect respiratory protective device selection and use, for example: cardiovascular problems, respiratory illnesses, upper respiratory tract infections, neurological problems such as epilepsy, ataxia or tremor, psychological problems such as severe depression or claustrophobia, impaired sight, hearing problems such as noise induced hearing loss or other medical symptoms such as vertigo or balance problems from ear infections.

People with a history of heart or severe lung diseases should consult a medical practitioner before wearing a respiratory protective device.

People with temporary lung disease such as tuberculosis, bronchitis or pneumonia should not wear any respiratory protective device that may form part of pooled equipment. People with chronic lung conditions (e.g. asthma) may be able to wear certain types of device with the agreement of their medical practitioner.

Where there is a short-term upper respiratory tract infection: cough, cold, mild influenza it may be possible to use a suitable device. When selecting a device the wearer's views should be sought. This would include the need for additional breaks.

Where there are neurological or psychological problems, the device selection will be very individual and the person concerned should be fully involved in the choice, be offered as wide a selection of alternative devices as possible and be completely comfortable with the final selection. In most cases, agreement of the medical practitioner should be sought.

Where there are sight or hearing deficits, the device selection will need to include an assessment of how further impact on communication can be minimised. If it is possible communication could be enhanced by the use of appropriate microphones, headphones and radios.

### D.4.2 Facial characteristics

Facial characteristics such as scarring or unshaven facial hair can significantly affect the protection offered by some devices. This will particularly be true for devices such as half and full face masks which rely on a tight face seal to achieve protection. These devices should not be selected where there is unshaven hair or an irregular facial feature in the area of the face seal. In these cases, subject to the suitability assessment in 9.3, devices with neck or other seals will be more suitable, e.g. certain compressed air line or powered filtering devices with hoods or suits. In this context unshaven means hair which has not been shaved within the previous 8 h period prior to the work shift, since studies have shown that even less than 1 day's growth can dramatically increase face seal leakage.

Devices which rely on a tight face seal will not provide the expected protection unless they fit the contours of the face properly and securely. Where this type of device is intended an assessment should therefore be made to check that the intended device will fit the individual correctly. Possible methods of fit checking and fit testing are

described in Annex E. If the fit cannot be determined as adequate, devices not relying on a tight face seal such as hoods, helmets and suits may need to be considered.

### D.4.3 Spectacles

The use of standard prescription spectacles will interfere with the protection offered by many types of devices, particularly full face masks. Where prescription spectacles are required, they should be of a design which is compatible with the full face mask. Designs are available which fit completely inside the mask without breaking the face seal. Alternatively, a respiratory protective device which allows use of the standard spectacles can be selected, e.g. certain compressed air line or powered filtering devices incorporating hood or helmet. Advice on this aspect should be sought from the respiratory protective device manufacturer.

### D.4.4 Contact lenses

The use of contact lenses with respiratory protective devices may cause problems in certain cases. These may include excessive drying of the eyes from the airflow of the device or lenses becoming dislodged during use. In both cases there may be a temptation for the wearer to remove the device to correct the problem causing exposure to contaminant. An assessment should therefore be made as to whether the wearer can easily move to a clean area and remove the device to attend to the lenses. If this cannot be achieved quickly and without spreading contamination, it may be that the use of contact lenses should be discouraged. In high risk areas such as oxygen deficient areas, confined spaces, or areas immediately dangerous to life or health the use of contact lenses is unlikely to be safe and appropriate spectacles should be issued (see D.4.3).

### D.4.5 Non PPE accessories

Certain accessories worn for religious or personal reasons may interact with respiratory protective devices reducing protection or causing additional risks. Examples could include wrist or fob watches, necklaces, scarves, bracelets or bangles, turbans or other headgear, earrings or other body piercing jewellery. Cellular telephones, pagers or bunches of keys carried on the person could also cause problems.

