TECHNICAL SPECIFICATION

ISO/TS 16975-1

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Respiratory protective devices — Selection, use and maintenance —

Part 1: Establishing and implementing a respiratory protective device programme

Appareils de protection respiratoire — Choix, utilisation et entretien —

Partie 1: Élaboration et mise en oeuvre d'un programme pour les appareils de protection respiratoire

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 15, *Respiratory protective devices*.

ISO 16975 consists of the following parts, under the general title *Respiratory protective devices — Selection, use and maintenance*:

— *Part 1: Establishing and implementing a respiratory protective device programme* [Technical Specification]

— *Part 2: Condensed guide to establishing and implementing a respiratory protective device programme* [Technical Specification]

— *Part 3: Fit testing procedures*

Introduction

This part of ISO 16975 contains the essential requirements for establishing and implementing a complete respiratory protective device (RPD) programme for respiratory protective devices that meet the requirements of the performance standards. It contains information on risk assessment, selection procedure, training, use and maintenance.

Informative Annexes provide additional guidance on how to implement such a programme.

Respiratory protective devices — Selection, use and maintenance —

Part 1: Establishing and implementing a respiratory protective device programme

1 Scope

This part of ISO 16975 specifies detailed information to assist persons responsible for establishing and implementing a programme for respiratory protective devices (RPD) that meet the performance requirements of the performance standards.

This part of ISO 16975 does not apply to RPD programmes for RPD used exclusively under water, for use in aircraft, and medical life support respirators and resuscitators.

NOTE The information contained in this part of ISO 16975 can be used to assist in the preparation of national or local regulations; however, this part of ISO 16975 does not supersede national or local regulations.

WARNING — Failure to select, use and maintain RPD correctly can result in injury, illness or death.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16900-1, *Respiratory protective devices — Methods of test and test equipment — Part 1: Determination of inward leakage*

ISO 16972, *Respiratory protective devices — Terms, definitions, graphical symbols and units of measurement*

ISO/TS 16975-2, *Respiratory protective devices — Selection, use and maintenance — Part 2: Condensed guide to establishing and implementing a respiratory protective device programme*

ISO 16975-3[1)], *Respiratory protective devices — Selection, use and maintenance — Part 3: Fit testing procedures*

ISO 17420-3, *Respiratory protective devices — Performance requirements — Part 3: Thread connection*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16972 and the following apply.

3.1
adequate RPD
RPD (3.8) capable of reducing the inhalation exposure to an acceptable level

1) To be published.

3.2
assigned protection factor
APF
anticipated level of respiratory protection that would be provided by a properly functioning *RPD* (3.8) or class of RPD within an effective *RPD programme* (3.10)

3.3
competent person
person with suitable and sufficient experience and with practical and theoretical knowledge of the elements of an *RPD programme* (3.10) for which (s)he is responsible

3.4
hazardous substance
substance that presents a potential to cause injury or ill health if it is inhaled, ingested or comes into contact with, or absorbed through, the skin.

Note 1 to entry: A hazardous substance may be a pure substance or generated as by-products during work activities; for example, wood dust and stone dust welding fume.

Note 2 to entry: Hazardous substances can be present in the atmosphere in a number of physical states as

a) gases, such as ammonia and chlorine,

b) vapours, such as from solvents, and

c) particles, such as dust, mist, smoke, fumes, fibres, fog and bioaerosols.

3.5
hazardous atmospheres
atmosphere that is oxygen-deficient and/or the level of substances in the atmosphere is at a concentration deemed to be hazardous

3.6
protection class
PC
numerical designation from PC1 to PC6 allocated to individual *RPD* (3.8) based upon laboratory testing indicating its relative protection

3.7
protection level
degree of respiratory protection allocated to an *RPD* (3.8) for the purposes of selection and use that is expected to be provided to wearers when used within an effective *RPD programme* (3.10)

3.8
respiratory protective device
RPD
personal protective equipment designed to protect the wearer's respiratory tract against inhalation of *hazardous atmospheres* (3.5)

3.9
risk assessment
process of hazard, adequacy and suitability assessments relating to the selection of *RPD* (3.8)

3.10
RPD programme
process of selecting, using and maintaining *RPD* (3.8) to ensure adequate protection to the wearer

3.11
suitable RPD
RPD (3.8) that is adequate and is matched to the requirements of the wearer, the task and the working environment

3.12
work rate class
numerical designation from W1 to W4 allocated to individual *RPD* (3.8) based upon laboratory testing indicating its relative ability to meet the wearer's demand for breathable gas at different activity levels

Note 1 to entry: Further information on work rate is given in 7.3.3.4.

3.13
immediately dangerous to life or health
IDLH
atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere

4 Abbreviated terms

AB	Abrasive Blasting (Special Application Class)
ADE ASM	Adequacy Assessment
APF	Assigned Protection Factor
CBRN	Chemical, Biological, Radiological, and Nuclear (Special Application Class)
ES	Escape (Special Application Class)
FF	FireFighting (Special Application Class)
HAZ-ASM	Hazard Assessment
HHG	Health Hazard Group
HR	Hazard Ratio
IDLH	Immediately Dangerous to Life or Health
MA	Marine (Special Application Class)
MN	Mining (Special Application Class)
NPF	Nominal Protection Factor
OEL	Occupational Exposure Level
OEL-TWA	Occupational Exposure Level-Time Weighted Average
PC	Protection Class
PL	Protection Level
PPE	Personal Protective Equipment
QLFT	Qualitative Fit Test
QNFF	Quantitative fit factor
QNFT	Quantitative Fit Test
RFF	Required Fit Factor
RI	Respiratory interface

RPD Respiratory Protective Devices

S Breathable gas capacity

SU ASM Suitability Assessment

SY Breathable gas capacity Class of airline supplied RPD

W Work rate Class

WE Welding (Special Application Class)

5 Situations for using RPD

RPD is considered to be at the bottom of the hierarchy of control measures and should only be used after an acceptable case for its use has been established by way of an appropriate risk assessment. RPDs are used to further reduce inhalation exposures to hazardous atmospheres:

— when sufficient engineering and administrative controls are lacking;

— when these controls are not reasonably practical (maintenance, escape or rescue work);

— prior to implementing or improving a control measure.

6 RPD programme

6.1 General

The RPD programme includes processes for selecting, using and maintaining RPD to ensure adequate protection to the wearer.

Prior to using RPD, it is essential to establish a written RPD programme. The RPD programme needs to be understood by all persons within the organization, as appropriate.

6.2 RPD programme elements

The RPD programme consists of the following elements:

a) roles and responsibilities (see 6.3);

b) RPD programme implementation (see 6.4);

c) risk assessment (see Clause 7);

d) selection procedures (see Clause 7);

e) medical assessment (see 7.3.3.2);

f) fit testing (see 7.4);

g) training (see 7.5);

h) use (see 7.6);

i) maintenance procedures (see 7.7);

j) storage (see 7.8);

k) programme review (see 7.9);

l) records and record keeping (see 7.10).

6.3 Roles and responsibilities

6.3.1 General

All persons involved in the respiratory protection programme shall be competent in their area of responsibility within the RPD programme and maintain the appropriate knowledge, experience and training to effectively carry out their duties.

6.3.2 Employer

The employer shall

— be responsible for the entire RPD programme,

— define, implement and document the RPD programme,

— provide adequate resources and organization to ensure the programme's continued effectiveness, and

— assign an RPD programme administrator.

The employer and the programme administrator may be the same person.

6.3.3 RPD Programme administrator

The programme administrator shall be responsible for effective management of the entire RPD programme.

6.3.4 Wearer

The wearer shall be responsible for

— using the RPD in accordance with the instructions and training received,

— reporting of any damage, defects or non-function of the RPD provided, and

— reporting any physical or medical limitations or changes that can impact their ability to wear and use the RPD correctly.

6.4 RPD programme implementation

The RPD programme shall be implemented, evaluated and updated as necessary to reflect those changes in workplace conditions that affect RPD use.

7 Risk assessment and RPD selection

7.1 General

A risk assessment is essential for the correct selection and use of RPD. It shall be conducted by a competent person before RPD is used for routine work, emergency work, rescue (including response to catastrophic incidents) or escape.

The risk assessment shall be conducted

— prior to the start of all new work processes,

— if the work conditions change,

— for new wearers, not covered by the existing suitability assessments, and

— periodically thereafter, at least annually or in accordance with national or local regulations.

The RPD selection procedure, shown in the following flow charts in 7.2 and described in 7.3, uses the information gathered from the risk assessment which shall include the following.

a) The Hazard Assessment flow charts identify the nature of the hazard, e.g. oxygen deficiency, contaminant level, Immediately Dangerous to Life or Health (IDLH).

b) The Adequacy Assessment flow chart determines the protection level required for the hazard.

c) The Suitability Assessment flow charts identify the factors to consider when selecting the RPD that meets the needs of the wearer and is appropriate for the task and the environment.

d) The special application flow chart identifies the minimum work rates and the minimum protection classes of the various classes within the special applications.

(0) This is an example of a navigation marker. These navigation markers precede text and are cross referenced in the flow charts. All markers are listed sequentially in 7.3. In addition, a flow chart may contain markers out of sequence. Follow the flow charts in the order given above and always begin at the top block. Read the contents of each block in sequence and follow the decision logic.

The diamond shape indicates that a decision shall be made in order to proceed. Answer each with a "Yes" or "No" response and follow the arrow to the next block.

The rhomboid shape provides data that leads to the final specification and class of suitable RPD.

The "wave shape" is an instruction to document the output of the suitability assessment.

The irregular pentagon is an instruction to go to the next flow chart.

The cylinder is an indication of the mode of operation.

Record the outcome of the selection procedure in accordance with ISO/TS 16975-2. The example of the selection record sheet can be used (see Annex J). Where the table in Annex J recommends seeking professional advice RPD manufacturers/suppliers and safety consultants are a good source of information.

7.2 Selection procedure — Flow charts

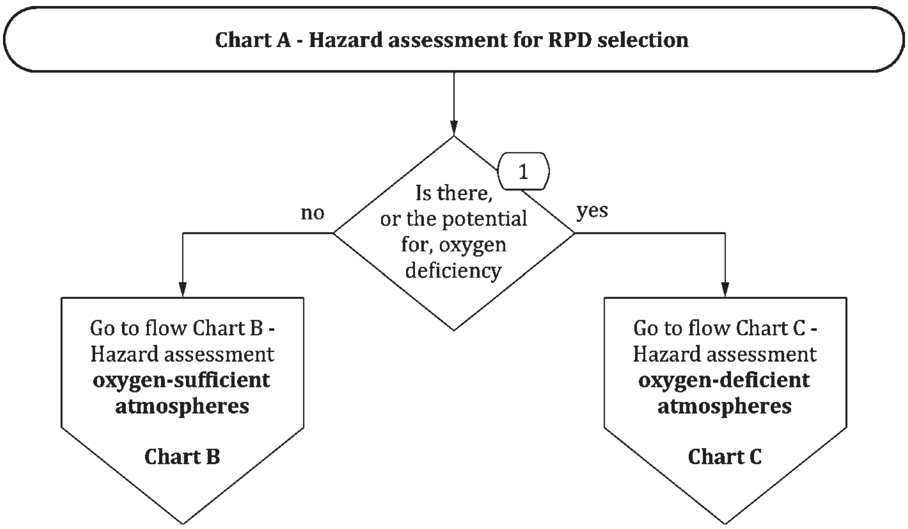


Figure 1 — Chart A Hazard assessment (HAZ-ASM)

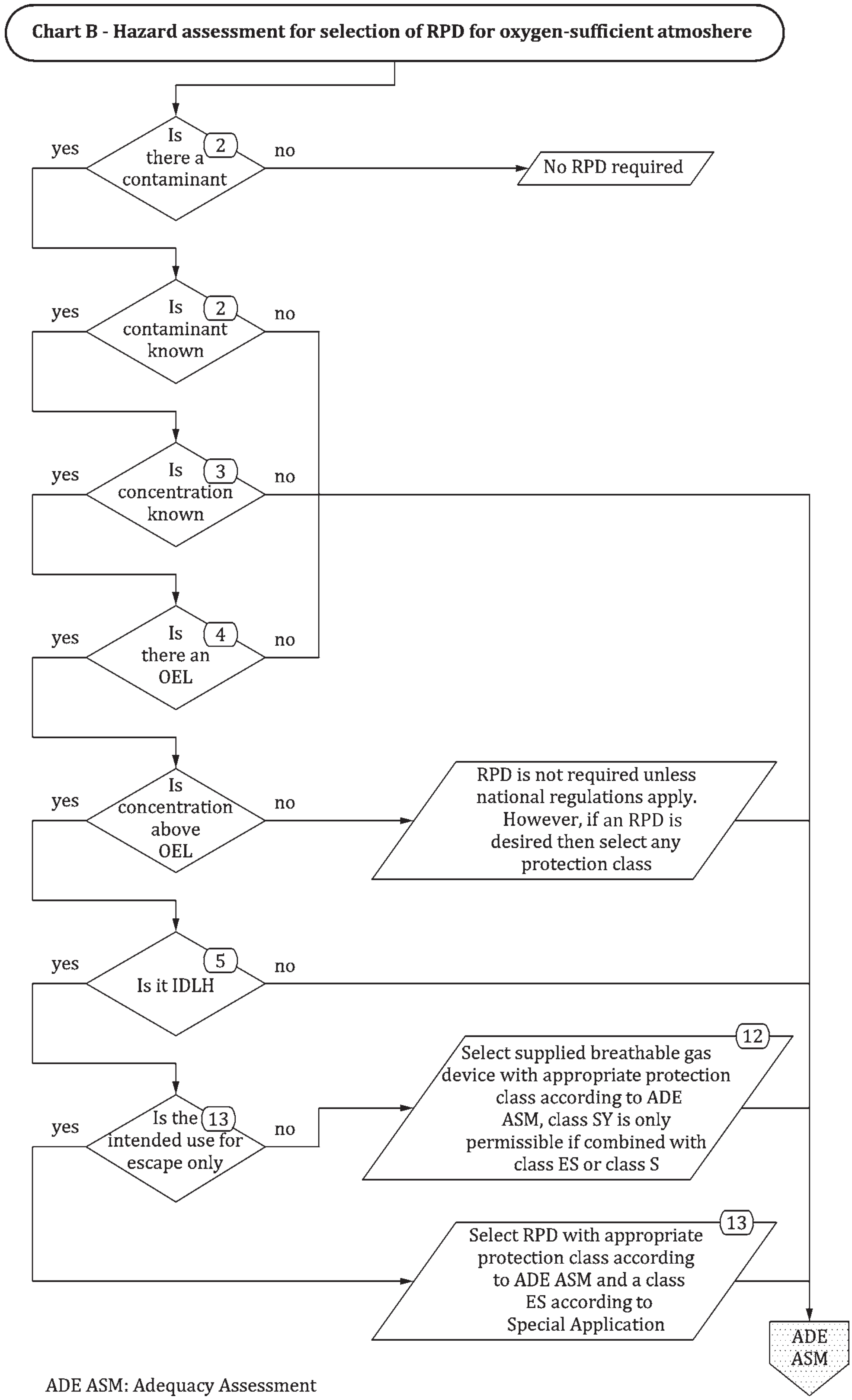


Figure 2 — Hazard ASM — Chart B for oxygen-sufficient atmospheres

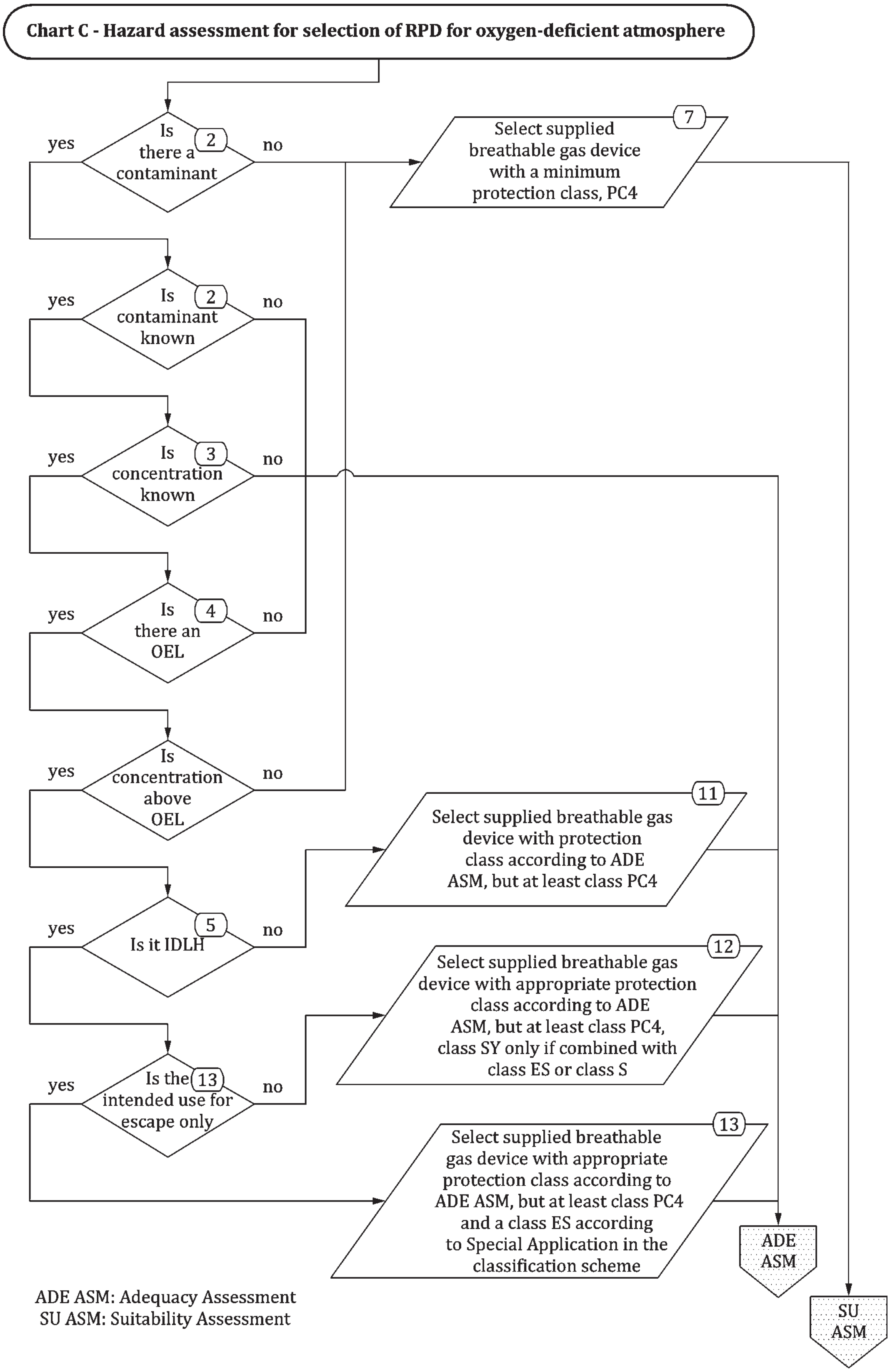


Figure 3 — Hazard ASM — Chart C for oxygen-deficient atmospheres

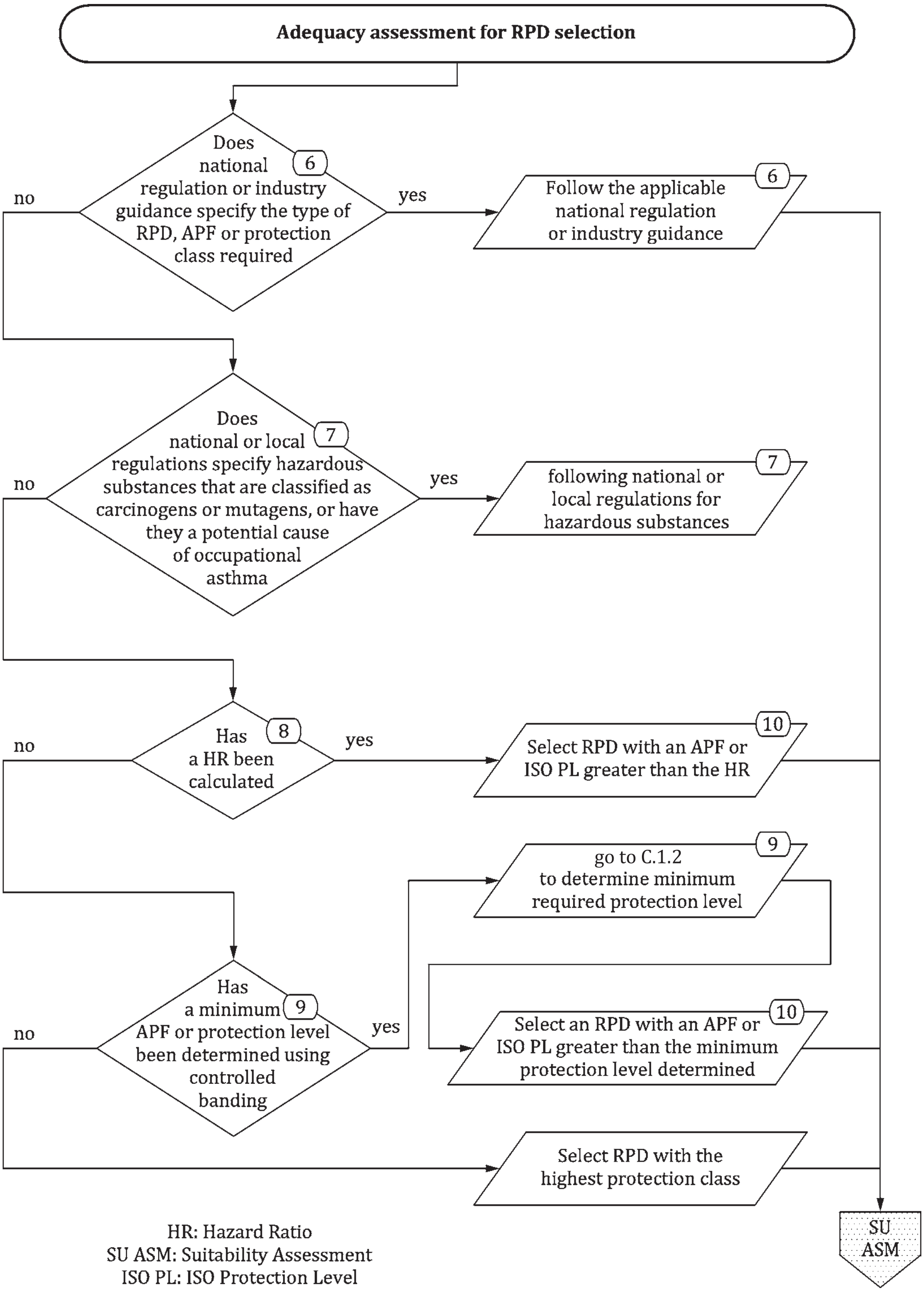


Figure 4 — Adequacy assessment

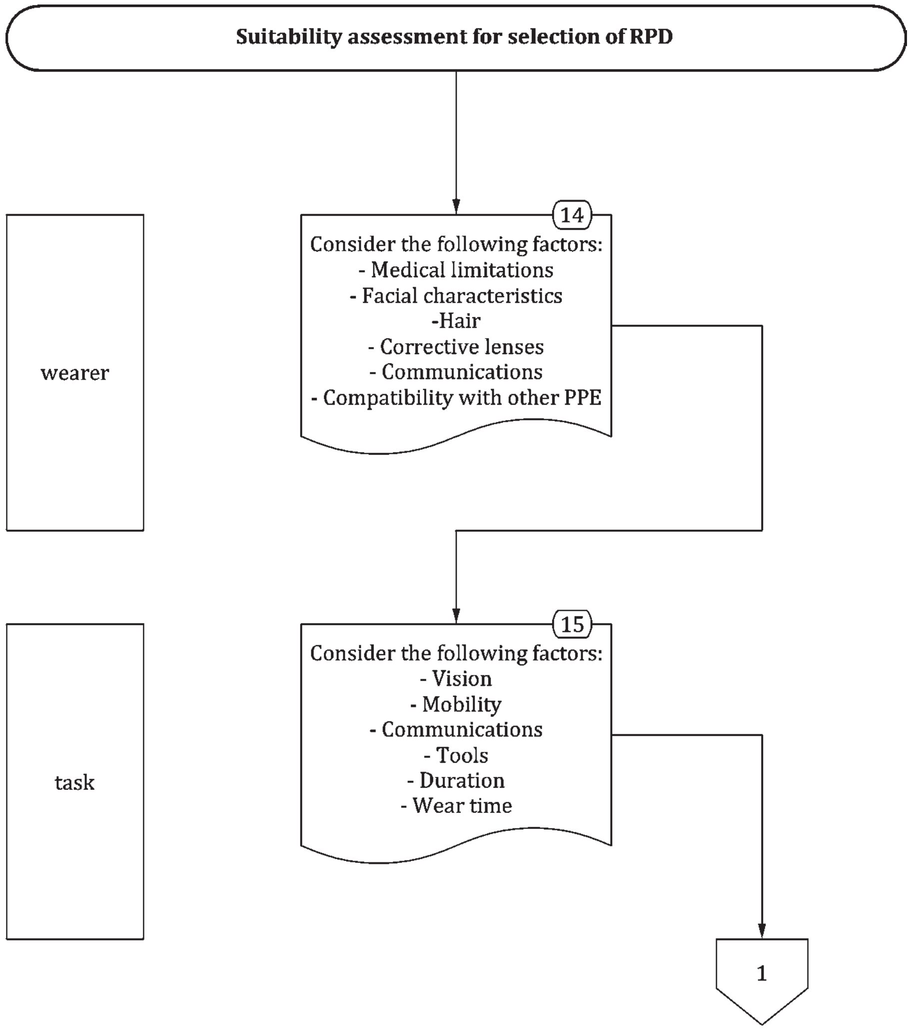


Figure 5 — Suitability assessment — Wearer/task

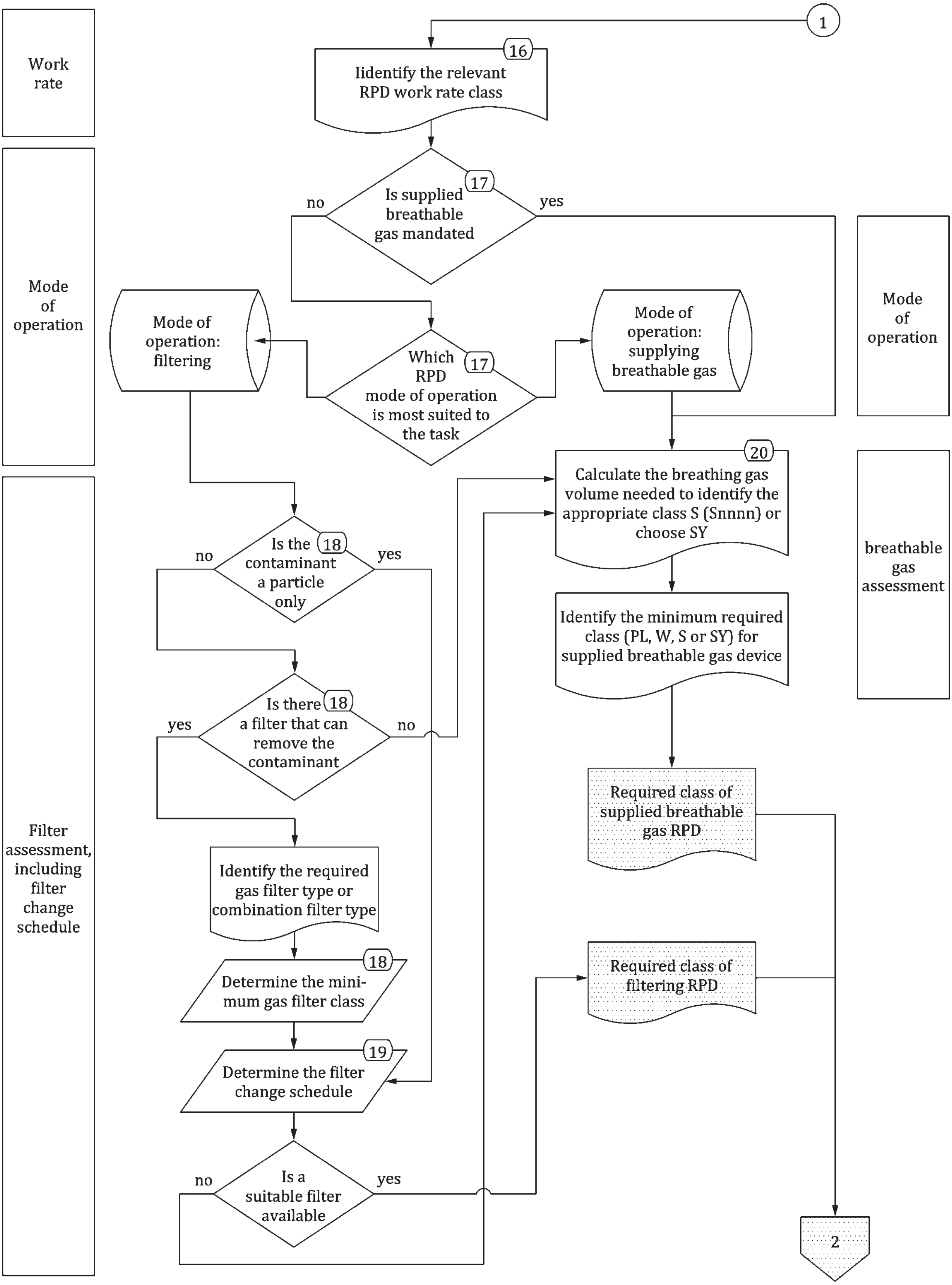


Figure 6 — Suitability assessment — Work rate, mode of operation, filter assessment, filter exchange programme, breathable gas supply assessment