If these items cannot for any reason be removed for the duration of the device use, selection of a suitable device will need to include an assessment of any possible interaction with the personal items. Most critically, the device selected should not catch on any personal items when being donned, worn or removed. There should be no interference with any face, neck, wrist or waist seal and the normal air flow of the device should not be impeded in use. Any discomfort caused by interaction may tempt the wearer to remove or interfere with their respiratory protective device reducing protection.

### D.4.6 Interaction with other PPE

In many work situations there will be multiple hazards and several modes of protection may be needed. Where it is assessed that for example industrial safety helmets, hearing protectors, eye protectors or protective clothing will be needed, it is essential that the protection from each of these modes is not degraded by any possible interaction. Examples of undesirable interactions include: mask harnesses passing under the hearing protector ear-muff seals, goggles dislodging half masks, protective suits interfering with mask face seals, masks preventing correct wearing of industrial safety helmets and hoses creating gaps for high velocity particles to enter past face shields.

The selection of the respiratory protective device should include an assessment of any interaction with other personal protective equipment. Preference should be given to devices which are intended by the manufacturer to be worn together. Ideally multi protection type devices should be selected provided they are adequate and suitable. Powered and power assisted filtering devices and compressed air line devices are available with integrated head and/or face protection, in some cases also including additional protection such as welding filters and hearing protectors. Full face masks generally include protective visors which can also be fitted with welding filter adapters. Advice should be sought from manufacturers that these devices are approved against all relevant European Standards.

## D.5 Legal factors

### D.5.1 European Product Directives

Any respiratory protective device selected have to carry a CE-mark. Any RPD selected carries a CE-mark in conjunction with the identification number of the notified body in charge of the surveillance procedure. The CE-mark indicates that the device meets essential safety requirements of one or more product directives. All respiratory protective devices have to meet the essential safety requirements of the Personal Protective Equipment Directive 89/686/EEC and be certified by a notified body. It is the responsibility of the device manufacturer or importer into the EU to ensure that their product meets this requirement. If there is any doubt about the legality of a respiratory protective device evidence of certification should be sought from the manufacturer or importer.

It is possible that a respiratory protective device may also fall under other European Product Directives, e.g. Low Voltage Equipment Directive (73/23/EEC), the EMC Directive (89/336/EEC) or PED Directive (97/23/EC). In such cases it is possible that some parts of the respiratory protective device may require to be assessed under another directive.

### D.5.2 European Standards

The preferred method of demonstrating compliance with the Personal Protective Equipment Directive is for the notified body to assess the product against a European Standard and against the manufacturer's technical specification. Where an appropriate European Standard is not available or cannot be used in full, a manufacturer can compile a technical specification on the product and ask the notified body to assess the product against this specification only together with another test protocol agreed between the two parties. Certification may be granted if the notified body is satisfied the product meets the essential health and safety requirements of the directive.

Since there is a comprehensive set of European Standards available for respiratory protective devices (see references for listing) products meeting these will generally be preferred, unless it has been assessed that another product will be more suitable for the particular application.

# Annex E
(informative)

# Assessing the fit of tight fitting facepiece

## E.1 General

A facepiece (quarter, half and full face mask and filtering half mask) will not provide optimum performance if they leak. Leakage can result from either a bad fit on the face or from faults in the facepiece such as dirty exhalation valve or a damaged face seal on the facepiece. The facepiece provided with a respiratory protective device should fit the wearer properly and the wearer should know how to check the fit.

One size of facepiece is unlikely to fit all users within a workforce. Assessment of correct fitting is an essential part of initial selection process and every day use. This annex describes some of the commonly used methods for assessing the fit of facepiece. These fall in to two broad categories – fit checking methods and fit test methods.

## E.2 Fit checking

### E.2.1 General

Fit checking provides a simple assessment of the correct fitting of a facepiece, based on the opinion of the wearer. Fit checking methods are quick and simple, but can be relatively insensitive to small leaks. They are used as a daily pre-use check for a facepiece already matched to the wearer by use of a fit testing method.