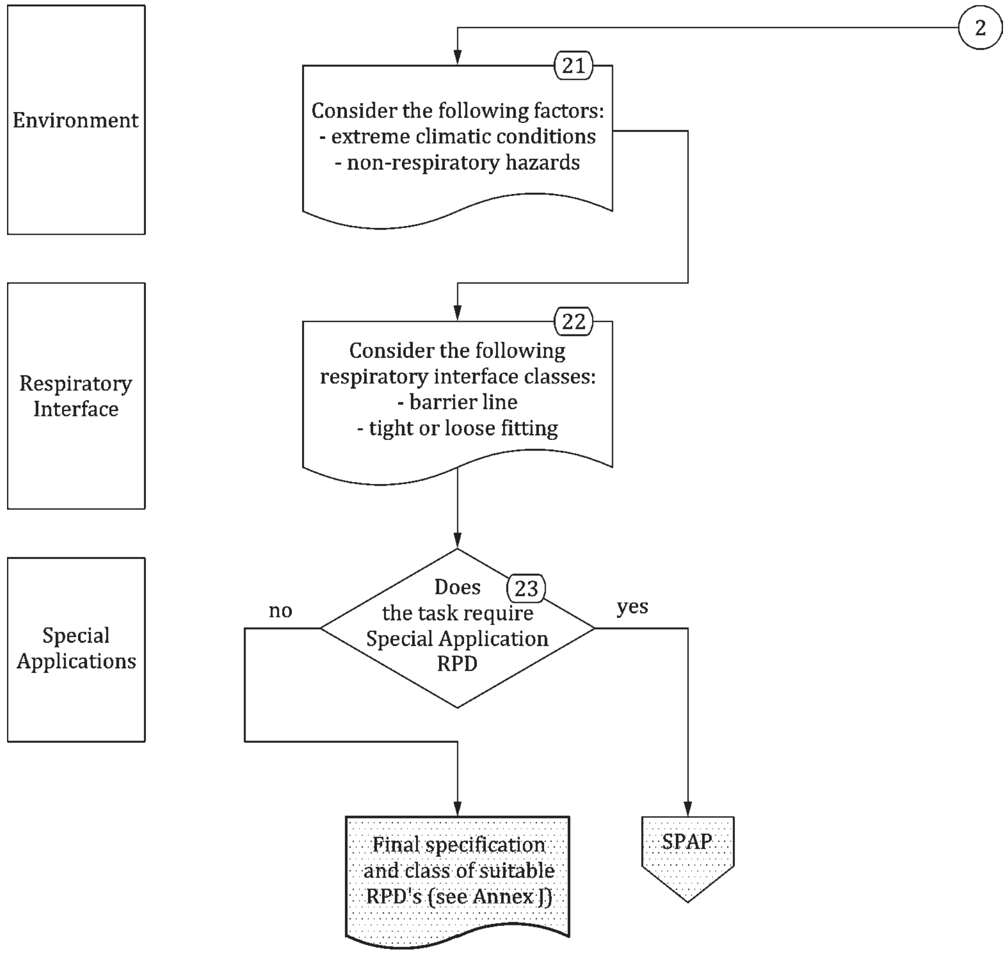


Figure 7 — Suitability assessment — Intended work, mode of operation, filter assessment and change schedule

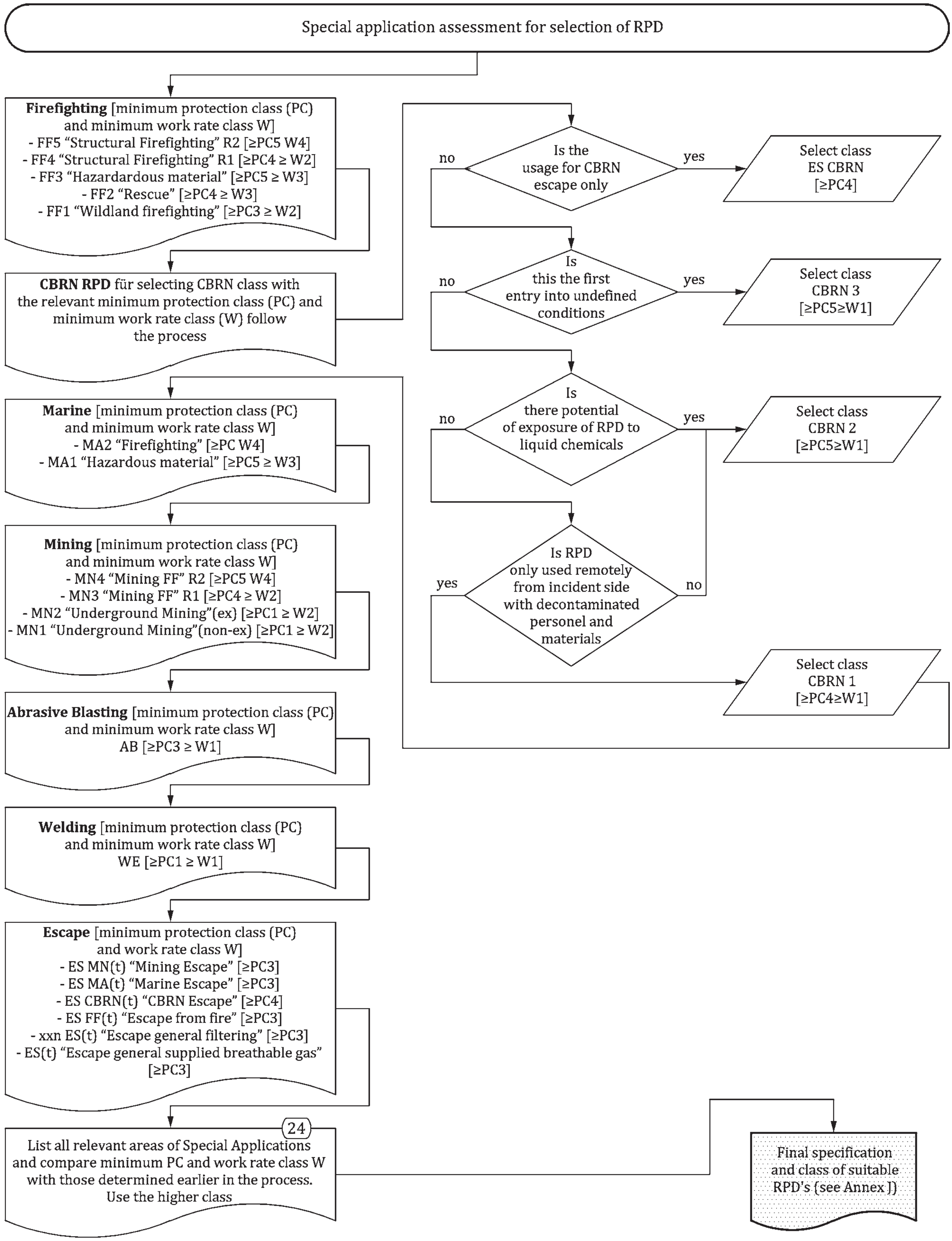


Figure 8 — Special application assessments

7.3 Selection procedure

7.3.1 Hazard assessment

7.3.1.1 General

The hazard assessment shall identify the nature of the hazard(s) present for which respiratory protection may be required.

7.3.1.1.1 Oxygen deficiency

(1) The potential for oxygen deficiencies shall be considered. When national or local regulations that relate to oxygen deficiency levels exist, these should be followed.

7.3.1.1.2 Identification of contaminants

(2) The contaminant(s) likely to be present as gas, vapour or particle shall be identified.

All materials used, produced or stored, including raw materials, end products, by-products and wastes, should be reviewed by assessing the work process and by referring to the safety data sheets (SDS). From this review, the contaminant(s) that may be present in the workplace shall be identified.

National or local regulations that relate to specific contaminants (e.g. asbestos, lead, benzene) shall be followed. If the contaminant is unknown and if there is a national or industry guidance document that is specific to the task, then the assigned protection factors (APF) or the recommended Protection Level shall be chosen.

When the contaminants cannot be identified and no guidance is available, the hazard is considered unknown and the atmospheres shall be considered IDLH, and only breathable gas supplying RPD with the highest APF or protection class shall be selected.

(3) The foreseeable worst-case airborne exposure concentrations of contaminants in the atmosphere shall be determined. If the contaminant concentration is unknown and if there is a national or industry guidance document that is specific to the task, then the assigned protection factors (APF) or the recommended Protection Level shall be chosen.

(4) The occupational exposure limits or the safe exposure levels shall be identified for contaminants where available. Where no OEL is published for the contaminant and there are no national or local regulations that relate to the contaminant, then control-banding method may offer a solution; see C.1.3. If the control banding method cannot be used, then select an RPD with the highest protection class.

(5) Does the potential for IDLH conditions exist? An IDLH atmosphere is one that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape. It is an atmosphere where the potential exists where one could not escape without the aid of an RPD. Selection of RPD for work in IDLH atmospheres shall consider the method of escape in the event that the primary RPD mode fails, including level during the escape. IDLH levels may be established by national or local regulations or published by professional bodies. If there is uncertainty whether the concentration is above or below IDLH, the atmosphere shall be considered to be IDLH.

7.3.2 Adequacy assessment

7.3.2.1 General

The adequacy assessment determines the minimum protection required from the RPD for adequate protection against the identified hazardous substance and/or oxygen deficiency.

7.3.2.2 Methods for determining the protection required:

The required protection shall be determined by one of the following methods:

a) (6) following national or local regulations that specify the type of RPD, APF or protection class for specific contaminants;

b) (7) following national or local regulations for hazardous substances that are classified as carcinogens or mutagens, or are a potential cause of occupational asthma. These may require that exposure be reduced to as low as is reasonably practicable or technically feasible and to below any control or exposure levels/limits;

c) (8) calculating the hazard ratio using the determined foreseeable worst-case airborne concentration (see C.1.2) and the relevant occupational exposure limit values;

The hazard ratio (HR) can be calculated using Formula (1):

$$HR = \frac{CC_{out}}{PC_{in}} \tag{1}$$

where

CC_{out} is the contaminant concentration outside the RPD;

PC_{in} is the permissible concentration allowed inside the respiratory interface, i.e. OEL.

d) (9) using the "control banding method". The control banding method utilizes the hazard statements associated with the hazardous substance(s) being used or generated, combined with the potential for inhalation exposure based on the amount of substance used and its dustiness or volatility. See C.1.3.

7.3.2.3 Use of Assigned Protection Factors (APF)

(10) Where nationally accepted APF are used, an RPD having an APF higher than the hazard ratio (HR) shall be selected.

APF relate to the protection provided by specific design types and classes of RPD and these will be different than the ISO RPD classifications. RPD complying with the performance standards are classified based on laboratory performance measured in accordance with ISO 16900-1, and therefore, RPD of the same basic design can have different laboratory performance and can therefore fall into a different protection class (PC).

National or local regulations can require that RPD be selected using APF or equivalent. In this case, the adequacy assessment and related flow chart (see Figure 4) provide a method for using APF.

7.3.2.4 Use of ISO Protection Classes (PC) and Protection Levels (PL)

The PC is the class of respiratory protection allocated to an RPD as a result of laboratory testing. The PL is the level of protection associated with the PC that is expected to be provided to wearers when the RPD is used within an effective RPD programme as described in this part of ISO 16975. The PL is used in the selection process. These can be found in the Selection Record Form; see Annex J.

(11) For oxygen-deficient atmospheres, a supplied breathable gas RPD of class SY ES or class S shall be selected. The PC needed depends upon the concentration of any hazardous substance(s) present.

(12) For working in IDLH atmospheres, only supplied breathable gas RPD shall be selected. The minimum PL shall be determined by the hazard ratio in the adequacy assessment (See C.1). When class

SY RPD, e.g. airline RPD, is selected, it shall be combined with a class ES (escape only RPD) or class S RPD, e.g. self-contained breathing apparatus.

For oxygen-deficient atmospheres, a supplied breathable gas RPD with a protection class of at least PC4 shall be selected.

(13) For escape from oxygen-sufficient IDLH atmosphere, an RPD of class ES with the minimum PL determined by the hazard ratio in the adequacy assessment shall be selected.

For escape from oxygen-deficient IDLH atmospheres, only a supplied breathable gas RPD of class SY ES or class S with a protection class of at least PC4 shall be selected.

When class SY RPD, e.g. airline device, is selected, it shall be combined with a class ES, (escape only device) or class S RPD, e.g. self-contained breathing apparatus. A higher PC can be needed depending upon the concentration of any hazardous substance(s) present.

7.3.3 Suitability assessment

7.3.3.1 General

The suitability assessment shall consider the following:

— wearer;

— task;

— work rate;

— environment;

— any special application.

7.3.3.2 Wearer

(14) The suitability assessment for the wearer shall consider the following factors.

a) **Medical limitations**. The programme administrator shall arrange for appropriate medical assessment, in accordance with national or local regulations, to ensure that the individual is free from any condition that may preclude or limit the use of RPD.

NOTE Further information is given in D.2.1.

b) **Facial characteristics**. The RPD selected shall accommodate the facial characteristics of the wearer, such as deep scars or grooves. Where these facial characteristics prevent a good fit, consider the use of a loose-fitting respiratory interface, which does not rely on a tight seal in this region. Body jewellery which affects the fit shall be removed while wearing the RPD, or a different type of RI may be considered.

NOTE Further information is given in D.2.2.

c) **Hair**. No hair comes between the sealing surfaces of a tight-fitting respiratory interface and the wearer's skin, or interferes with the function of the RPD, e.g. interference with the operation of valves shall not be permitted. Where any hair comes between the sealing surface, the use of loose-fitting respiratory interface, which do not rely on a tight seal in this region may be considered.

d) **Corrective lenses**. The RPD shall be able to accommodate corrective lenses (spectacles or contact lenses) if needed.

NOTE Further information is given in D.2.3.

e) **Communication.** The RPD shall permit communication to the level needed for the task (e.g. speaking, hearing and visual communications).

NOTE Further information is given in D.2.4.

f) **Compatibility with other PPE**. Different items of PPE shall not interfere with the RPD during use, preventing one or more of the components from working correctly. Where possible, RPD, where the different forms of protection required are integrally combined, (e.g. RPD providing eye, face, head and respiratory protection) should be considered.

NOTE Further information is given in D.2.5.

7.3.3.3 Task

15 Suitability assessment for the task shall consider the following factors.

a) **Vision**. Special needs for vision, e.g. magnification, clarity or wide field of view, shall be considered.

NOTE Further information is given in D.3.1.

b) **Mobility**. Mobility requirements demanded by the task and location can limit the type of RPD that can be used safely. Confined spaces require special considerations. RPD that does not impede mobility shall be selected.

NOTE Further information is given in D.3.2.

c) **Communications**. Communication requirements shall be taken into consideration especially for confined spaces and IDLH atmospheres. RPD with speech transmitters and RPD models incorporating voice amplifiers or radios should be considered to aid communications.

NOTE Further information is given in D.3.3.

d) **Tools**. Use of tools (e.g. welding equipment, equipment used during spraying operations and power tools) can influence the performance of RPD and shall be considered. RPD compatible with the tools shall be selected. If the RPD and air-powered tools are connected to the same air supply, it shall be ensured that the compressor can supply enough air for both at the same time and that the air supplied to the RPD remains of breathable quality (see 7.6.3.2). This practice can result in excess oil in the breathable gas. Some types of RPD, e.g. compressed breathable gas supplied RPD, are equipped with an air take-off for air-powered tools. Preferably, the RPD air supply and other air sources should be kept separated. Any national or local regulations prohibiting the supply of both RPD and tool from the same air source shall be followed.

NOTE Further information is given in D.3.4.

e) **Duration**. Task duration (including any preparation, entry, exit and decontamination time) shall be considered in order to establish the requirements for the service life of the RPD. Depending upon the type of RPD, this shall include consideration of breathable gas capacity, battery life, filter service life and a filter change schedule.

NOTE Further information is given in D.3.5.

f) **Wear time**. This is the length of time the RPD has to be worn continuously to perform the task. For some types of RPD, the maximum possible wear time and frequency of use may be limited due to wearer comfort and physical burden. Using assisted RPD can help minimize fatigue and discomfort. Any national or local regulations concerning wear time shall be followed.

7.3.3.4 Work rate

16 The expected work rate shall be determined in order to select RPD with the appropriate work rate class.

Four work rate classes, W1, W2, W3 and W4, are designated for RPD; however, those with standardized connector according to ISO 17420-3 are limited up to work rate W2.

To determine the required work rate class, the highest class according to the descriptions in Table 1 shall be selected.

NOTE Further information on work rates and work activities is given in ISO/TS 16976-1.

Table 1 — Work rates and examples of corresponding activities

Work rate class	Work	Examples of work and activities
W1	Light to moderate	Average for full work shifts including breaks Sitting at ease: light manual work (writing, typing, drawing, sewing, bookkeeping); hand and arm work (small bench tools, inspection, assembly or sorting of light materials); arm and leg work [driving vehicle in normal conditions, operating foot switch or pedal, standing drilling (small parts), milling machine (small parts), coil winding, small armature winding, machining with low power tools] To: Sustained hand and arm work (hammering in nails, filing); arm and leg work (off-road operation of lorries, tractors or construction equipment); arm and trunk work (work with pneumatic hammer, tractor assembly, plastering, intermittent handling of moderately heavy material, weeding, hoeing, picking fruits or vegetables, pushing or pulling light-weight carts or wheelbarrows, forging); walking at a speed of up to 5,5 km/h
W2	Heavy to very heavy	Average for full work shifts including breaks Intense arm and trunk work (carrying heavy material, shovelling, sledgehammer work, sawing, planing or chiselling hard wood, hand mowing, digging, pushing or pulling heavily loaded hand carts or wheelbarrows, chipping castings, concrete block laying) To: Very intense activity at fast pace; working with an axe; intense shovelling or digging; climbing stairs, ramp or ladder; walking quickly with small forms; running; walking at a speed greater than 5,5 km/h
W3	Very, very heavy to extremely heavy	Continuous work for up to 2 h without breaks Safety and rescue work with heavy equipment and/or personal protective equipment; fit individuals pacing themselves at 50 % to 60 % of their maximal aerobic capacity; walking quickly or running with protective equipment and/or tools and goods; walking at 5 km/h and 10 % elevation To: Continuous work for up to 15 min without breaks. Rescue and fire-fighting work at high intensity; fit and well-trained individuals pacing themselves at 70 % to 80 % of their maximal aerobic capacity; searching contaminated spaces; crawling under and climbing over obstacles; removing debris; carrying a hose; walking at 5 km/h and 15 % elevation
W4	Maximal	Continuous work for less than 5 min without breaks Rescue and firefighting work at maximal intensity; fit and well-trained individuals pacing themselves at 80 % to 90 % of their maximal physical work capacity; climbing stairs and ladders at high speed; removing and carrying victims; walking at 5 km/h and 20 % elevation

7.3.3.5 Mode of operation

17 The mode of operation gives the primary means of supplying the wearer with breathable gas, i.e. filtration or breathable gas supply.

National or local regulations can exist (e.g. asbestos, lead, benzene) that mandate the use of supplied breathable gas RPD.

Where the hazard assessment indicates that either filtering RPD or supplied breathable gas RPD could be used, the choice of RPD mode of operation most suited to the task should depend on the output of the suitability assessment and the limitations of the RPD. Further information is given in A.2 and A.3.

7.3.3.6 Filter assessment

(18) Where the risk assessment indicates that a particle filtering RPD is suitable, the selection of the appropriate particle filtering RPD shall be determined by the required PL and work rate.

Where the risk assessment indicates that a gas/vapour or combination filtering RPD is suitable, the selection of the appropriate type and class of filter will depend on many workplace factors. These include contaminant(s), their concentration(s), work rate, task duration, temperature and humidity. Users should seek guidance from the gas filter manufacturer about the filter classification to be used and whether the contaminant can be removed by filtration at all.

NOTE Further information is given in A.2.3.3, A.2.3.4, A.3.3 and Annex I.

7.3.3.7 Filter change schedule

(19) A filter change schedule shall be established, so that the filters are changed prior to their end of service life. Filters marked for single shift use only or that have time limitations shall be replaced in accordance with the manufacturer's instructions for use.

NOTE Further information is given in A.3.3 and B.2.1.

Filter(s) shall be replaced with new filter(s) of the same type and class. When more than one filter is used on an RPD, all filters shall be replaced at the same time.

7.3.3.8 Calculation of breathable gas volume needed for the task

(20) Supplied breathable gas RPD that have a fixed volume of breathable gas (self-contained) are classified by the volume of breathable gas available, and are designated by the letter S followed by the volume in litres.

The minimum volume of the breathable gas needed for the duration of the task, including entry and exit, shall be established by using the calculations below. A wearer's actual air consumption in use will change the useable duration of the breathable gas volume.

— For work rate W1 (light to moderate): Volume needed = duration of task (min) × 30 l/min (e.g. 20 min x 30 l/min = 600 l).

— For work rate W2 (heavy to very heavy): Volume needed = duration of task (min) × 40 l/min.

— For work rate W3 (very, very heavy to extremely heavy): Volume needed = duration of task (min) × 50 l/min.

— For work rate W4 (maximal): Volume needed = duration of task (min) × 65 l/min.

Alternatively, a supplied breathable gas RPD that has an external supply of breathable gas may be selected; these are classified "SY".

7.3.3.9 Environment

(21) Suitability assessment for the environment shall consider the following factors.

a) **Extreme climatic conditions**. Extreme climatic conditions can affect the performance of RPD or wearer comfort, both of which can lead to a loss of protection and reduction in service life of the

RPD. Elements that shall be assessed include the range of temperature and humidity, wind velocity and increased or decreased pressure in the environment in which the RPD is to be used These elements might have an impact on the core body temperature of the wearer, which may reduce the amount of time the RPD wearer can work.

NOTE Further information is given in D.5.1.

b) **Non-respiratory hazards**. Hazards such as sparks, abrasion, electromagnetic compatibility can affect the performance of RPD. RPD to be used in such environments shall be selected accordingly. Advice from the RPD manufacturer should be sought on the suitability of the RPD for the environment.

NOTE Further information is given in D.5.2.

7.3.3.10 Respiratory interface

(22) The class of the RI, i.e. the barrier line used and whether it is tight-fitting or loose-fitting shall be considered based on the factors given in 7.3.3.2 and 7.3.3.3.

NOTE Further information is given in A.2.1

7.3.3.11 Special applications

(23) RPD for special application are classified by the unique hazards in which they are used and for which additional performance requirements have been defined. Special applications include Firefighting, Chemical, Biological, Radiological and Nuclear (CBRN), Marine, Mining, Abrasive blasting, Welding and Escape. More than one special application may be applicable for the task or environment, e.g. structural firefighting concurrent with a CBRN environment.

Any of the above special applications that apply shall be identified.

NOTE Further information is given in 7.3.3.12.

(24) Special applications have minimum protection class and work rate class requirements. Special application Escape has minimum protection class at a given flow rate.

All special applications shall be listed and compared with the previously determined minimum protection class, PC, and work rate class, W. If they are different then the highest shall be selected.

7.3.3.12 Special application class

7.3.3.12.1 General

Special applications specify different areas of RPD use with specific performance requirements. Minimum protection class (PC) and work rate class (W) are set according to the performance standards, and are shown in 7.3.3.12.2 to 7.3.3.12.8. These classes shall be met in order to be classified for the special application. Higher PC and W classes shall not be excluded.

Special applications (see Annex C) include

— Firefighting,

— CBRN,

— Marine,

— Mining,

— Abrasive blasting,

— Welding, and

— Escape.

Special applications RPDs are designated by alpha-numeric designation.

RPD designated for special applications are required to comply with additional performance requirements (e.g. additional resistance to heat and flame for RPD intended for use in firefighting).

7.3.3.12.2 Firefighting class

RPD for Firefighting are designated by FF, followed by the numeric designation for specific firefighting application. These specific applications are: Wildland firefighting, Rescue, Hazardous materials and Structural firefighting, where two levels of environmental conditions are covered (FF5 to be selected when high thermal exposure is involved); see Table 2 and Table I.1.

Table 2 — Firefighting classes

Class	Application	Minimum protection class and minimum work rate class
FF5	Structural firefighting Type R2[a]	≥PC5 ≥W4
FF4	Structural firefighting Type R1	≥PC5 ≥W3
FF3	Hazardous materials	≥PC5 ≥W3
FF2	Rescue	≥PC4 ≥W3
FF1	Wildland firefighting	≥PC3 ≥W2

[a] Type R2 includes higher level of thermal exposure than Type R1.

7.3.3.12.3 Chemical, Biological Radiological and Nuclear class

RPD for CBRN are designated by CBRN followed by the numeric designation for specific CBRN application; see Table 3 and Table I.1.

If the exposure conditions are potentially classifiable as “CBRN” (chemical-biological-radiological-nuclear), then the flow chart shown in Figure 8 shall be followed after completion of the full selection process ending with the suitability assessment.

It is noted that national guidance may exist to provide the definition of a CBRN event and/or national guidance may define respiratory protective device selection criteria for use in these events. Familiarity with such guidance should be ensured prior to using the flowchart.

All requirements for selection of RPD established in the rest of the selection process shall be followed with respect to the selection of CBRN RPD (including determination of filtering or supplied breathable gas requirements, work rate and minimum protection class). The CBRN RPD selection flow chart only defines the class of CBRN RPD.

Table 3 — CBRN classes

Class	Application	Minimum protection class and minimum work rate class
CBRN3	First on-scene responder	≥PC5 ≥W3
CBRN2	Responder (known threat environment)	≥PC5 ≥W1
CBRN1	Receiver/first receiver	≥PC4 ≥W1

7.3.3.12.4 Marine class

RPD for Marine are designated by MA followed by the numeric designation for specific Marine application. These specific applications are: Firefighting and Hazardous materials; see Table 4 and Table I.1.

Table 4 — Marine classes

Class	Application	Minimum protection class and minimum work rate class
MA2	Firefighting	≥PC5 ≥W4
MA1	Hazardous materials	≥PC5 ≥W3

7.3.3.12.5 Mining class

RPD for Mining are designated by MN followed by the numeric designation for specific Mining application. These specific applications are: Underground non-explosive atmosphere, Underground explosive atmosphere and Firefighting and Rescue, where two levels of environmental conditions are covered (MN4 to be selected when high thermal exposure is involved); see Table 5 and Table I.1.