### E.2.2 Negative pressure fit check

This method is generally used for tight fitting facepieces. Fit the facepiece in accordance with the manufacturers instructions. Block off the air inlet (filtering element of the filtering device) and inhale gently until the facepiece collapses slightly onto the face. Hold the breath for about 10 s. If there are no significant leaks the facepiece will remain collapsed for several seconds. If leakage is detected, re-adjust the facepiece/straps and re-test. If a satisfactory fit check cannot be achieved the wearer should not use the device.

### E.2.3 Positive pressure fit check

This method may be used for unvalved filtering facepiece device (FF) and valveless half masks (FM) type. Fit the facepiece in accordance with the manufacturer's instructions. Cover the filtering element of the filtering device with the hands and exhale sharply. If leakage is detected by air escaping around the edges of the facepiece, re-adjust the facepiece/straps and re-test. If a satisfactory fit check cannot be achieved the wearer should not use the device.

## E.3 Fit test methods

### E.3.1 Qualitative fit testing

In this method test agents (e.g. saccharin, bitrex or amyl acetate) with distinctive taste or smell are used for detecting leaks. This method is suitable for half masks, filtering facepieces and full face masks. If for reasons of high protection factors full face masks are required, this method is unlikely to be suitable. A quantitative fit testing is recommended.

The wearer will be exposed to an atmosphere containing the suitable test agent. Specially adapted chambers/hoods may be used for creating a localised atmosphere. Commercial kits are available for this purpose.

If the wearer detects the substance the facepiece should be readjusted and the test repeated.

Some people may not be sensitive enough to the agent at very low concentrations and as a consequence of this leaks may not be detected. Therefore, it is first necessary to establish whether the person under test will be able to detect the agent at low concentrations.

### E.3.2 Quantitative fit testing

#### E.3.2.1 Test chamber method

This test is a measure of the fit and provides a numerical value. It can be sensitive to any leaks. Fit testing using an aerosol of sodium chloride particles or sulphur hexafluoride tracer gas, can be carried out in a test chamber. Measurements are made of the chamber concentration and inside the facepiece. During the measurements the wearer will carry out a series of exercises. The value obtained is personal to the wearer and the facepiece involved. Fit factor can be derived from this value. This factor is different from the protection factor (see Annex C) and should not be confused.

#### E.3.2.2 Non chamber methods

There are alternative methods which employ commercially available portable equipment measuring fit. These methods are relatively easy to do and can be inexpensive compared to a test chamber method.

##### E.3.2.2.1 Particle counting method

A particle counting device counts the number of ambient particles leaking into the facepiece and compares this with the particle number challenging the facepiece while the wearer carries out a number of specified exercises. This method can either use particles in the ambient or generated aerosols as the test challenge.

##### E.3.2.2.2 Pressure method

A device generates and then maintains a constant pressure inside the facepiece whilst the wearer remains motionless. The rate of air exhausted is controlled so that a constant negative pressure is maintained in the facepiece during the fit test. The amount of exhaust air that is required to hold the pressure in the temporarily sealed facepiece constant, yields a direct measure of leakage airflow into the facepiece. The leak is converted into an equivalent fit factor. This method requires a facepiece that can be sealed and therefore is not applicable to filtering facepieces.

# Annex F
(informative)

## Respiratory protection passport

For users of respiratory protective devices, a passport or training licence will show their competence in the correct use and maintenance (if required) of respiratory protective devices.

Example for a training licence:

**I.D.Number …….....**

**Training licence**

This certifies that:

**Name …….....**
has been trained in the use of respiratory protective devices detailed below and is competent to use them.

**Type of the device…**

**Valid to …….....**

**Signed …….....**

**Keep this safe**

You will need it if you withdraw or use respiratory protective devices.

Inform your supervisor before the expiry date.

If you require further information please contact
…….....

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