Table 5 — Mining classes

Class	Application	Minimum protection class and minimum work rate class
MN4	Firefighting and Rescue Type R2[a]	≥PC5 ≥W4
MN3	Firefighting and Rescue Type R1	≥PC4 ≥W2
MN2	Underground mining explosive	≥PC1 ≥W2
MN1	Underground mining non-explosive	≥PC1 ≥W2

NOTE For further information about explosive atmosphere, see D.5.2.3.

[a] Type R2 includes higher level of thermal exposure than Type R1.

7.3.3.12.6 Abrasive blasting class

RPD for Abrasive blasting are designated by AB followed by the numeric designation for specific abrasive blasting application. Currently, only one numeric designation has been identified; see Table 6 and Table I.1.

Table 6 — Abrasive blasting classes

Class	Application	Minimum protection class and minimum work rate class
AB1	Abrasive blasting	≥PC3 ≥W1

7.3.3.12.7 Welding class

RPD for Welding are designated by WE followed by the numeric designation for specific welding application. Currently, only one numeric designation has been identified; see Table 7 and Table I.1.

Table 7 — Welding classes

Class	Application	Minimum protection class and minimum work rate class
WE1	Welding	≥PC1 ≥W1

7.3.3.12.8 Escape class

RPD for Escape only are designated by ES followed by the specific application and the duration in minutes. Escape RPD can be filtering or supplied breathable gas RPD.

Escape general filtering RPDs are designated by ES followed by the gas type, e.g. ES OV (t).

Escape general, supplied breathable gas RPDs are not designated for a specific contaminant; see Table 8, Table 9 and Table I.1.

Table 8 — Escape classes

Class	Application	Duration min	Minimum protection class
ES MN t	Mining Escape	"t[b]"	≥PC3
ES MA t	Marine Escape	"t"	≥PC3
ES CBRN t	CBRN Escape	"t"	≥PC4
ES FF t	Escape from fire	"t"	≥PC3
ES XX[a] t	Escape general filtering RPD	"t"	≥PC3
ES t	Escape general supplied breathable gas RPD	"t"	≥PC3

[a] XX is the type of gas filter.

[b] The "t" values are listed in Table 10.

Table 9 — Designated durations

"t" — Designated duration min	Steps
5 to 30 (5, 10, 15, 20, 25, 30)[a]	5 minutes
30 to 60 (40, 50, 60)	10 minutes
60 to 120 (90, 120)	30 minutes
120 and above (180, 240.....)	60 minutes

[a] 15-minute minimum for ES CBRN.

7.4 Fit testing

7.4.1 General

Assessment of fit is an essential part of an effective respiratory protection programme. Tight-fitting respiratory interfaces, those that have a face or neck seal (classes bT, cT and dT), will not provide optimum performance if they do not fit and therefore need to be fit tested on the individuals who will wear the RPD. All other respiratory interfaces do not require a fit test.

All wearers of tight-fitting RPD shall pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT) as described in ISO 16975-3. The fit test shall be performed prior to the RPD being first issued to the wearer during the selection process and shall be conducted by a competent person. Before being fit tested, the wearer being fitted shall be trained on proper RPD donning and the purpose and procedures for the fit test. The wearer being fit tested shall be free from hair in the area of the sealing surface of the RPD during the fit test and subsequent RPD use.

National or local regulations can require periodic repeat fit testing. It is recommended that it be done at least annually.

All tight-fitting respiratory interfaces shall be fit tested in the unassisted filtering mode regardless of the mode of operation in which the RPD is used. For breathable gas RPD and assisted RPD, this can be accomplished by temporarily converting the respiratory interface into a filtering RPD by using appropriate filters, or by using an unassisted filtering RPD with an identical respiratory interface sealing surface. Either qualitative or quantitative fit testing methods may be used where appropriate. Qualitative fit testing may only be used where a required fit factor (RFF) of 100 or less is needed. Quantitative fit testing shall be used when the required fit factor is greater than 100. The quantitative fit factor (QNFF) measured shall be equal to or greater than the RFF.

The RFF determines which fit test methods are acceptable.

— For RFF, up to 100 QLFT or QNFT may be used.

— For RFF from 1 000 to 2 000, only QNFT may be used.

Table 10 and Table 11 summarize the RFF needed for tight-fitting RPD and the acceptable fit testing methods.

Table 10 — Required fit factors (RFF)

PC class	Required fit factor
6	2 000
5	2 000
4	1 000
3	100[a]
2	100[a]
1	100[a]

[a] Validated FF of QLFT.

Table 11 — Acceptable fit testing methods

PC class	QLFT	QNFT
6	No	Yes
5	No	Yes
4	No	Yes
3	Yes	Yes
2	Yes	Yes
1	Yes	Yes

NOTE Further information on fit testing is given in ISO 16975-3.

7.5 Training

7.5.1 General

All people involved in the RPD programme shall be adequately trained. The training content, method, and frequency should be matched to the inhalation exposure risks involved and the complexity of the RPD used.

Records of training shall be retained (see 7.10).

NOTE National or local regulations may specify training programme content and training frequency, e.g. annually.

7.5.2 Training programme elements

7.5.2.1 RPD wearer

The training programme shall include the following elements, where applicable:

a) RPD programme policies;

b) need for RPD;

c) hazards, risks and the consequences of not wearing the RPD;

d) type of RPD being provided;

e) how the RPD works;

f) pre-use checks;

g) correct donning, use and doffing;

h) cleaning and maintenance;

i) correct storage;

j) reporting of RPD malfunctions;

k) cautions, limitations and capabilities of the RPD;

l) medical signs/symptoms that prevent effective use of RPD;

m) other special training needs — special use, etc;

n) including emergency situations.

7.6 Use

7.6.1 General

RPD shall only be used in the configuration(s) permitted by the manufacturer, in accordance with the manufacturers' instructions for use and the training received.

If the wearer smells, tastes or otherwise senses a contaminant, or determines that the RPD is not functioning properly, the wearer shall exit the hazardous area immediately.

7.6.2 Pre-use checks

All pre-use checks shall be carried out in accordance with the manufacturer's instructions and the training received.

Pre-use checks shall include the following, where applicable:

a) inspect the RPD integrity;

b) where filters are used, check that the filters are the right type and class, fitted correctly, not damaged, are within shelf life and have not reached the end of their service life;

c) for assisted RPD, check that the manufacturer's minimum design flow rate is supplied and/or the manufacturer's minimum design condition is fulfilled;

d) for supplied breathable gas RPD, check for the correct supply pressure and/or flow rate;

e) conduct a wearer seal check each time a tight-fitting RPD is donned;

f) where the RPD has integrated communication equipment, check for correct operation.

RPD shall only be used when all pre-use checks are satisfactory.

7.6.3 Filter change schedule (filtering RPD)

The filter(s) shall be changed in accordance with the established filter change schedule.

NOTE For further information, see 7.3.3.7.

7.6.4 Breathable gas quality

7.6.4.1 General

For supplied breathable gas RPD, the supply system shall deliver breathable gas in sufficient quality, quantity and at the required pressure for each wearer.

The quality of the breathable gas shall be checked regularly by a competent person and records kept.

Where national or local regulations exist for the breathable gas quality, then these shall be met.

7.6.4.2 Breathable air for low pressure supplied breathable gas RPD

The minimum requirements for breathable air quality given below are applicable to low pressure systems unless otherwise specified by national or local regulations or standards.

When measured at normal atmospheric conditions (1 013 hPa and 20 °C), the following shall apply:

— oxygen content with a volume fraction of 19,5 % to 23,5 %;

— carbon monoxide ≤ 10 ml/m^3;

— carbon dioxide ≤ 1 000 ml/m^3;

— volatile organic compounds (as methane equivalent) ≤ 25 ml/m^3;

— oil, particulate and condensate ≤ 2 mg/m^3;

— odour — no significant odour or taste;

— water content.

The dew point shall be sufficiently low to prevent condensation and freezing. Where the RPD is used and stored at a known temperature, the pressure dew point shall be at least 5 °C below the likely lowest temperature

7.6.4.3 Breathable air for medium and high pressure supplied breathable gas RPD

The minimum requirements for breathable air quality given below are applicable to medium and high pressure systems, unless otherwise specified by national or local regulations or standards.

When measured at normal atmospheric conditions (1 013 hPa and 20 °C), the following shall apply:

— oxygen content with a volume fraction of 19,5 % to 23,5 %;

— carbon monoxide ≤ 5 ml/m^3;

— carbon dioxide ≤ 500 ml/m^3;

— volatile organic compounds (as methane equivalent) ≤ 25 ml/m^3;

— oil, particulate and condensate ≤ 0,5 mg/m^3;

— odour — no significant odour or taste;

— water content.

The dew point shall be sufficiently low to prevent condensation and freezing. Where the RPD is used and stored at a known temperature, the pressure dew point shall be at least 5 °C below the likely lowest temperature. Where the conditions of usage and storage of the compressed air supply is not known, the pressure dew point shall not exceed −11 °C to which any part of the system is exposed.

The maximum water content of air measured at atmospheric pressure given in Table 12 shall be used.

Table 12 — Water content of compressed air[a]

Nominal pressure MPa	**Maximum water content of air measured at atmospheric pressure and 20 °C** mg/m³
0,5	290
1,0	160
1,5	110
2,0	80
2,5	65
3,0	55
4,0	50
4,0 to 20,0	≤50
>20,0	≤35

Application of Table 12 will ensure compliance with this part of ISO 16975 and is the preferred approach. An alternative method can be used to take account of local ambient temperatures but the calculations are complex. A competent person would need to carry out a detailed risk assessment in order to ascertain minimum requirements.

NOTE Further information on compressed air is given in Annex E.

[a] Table 13 to Table 16 have been taken from Reference [7].

The water content of compressed air in relation to cold environment is given in Table 13.

Table 13 — Water content of compressed air in relation to cold environment

Humidity in air mg/m³		**Δ Pressure** (MPa) **50**	**35**	**30**	**20**	**<1**
Ambient Temperature (°C)	−5 °C	130	170	220	220	220
	−15 °C	40	50	75	90	220
	−25 °C	15	20	25	35	220
	−32 °C	10	15	15	20	220
	−40 °C	5	10	10	15	110
	−50 °C	5	5	5	5	30

7.6.4.4 Breathable oxygen for supplied breathable gas RPD

Where oxygen is a source for the RPD, the purity and contaminant levels shown in Table 14 apply.

Table 14 — Composition of breathing oxygen

Component	Concentration at atmospheric pressure and 20 °C
Oxygen	>99,5 %
Water	≤15 mg m^{-3}
Carbon dioxide	≤5 ml m^{-3} (ppm)
Carbon monoxide	≤1 ml m^{-3} (ppm)
Oil	≤0,1 mg m^{-3}
Total volatile non-substituted hydrocarbons (vapour or gas) as methane equivalent	≤30 ml m^{-3} (ppm)
Total chlorofluorocarbons and halogenated hydrocarbons	≤2 ml m^{-3} (ppm)
Other non-toxic gases[a]	<0,5 %

[a] These gases include argon and all other noble gases (see Reference [11]).

7.6.4.5 Breathable gas mixtures for supplied breathable gas RPD

7.6.4.5.1 General

Where gases specified in Table 15 and Table 16 are mixed to produce breathable gas, the resultant gas mixtures shall be within the limit values as given for the particular gas mixture, shown in Table 15 and Table 16.

As the purity and contaminant levels of the gases used for mixing are specified in Table 15 and Table 16, it is only the ratio of the mixing that needs to be confirmed. Therefore, post mixing, the oxygen content shall be tested to confirm that the correct mixture has been achieved.

7.6.4.5.2 Oxygen and nitrogen gas mixtures for supplied breathable gas RPD

Where oxygen and nitrogen gas mixtures are a source for the RPD, the purity and contaminant levels shown in Table 15 apply.

Table 15 — Composition of oxygen and nitrogen gas mixtures

Component	Concentration at atmospheric pressure and 20 °C
Oxygen mixtures containing <20 % by volume ≥20 % by volume	 (Stated[a] ± 0,5[b]) % (Stated[a] ± 1,0[b]) %
Nitrogen	Remainder
Water	≤15 mg m^{-3}
Carbon dioxide	≤5 ml m^{-3} (ppm)
Carbon monoxide	≤3 ml m^{-3} (ppm)
Oil	≤0,1 mg m^{-3}
Total volatile non-substituted hydrocarbons (vapour or gas) as methane equivalent	≤30 ml m^{-3} (ppm)
Other non-toxic gases[c]	<1 %

[a] Percentage as stated by the supplier.

[b] Tolerance value is a percentage of the total gas mixture.

[c] These gases include argon and all other noble gases (see Reference [11]).

7.6.4.5.3 Oxygen and helium gas mixtures for supplied breathable gas RPD

Where oxygen and helium gas mixtures are a source for the RPD, the purity and contaminant levels shown in Table 16 apply.

Table 16 — Composition of oxygen and helium gas mixtures

Component	Concentration at atmospheric pressure and 20 °C
Oxygen mixtures containing ≤10 % by volume >10 % to ≤20 % by volume >20 % by volume	 (Stated[a] ± 0,25[b]) % (Stated[a] ± 0,5[b]) % (Stated[a] ± 1,0[b]) %
Helium	Remainder
Water	≤15 mg m^{-3}
Carbon dioxide	≤5 ml m^{-3} (ppm)
Carbon monoxide	≤0,2 ml m^{-3} (ppm)
Oil	≤0,1 mg m^{-3}
Total volatile non-substituted hydrocarbons (vapour or gas) as methane equivalent	≤30 ml m^{-3} (ppm)
Hydrogen	≤10 ml m^{-3} (ppm)
Other non-toxic gases[c]	<0,5 %

a Percentage as stated by the supplier.

b Tolerance value is a percentage of the total gas mixture.

c These gases include argon and all other noble gases (see Reference [11]).

7.7 Maintenance Procedures

The RPD maintenance procedures shall address the following, as appropriate:

a) inspection;

b) decontamination;

c) cleaning and/or disinfecting;

d) routine maintenance (including performance checking);

e) filling of breathable gas cylinders;

f) repair;

g) disposal.

These procedures shall be established and carried out by competent persons in accordance with the manufacturer's instructions.

The frequency of inspection shall be at least monthly or in accordance with national or local regulations.

The inspection for hydrostatic test date shall be conducted prior to filling of any breathable gas cylinder. If out of date, the cylinder shall not be filled.

RPD, other than those designated for single shift use only, shall be cleaned and disinfected at the following intervals.

— RPD for the exclusive use of an individual shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition.

— RPD used by more than one individual shall be cleaned and disinfected before being worn by different individuals.

— RPD used in fit testing and training shall be cleaned and disinfected after each fit test.

RPD that have undergone decontamination, reconditioning, leak testing and/or reassembly shall be inspected and recommended for reuse. Repairs or adjustments to RPD shall be made only by competent persons and shall use only the RPD manufacturer's parts designed for the RPD.

Records of the maintenance shall be retained (see 7.10).

NOTE Further information is given in Annex G.

7.8 Storage

7.8.1 General

All RPD shall be stored in accordance with the information supplied by the manufacturer in order to prevent contamination, damage and deterioration of the RPD.

7.8.2 Escape devices

Escape RPD placed in work areas shall be quickly accessible at all times, and the storage cabinet, container or holder shall be clearly marked.

7.9 Programme review

The RPD Programme administrator shall ensure that the programme is reviewed by a competent person at a frequency appropriate to the hazard and complexity of the RPD programme to ensure that the programme is being implemented effectively.

The programme elements shall be reassessed when there has been a change in conditions.

The frequency of the review shall be at least annually or in accordance with national or local regulations.

Where medical checks and biological monitoring are performed, the information derived can be used to evaluate the effectiveness of the respiratory protection programme.

NOTE Further information is given in Annex G.

7.10 Records and record keeping

Records and record keeping are essential elements of the RPD programme.

Records required by this part of ISO 16975 shall be maintained for a time period appropriate to the toxicity and latency of diseases associated with the contaminants concerned and at least for the minimum period required by any national or local regulations or standards.

The following shall be recorded:

a) risk assessment, including all results from the hazard assessment, and the information used in the adequacy and suitability assessment;

b) the selection procedure, and the RPD selected;

c) any statement of the fitness to wear RPD;

d) breathable gas quality checks;

e) the date, location and type of training received, details of the type(s) of RPD for which training has been received, and by whom;

f) the date, inspection details, identification of the RPD and remedial action taken (if any);

g) fit test records;

h) the RPD programme review.

Annex A
(informative)

Types and components of RPD

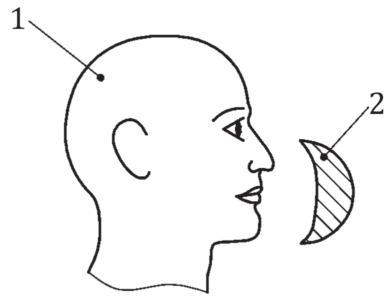
A.1 General

A.1.1 Modes of RPD

There are two modes of RPD — filtering RPD and supplied breathable gas RPD.

A.1.2 Filtering RPD

Filtering RPD contains at least a respiratory interface and filter(s); these components can be integral or separate. Filtering RPD remove (by, e.g. filtration, adsorption or chemical reaction) hazardous substances present in the ambient air before being inhaled by the wearer. The air is drawn through the filter(s) either by the wearer's inhalation action or with the assistance of a blower unit.

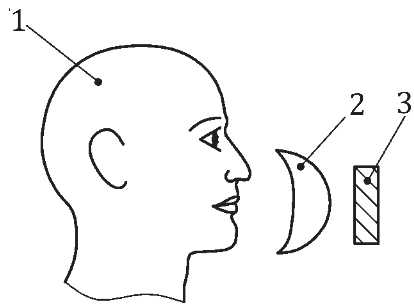


Key

1 wearer

2 respiratory interface with integral filter

Figure A.1 — Schematic diagram of respiratory interface with integral filter



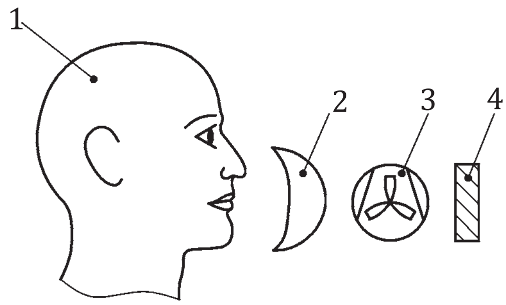
Key

1 wearer

2 respiratory interface

3 filter

Figure A.2 — Schematic diagram of respiratory interface with separate filter



Key

1 wearer
2 respiratory interface
3 blower unit
4 filter

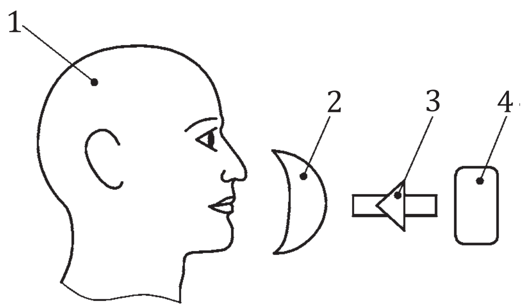
Figure A.3 — Schematic diagram of respiratory interface and separate or integral blower unit and filter

A.1.3 Supplied breathable gas RPD

Supplied breathable gas RPD contains at least a respiratory interface and a means for supplying uncontaminated breathable gas to the wearer. This can be achieved by a number of means.

Self-contained RPD provides the highest independence for the wearer mobility by using pressurized breathable gas in valved cylinders or generated by a chemical reaction during use, as an integral part of the RPD.

Other supplied breathable gas RPD use a gas source that is not part of the RPD nor carried by the wearer. The breathable gas can be supplied by a compressor located outside the hazardous area, from pressurized cylinders or from an uncontaminated area by a blower or drawn by the breathing action of the wearer.



Key

1 wearer
2 respiratory interface
3 breathable gas supply chain
4 breathable gas source

Figure A.4 — Schematic diagram of respiratory interface and separate or integral breathable gas regulation and source

A.2 Main components

A.2.1 Respiratory interfaces tight- and loose-fitting

The primary purpose of the respiratory interface is to form a barrier between the wearer's respiratory tract and the contaminated environment. The respiratory interface may or may not be separable from the rest of the RPD; however, it is always part of the complete RPD. Some complete RPD includes respiratory interfaces and filters with standardized connectors according to ISO 17420-3 to allow interchangeability of filters between different RPD manufacturers.

There are two types of respiratory interface: tight-fitting and loose-fitting.

a) Tight-fitting respiratory interfaces rely on a good seal between the RPD and the wearer.

b) Loose-fitting respiratory interfaces rely on sufficient air being provided to prevent hazardous substances leaking in to the area covering the face.

Respiratory interfaces are classified by barrier lines and type, tight-fitting or loose-fitting (see Table A.1).

Table A.1 — Respiratory interface classes

Class[a]	Barrier line	Type
aT	Mouth only	Tight-fitting
bT	Mouth and nose	Tight-fitting
bL	Mouth and nose	Loose-fitting
cT	Face	Tight-fitting
cL	Face	Loose-fitting
dT	Head	Tight-fitting
dL	Head	Loose-fitting
eT	Body	Tight-fitting
eL	Body	Loose-fitting

[a] Not all classes of respiratory interfaces may be available.

A.2.2 Examples of respiratory interfaces

A.2.2.1 Mouth-only — Class aT

This class of tight-fitting mouth-only respiratory interface has commonly been known as a "mouthpiece" or "mouthbit". To avoid breathing through the nose, a nose clip is necessary. In many cases, the mouthpiece is equipped with a head harness.

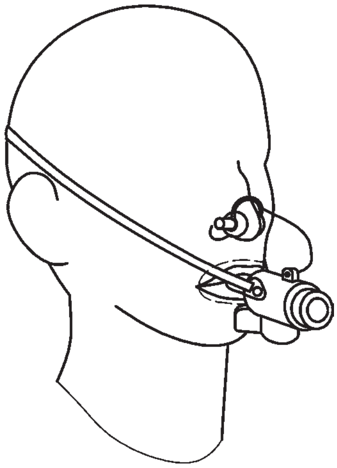


Figure A.5 — Example of a respiratory interface inserted into the mouth, with nose clip in position — Class aT

A.2.2.2 Mouth and nose — Class bT

Tight-fitting respiratory interfaces covering the mouth, nose and chin area have been commonly known as “half masks”. Tight-fitting respiratory interfaces covering the mouth and nose only have been known as “quarter masks” (not shown).

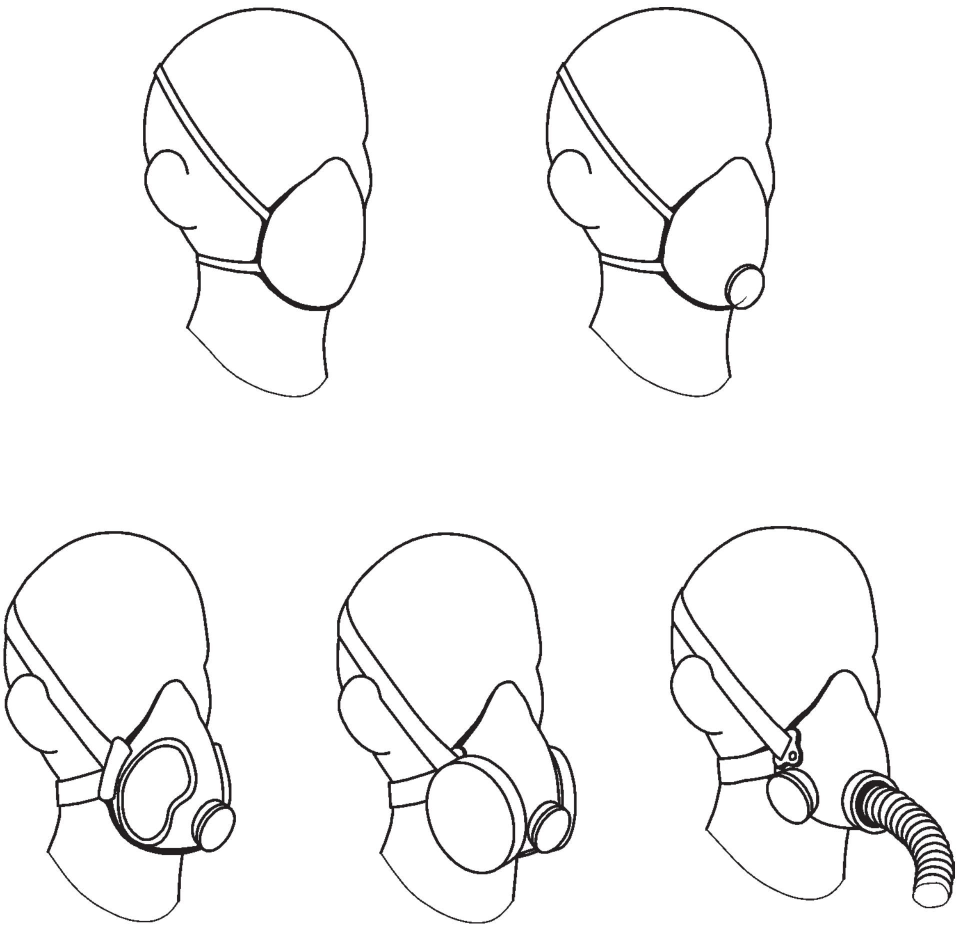


Figure A.6 — Examples of respiratory interfaces covering the mouth, nose and chin — Class bT

A.2.2.3 Face — Class cT and Class cL

Respiratory interfaces covering the entire face can be either tight-fitting (see Figure A.7) or loose-fitting (see Figure A.8). When the respiratory interface is tight-fitting, it is commonly known as "full face mask" or "full facepiece". In both cases, the wearer's eyes are protected from the contaminated environment.

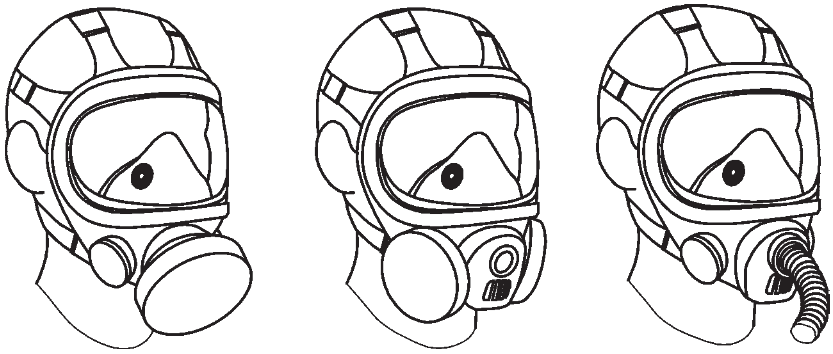


Figure A.7 — Examples of tight-fitting respiratory interfaces covering the face — Class cT

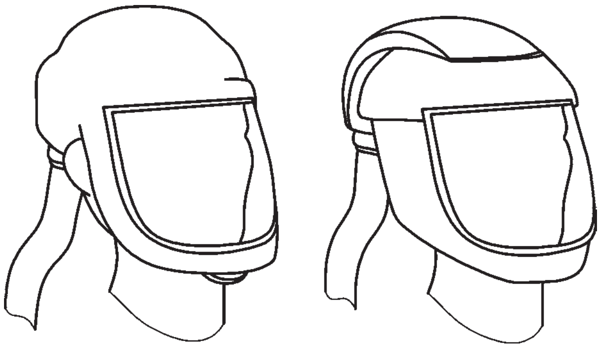


Figure A.8 — Examples of loose-fitting respiratory interfaces covering the face — Class cL

A.2.2.4 Head — Class dL and Class dT

Respiratory interfaces covering the entire head can be either loose-fitting or tight-fitting (see Figure A.9 and Figure A.10), and have been commonly known as "hoods" or "helmet". Hoods and helmets that are tight-fitting usually seal around the wearer's neck.

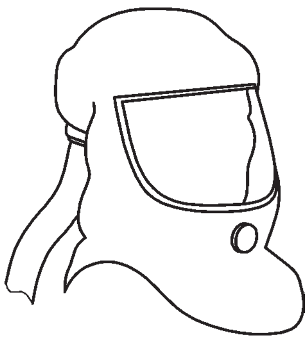


Figure A.9 — Examples of loose-fitting respiratory interfaces covering the head — Class dL

Figure A.10 — Examples of tight-fitting respiratory interfaces covering the head — Class dT

A.2.2.5 Head and part or all of the body — Class eL and Class eT

Respiratory interfaces covering the head and additional parts of the body have been commonly known as “blouses” or “suits”.

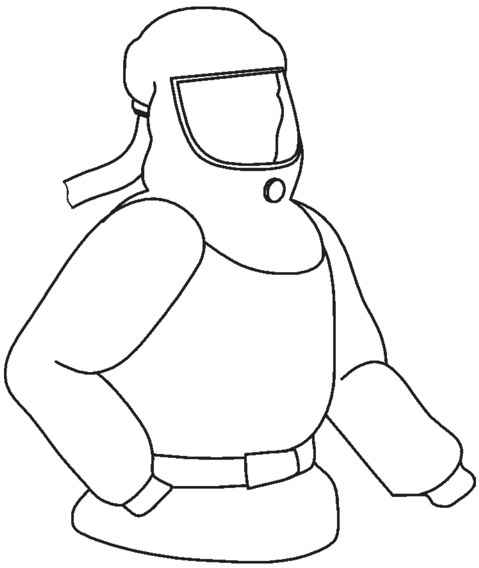


Figure A.11 — Example of respiratory interface covering part of the body — Class eL

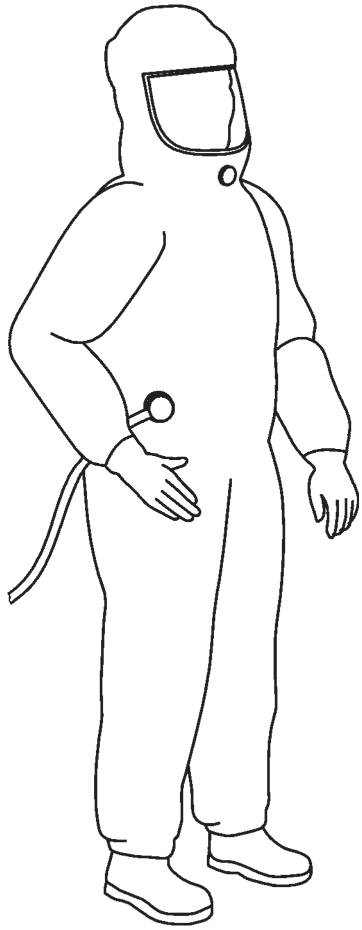


Figure A.12 — Example of respiratory interface covering all of the body — Class eT

A.2.3 Filters

A.2.3.1 General

Filtering RPDs have two methods of operation — particle filtration and gas/vapour filtration.

a) Particle filters are intended to remove solid and liquid particles (e.g. dusts, fibres, metal fumes and mists).

b) Gas filters are intended to remove gases and vapours.

Combination filters are intended to remove both particles and gases/vapours.

A.2.3.2 Particle filters

Particle filters trap and hold particles from the air flowing through them. As a filter is used, it becomes loaded with the contaminant and eventually clogs. This makes it difficult for the air to flow through the filter indicating that the filter should be replaced.

There are five classes of particle filters based on their efficiencies from low (class F1) to high (class F5).

A.2.3.3 Gas filters

Gas filters remove gases/vapours in the air passing through the filter by various mechanisms depending upon the gaseous contaminants for which the filter is designed.

Gas filters are available for use against groups of contaminants such as organic vapours or specific contaminants, such as mercury, and are available in different capacities. Gas filters are also available as multi-type gas filters which can be used against more than one type or group of contaminants.

As a gas filter is used, it becomes saturated with the gaseous contaminant and will eventually no longer be able to remove the contaminant — this is referred to as "breakthrough" and indicates the end of service life of the filter. It is important that the gas filter be changed before breakthrough occurs; otherwise, the wearer will be exposed to the contaminant.

Relying on the smell or taste of the gaseous contaminant to detect breakthrough is not suitable as the primary means of determining end of service life. The wearer's senses may be affected for a variety of reasons or the contaminant's warning properties may not be detectable at a safe level. However, any smell or taste of the gaseous contaminant detected by the wearer should be regarded as breakthrough. Breakthrough may occur earlier in the presence of gas mixtures or when used against different gases sequentially, than for a single gas. Certain contaminants can migrate through the filter during storage. This can lead to earlier than the expected breakthrough when the filter is next used. For this reason, some gas filters are designated for single shift use only.

NOTE Seek manufacturer's guidance on filter service life.

A.2.3.4 Combination filters

Combination filters contain both a particle filter and a gas filter.

Information given in A.2.3.2 and A.2.3.3 apply.

A.2.3.5 Breathable gas sources

Breathable gas can be supplied from a number of sources.

A.2.3.5.1 Self–contained sources

Supplied breathable gas RPD that have a fixed volume of breathable gas (self-contained) are classified by the volume of breathable gas available and are designated by the letter S, followed by the volume in litres corresponding to the capacity designated in litres rounded down to increments of 150 L up to 900 L and increments of 300 L above 900 L.

Typical examples of self-contained sources are as follows.

Breathable gas cylinder(s)

These sources contain a finite supply of compressed breathable air, compressed oxygen or breathable gas mixtures.

Chemical oxygen

These sources provide a fixed volume of breathable gas to the wearer by means of a chemical reaction. The chemical reaction generates heat inside the breathing circuit which increases the inhalation temperature. The chemicals typically used in these RPDs are highly reactive with water and therefore need to be isolated from the environmental conditions.

Liquefied-breathable gas

These sources provide a fixed volume of breathable gas to the wearer from oxygen or air stored in liquid form.

A.2.3.5.2 External supply sources

Supplied breathable gas RPD, which are classified SY, have an external supply of breathable air.

Typical examples of external supply sources are as follows.

Compressed breathable air system

This system provides a continuous source of breathable air from a compressor to the RPD.

NOTE For further information, see Annex E.

Ambient air system

This system provides air to the wearer directly from a remote source of ambient air.

A.2.4 Combined RPD

Combined RPDs are RPDs that have both filtering and breathable gas supply modes. A combined RPD is a supplied breathable gas RPD with a filter attached to the RPD that

— provides protection in the event that the breathable gas supply fails, or

— permits the wearer to change the mode of operation to allow transit to and from a compressed breathable gas source.

These RPDs are designed to be used in either a filtering or breathable gas supply mode but not both modes together.

The change from the breathable gas supply mode to the filtering mode may be either automatic or by the wearer's intervention.

For automatic change over RPD, when breathable gas is supplied to the RPD, the filtration flow path is sealed automatically so air does not pass through the filter. When the breathable gas supply is interrupted, the filtration flow path is opened and air passes through the filter, allowing the wearer to breathe without removing the RPD.

A.2.5 Multifunctional RPD

Multifunctional RPDs are capable of operating within its mode of operation by using different methods, e.g. assisted filtering RPD, power on/power off, or compressed breathable gas system (class SY) with compressed breathable RPD (class Sxxxx).

The limitation for multifunctional RPD is the same as described in A.3.1 to A.3.4.

A.3 Limitations

A.3.1 General

All types of RPDs have limitations for use and are described in general terms in this Clause. However, it is always necessary to refer to the manufacturer's instructions for use for specific limitations relating to the specific RPD.

A.3.2 Limitations of respiratory interfaces

Respiratory interfaces have different limitations for use depending upon whether they are of a tight or loose-fitting design.

Loose-fitting respiratory interfaces do not seal to the wearer's skin and therefore can only be used with RPD that actively supply the breathable gas to the respiratory interface. They rely on enough breathable gas being supplied to the wearer to prevent ambient contaminants leaking into the respiratory interface as the wearer breathes and moves about. If the wearer's demand for air is higher than the supplied flow of breathable gas, there is the risk that contaminated air from the surrounding atmosphere is inhaled by the wearer.

Typical RPD with loose-fitting respiratory interfaces are assisted RPD and supplied breathable gas RPD. Tight-fitting respiratory interfaces form a tight seal to the wearer's skin, usually of the face or neck. It is essential that the sealing surface between the respiratory interface and the skin is not interrupted by facial hair, scars or eyewear, as this may cause additional leakage (inward or outward). Typical examples are filtering facepieces, a half mask with a filter and a self-contained breathing apparatus. Speaking may temporarily break the tight-fitting seal, resulting in a potentially higher leakage for those RPD. Speaking should not be done with a mouthpiece, and a mouthpiece should always be used with a nose clip.

A.3.3 Limitations of filtering RPD

Filtering RPD purify the ambient air to be breathed by the wearer using filters to remove contaminants. They do not protect against oxygen deficiency or provide oxygen. Therefore, they are not suitable for use in actual or potential oxygen-deficient atmospheres, such as confined spaces. Filtering RPD is not suitable for entry or use in IDLH atmospheres. Filtering RPD classified as escape RPD can be used for escape from IDLH atmospheres.

Filtering RPD can only be used against known contaminants which the filter is able to remove from the ambient air. Filtering RPD is only suitable for use up to its maximum use concentration for the contaminant(s).

Gas filtering RPD cannot be used against particles; particle filtering RPD cannot be used against gaseous contaminants. However, there are combination filtering RPD, which can filter both gases and particles.

Gas filters (including combination filters) are available in a number of capacities; however, the actual service life of gas filters depends on many factors including its designated capacity, the contaminant, the concentration, humidity, temperature and the work rate, i.e. the flow rate of air through the filter. A filter change schedule has to be calculated in advance according to the risk assessment.

Particle filtering RPD also have limitations to filter contaminants from the ambient air and need to be changed prior to their end of service life. Due to clogging effects, the breathing resistance might increase during use.

A.3.4 Limitations of supplied breathable gas RPD

A limitation for self-contained supplied breathable gas RPD is the limited capacity of the breathable gas source. The minimum volume of breathable gas required for the duration of the task needs to be calculated in advance according to the risk assessment. A specific work rate sequence has to be determined and this will depend upon the expected work profile. With these given work rates and the maximum capacity of the source, the minimum volume of breathable gas required can be calculated and the work task planned accordingly.

Supplied breathable gas RPD that rely on a supply of breathable air from a compressor require air at a pressure and volume as specified by the RPD manufacturer.

Supplied breathable gas RPD that rely on a supply of breathable air from remote breathable gas cylinders have the same limitations as a self-contained breathable gas source.

Where the RPD incorporates a hose (class SY RPD), this may restrict the wearer's mobility.

NOTE Further information is given in D.3.2.

When performing at high work rates, RPD whose oxygen supply is generated from chemical reactions may have increased inhalation temperatures that may be unacceptably high for some wearers.

A.3.5 Limitations of combined RPD

Since combined RPD can operate in both modes of operation, the limitations for the individual modes of operation are valid.

Annex B
(informative)

Hazard assessment for RPD selection

B.1 General

Hazard assessment is essential to the process of selecting correct respiratory protection and should be performed by competent personnel. Hazard assessment should be carried out before commencing work and reviewed appropriately. Work processes need to be re-evaluated when the work conditions change. The hazard assessment identifies the type and level of respiratory hazard present in the workplace. When this information is compared to RPD capabilities and limitations, an appropriate RPD can be selected for the hazard(s). The hazard assessment flow chart in 7.2 identifies basic information needed and a logical order for obtaining and using that information.

B.2 Gas or vapour contaminants

B.2.1 General

For contaminants in the gas or vapour phase, RPD with gas filters or a breathable gas supplying RPD may be acceptable.

To determine if a gas filter RPD is appropriate, the physical and chemical property information is used. Several gas filter types are available covering a range of gaseous hazards. Available gas filters and their effectiveness for removing the contaminants of interest need to be considered in order to make an appropriate selection.

B.2.2 Gas filter change schedule

When a gas filter is selected, a change schedule for replacing the filter before breakthrough occurs should be established. This can be accomplished with service life estimators or information from the gas filter manufacturer.

Gas filter service life data can be used to set change schedules for ensuring the replacement of the gas filter before breakthrough occurs. If the service life is determined to be too short for the task duration, a gas filtering RPD with a higher capacity should be considered. If the service life of the highest capacity is still too short for the task duration, then breathable gas supplying RPD should be selected.

B.3 Particulate contaminants

For particulate contaminants, RPD with particle filters or a breathable gas supplying RPD may be acceptable.

To determine if a particle filtering RPD is appropriate, the physical, chemical and biological (if applicable) property information is used.

B.4 Combination gas/vapour and particulate contaminants

For contaminants in both the gaseous and particulate phase, combination filter RPD or a breathable gas supplying RPD may be acceptable. Considerations for the use of particle and gas filters are appropriate for these RPD.

Annex C
(informative)

Adequacy assessment

C.1 Methods for the determination of the minimum required RPD protection level (PL)

C.1.1 General

The minimum protection level required can be determined by one of two methods.

C.1.2 Method 1 — Calculation method for the determination of the minimum required PL

C.1.2.1 General

In selecting a specific RPD for use, the RPD protection level should be sufficient to reduce the exposure to less than the occupational exposure limit (OEL). The minimum protection level required is determined by firstly calculating the hazard ratio (HR).

HR can be calculated using Formula (C.1):

$$HR = \frac{CC_{out}}{PC_{in}} \quad (C.1)$$

where

CC_{out} is the contaminant concentration outside the RPD;

PC_{in} is the permissible concentration inside the respiratory interface;

NOTE The permissible concentration is usually the occupational exposure limit value.

To calculate the HR, it is necessary to know the foreseeable worst-case concentration(s) of the airborne contaminant(s) and the relevant occupational health regulatory requirements, exposure limits or the safe exposure levels applying to these contaminant(s).

RPD with a protection level greater than the hazard ratio should be selected in order to reduce the wearer's exposure to below the OEL.

Example a): Ambient workplace air sampling indicates airborne concentrations for chemical X ranging between 6 mg/m^3 and 8 mg/m^3. The OEL for chemical X is 1 mg/m^3. To calculate the HR, one should use the highest concentration; in this case, 8 mg/m^3. Using Formula (C.1), an HR of 8 is calculated (8 mg/m^3 divided by 1 mg/m^3), and therefore, an RPD that has a protection level of 8 or greater should be selected.

C.1.2.2 Calculation of hazard ratio for two or more contaminants

The HR should be determined for each substance when more than one is present. When two or more contaminants are present, consideration should be given to assess potential additive or synergistic effect(s) of exposure rather than considering each substance individually. If the substances do not have similar toxicological effects on the same organ system (e.g. liver, kidney), the highest HR from all the *HR*s of the individual components should be used for the respirator selection process. See example (b).

When two or more substances have a similar toxicological effect on the same body organ system, their combined effect should be considered. This can be done by the use of an additive mixture formula.[8] If the additive mixture formula value is less than unity, RPD is not required unless required by national or local regulation. If the sum of this formula is greater than one, that value is the protection level needed for that mixture. See example (c).

When multiple contaminants are present that do not have additive health effects, the HR should be calculated for each contaminant and the highest HR should be used to determine the required PL.

Example b): Chemical X causes pneumoconiosis and chemical Y causes liver damage. Chemical X and chemical Y do not have similar toxicological effects. The calculated HR for chemical X is 8 and the calculated HR for chemical Y is 13. In this example, RPD with a protection level of 13 or greater is required that is effective against both chemicals. Using Figure 4, an RPD with a protection class of PC3 or higher should be selected.

Example c): A worker's airborne simultaneous exposure to three solvents was monitored for a full shift. In Table C.1, the sampling results are indicated.

Table C.1 — Sampling results

Chemical	**Full shift sampling results** ppm	**OEL-TWA** ppm
A	300	500
B	110	200
C	90	200

All three substances cause irritation effects on the respiratory system, so the toxicological effects would be considered additive. The mixture formula for additive toxicological effects is determined by the sum of concentrations divided by the OEL.

The hazard ratio can be calculated using Formula (C.2):

$$\mathrm{HR} = \sum_{n=1}^{N} \frac{C_n}{T_n} \tag{C.2}$$

where

C_n is the observed concentration;

T_n is the corresponding OEL;

N is the total number of substances.

Using the values from this example, we get the following results:

$$\frac{300}{500}+\frac{110}{200}+\frac{90}{200}=0{,}6+0{,}55+0{,}45=1{,}6$$

Because 1,6 is greater than 1, a hazardous exposure exists, and therefore, respiratory protection is required. This result indicates that the exposure is 1,6 times the exposure limit, thus a protection level of greater than 1,6 is required. Using the value obtained for the HR, identify RPD, which has a protection level equal to or greater than the HR value. The next step is to identify the most suitable RPD, taking into account the factors associated with the working environment, the task and the wearer and compatibility with other PPE to be worn in conjunction with the RPD.

NOTE Compare exposures to relevant occupational exposure limits, e.g. time-weighted average, short term and ceiling limits.

The possibility of synergistic effects should be assessed by a qualified person when more than one contaminant is present.

C.1.3 Method 2 — Control banding method for the determination of the minimum required PL

C.1.3.1 General

This method is provided as an alternative approach to determine the minimum required protection level.

Instead of relying on the determination of the foreseeable worst-case concentration(s) of the airborne contaminant(s) and knowledge of the relevant occupational health legislative requirements, occupational exposure limits (OELs) or the safe exposure levels, this approach is acceptable for the control of inhalation exposure, i.e. based on control banding.

This method utilizes the hazard statements associated with the chemical substance(s) being used or generated, combined with the potential for inhalation exposure based on the amount of substance used and its dustiness or volatility.

This procedure does not require the measurement of the airborne inhalation hazard and therefore may be suitable for situations where the actual measurement of the airborne inhalation hazard is impractical.

For certain materials, the minimum PL may be specified by local or national regulations.

This method is applicable for the determination of the minimum required PL up to 2 000. For levels of exposure requiring a higher PL, the method shown in C.1.2 should be used.

C.1.3.2 Hazard Statement Code

In many countries, national regulations require suppliers to give information about the chemicals they sell. Information is given on the hazardous properties of the chemical. Some countries utilize a “classification” number and a description of the level of danger associated to the chemical in simple terms. This classification number is referred to as a Hazard Statement Code.

Examples of Hazard Statement Codes are as follows.

— H335 = may cause respiratory irritation;

— H332 = harmful if inhaled;

— H331 = toxic if inhaled.

After a chemical is classified according to its health effects, the appropriate Hazard Statement Code is provided on the container label or separately with the chemical, along with other information that may be required by national or local regulations. More than one hazard statement code may be present.

NOTE The classification of hazardous substances is well-established in Europe, following the implementation of the European Regulation 1272/2008 on the Classification, Labelling and Packaging of Substances and Mixtures (CLP Regulations).[7]

C.1.3.3 Health Hazard Groups

For chemicals that have an effect on the respiratory system or that may cause sensitization or cancer via the inhalation route, the relevant Hazard Statements have been grouped according to their levels of toxicity (hazard). There are five groups referred to as “Health Hazard Groups” (HHG) and, for ease of reference, can be considered to be as follows.

— HHG — A “irritant”;

— HHG — B “harmful”;

— HHG — C “toxic”;

— HHG — D “very toxic”;

— HHG — E “special cases”, i.e. mutagens, carcinogen, respiratory sensitizers.

C.1.3.4 Control banding procedure

There are four steps to the control banding procedure for the determination of the minimum required protection level.

Step 1: Determination of the Health Hazard Group (HHG)

Determine the health hazard group(s) (see Table C.2) for all the substance(s) in use or process-generated during the task.

To complete this step, a copy of the safety data sheet (SDS) or other published safety data for the relevant substances/preparations is required.

— Identify and write down the Hazard Statement Code corresponding to the chemicals used or generated during the task.

— Based upon the list of Hazard Statement Codes, allocate the highest health hazard group for each of the listed substances using Table C.2. If there are a number of Hazard Statement Codes which appear in different groups from A (least hazardous) to E (most hazardous), always choose the higher group.

— For substances where no Hazard Statement Codes are provided, seek specialist advice or assume Health Hazard Group E.

Table C.2 — Health Hazard Groups A to E based on CLP-GHS Hazard (H) statements

Health Hazard Group (HHG)				
A	**B**	**C**	**D**	**E**
H304 H315 H319 H336 EUH66	H302 H312 H332 H371	H301 H311 H314 H317 H318 H331 H335 H370 H373 EUH71	H300 H310 H330 H360 H361 H362 H372 EUH201	H334 H340 H341 H350 H351 EUH70

Step 2: Determine the amount of substance being used

Determine and write down the amount of substances being used according to the categories in Table C.3, based on the total amount used or handled.

Table C.3 — Amount of substance used

Amount of substance used	
Small	Grams or millilitres
Medium	Kilograms or litres
Large	Tonnes or cubic metres

Step 3: Determine the dustiness/volatility of substance being used

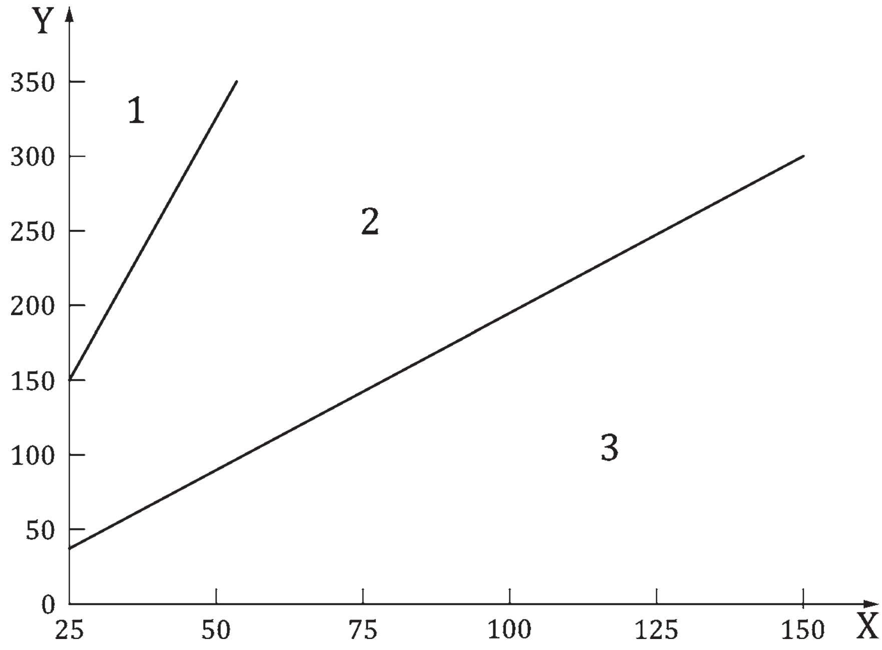
— For substances that generate particulate dust, determine and write down the level of dustiness by reference to Table C.4.

— For particulate/liquids that may generate gases or vapours, determine and write down the volatility by reference to Figure C.1.

— Gases are always placed in the "high volatility" category.

Table C.4 — Level of dustiness

Level of dustiness of substance used	
Low	Pellets, waxy flakes and pill-like solids that do not break up easily. No dust cloud produced and little or no dust in the area.
Medium	Crystalline granular solids and dust (visible, settles quickly). Fume or mist formed close to the task but dissipates very quickly.
High	Fine powder, fume or mist. Dust cloud, fume or mist is formed and remains in the air for several minutes.



Key

X task operating temperature (°C)

Y substance boiling point (°C)

1 low

2 medium

3 high

EXAMPLE A compound with a task operating temperature of 50 °C and a boiling point of 50 ° C would be a high volatility compound.

Figure C.1 — Volatility graph

Step 4: Determination of the minimum required protection level

Using the determined HHG(s), the amount(s) and the dustiness or the volatility of the substance(s) being used, determine the minimum required protection level by reference to Table C.5.

Table C.5 — Required protection level

Health Hazard Group (HHG)	**Amount**	**Protection level (PL)** Dustiness/Volatility		
		Low	Medium	High
A	Small	—	—	—
	Medium	—	4	10
	High	4	10	30
B	Small	—	4	4
	Medium	—	10	30
	High	10	30	250
C	Small	—	4	4
	Medium	10	10	30
	High	30	30	250
D	Small	10	30	250
	Medium	30	250	250
	High	30	250	2 000
E	Small	10	30	250
	Medium	30	250	250
	High	30	250	2 000

Annex D
(informative)

Suitability assessment

D.1 General

This Annex is intended to provide best practice advice in complying with the suitability assessment in 6.3.4. It provides additional explanation and clarification of the suitability for the wearer, the task, the intended work rate, the environment and any special application(s).

D.2 Wearer

D.2.1 Medical limitations

If a wearer is not able to wear a certain type of RPD because of physiological and/or psychological effects, another type of RPD based on medical assessment should be selected, giving the same or higher level of protection.

D.2.1.1 Medical assessment

All RPDs impose some burden and discomfort to the wearer, and therefore, the wearer's health should be checked before initial use and repeated on a regular basis in accordance with national regulations.

Depending on the type of RPD, the medical assessment may include a medical history and any assessment deemed necessary by the health care professional.

D.2.1.2 Weight of the RPD

The individual physiological ability of the wearer should be considered during the medical assessment. Some RPD might be too heavy to be worn by some persons, especially for a long period of time.

D.2.1.3 Use of other equipment

If other PPE and/or heavy equipment (tools) need to be used at the same time, the overall burden needs to be considered.

D.2.1.4 Temperature hazards created by the RPD

Some RPD produce hot surfaces or hot inhaled breathing gas during use, e.g. vortex cooling tubes, chemical filters or chemical oxygen RPD. Other RPD can create an air stream on the face, which cools the skin, e.g. assisted filtering RPD.

D.2.1.5 Skin irritation

The wearer's skin might be sensitive to certain materials of the RPD, which have direct contact to the wearer's skin.

D.2.1.6 Psychological requirements

Some wearers may not be able to wear RPD because of psychological reasons, like claustrophobia or feeling isolated. Sometimes psychological restrictions can be overcome by training and acclimatisation or desensitization.

D.2.2 Facial characteristics of the wearer

Facial characteristics have to be considered within the suitability assessment because fit will impact the overall protection provided by the RPD.

Facial characteristics which are surface-related, such as scarring, wrinkles, jewellery or unshaven hair can significantly affect the protection offered by some tight-fitting RPD. In these cases, loose-fitting respiratory interfaces may be more suitable. In this context, unshaven means hair which has not been shaved within the previous 8-hour period prior to the work shift, since studies have shown that even less than one day’s growth can dramatically increase face seal leakage.

Tight-fitting respiratory interfaces will not provide the expected protection unless they fit the contours of the wearer’s face properly and securely. Where this type of RPD is selected for use, a fit test should be conducted to ensure that the RPD will fit the wearer correctly. If a successful fit test cannot be achieved, alternative tight-fitting respiratory interfaces should be assessed or a loose-fitting respiratory interface should be selected.

Methods of fit testing are described in ISO 16975-3.

D.2.3 Corrective lenses

D.2.3.1 Spectacles

The use of corrective spectacles can interfere with the protection offered by many types of RPD. Where corrective spectacles are required, they should be of a design which is compatible with the RPD. Spectacles may be available (as an accessory from the RPD manufacturer) which fit completely inside the respiratory interface without breaking the face seal. Alternatively, an RPD which allows use of the corrective spectacles can be selected, e.g. loose-fitting RPD. Advice on this aspect should be sought from the RPD manufacturer.

D.2.3.2 Contact lenses

Contact lenses may be used where the wearer has successfully worn contact lenses before and practiced wearing them with the RPD. An assessment should be made as to whether the wearer can use contact lenses with his RPD.

D.2.4 Speaking and hearing

Many tasks involve verbal communication between co-workers. Since RPD will in general impede communication, an assessment of the additional risks involved may be required.

When workers find communication difficult, there may be a temptation to remove RPD in work areas, resulting in exposure to contaminants. Loose-fitting respiratory interface may interfere less with speech since the whole face may be visible; however, RPD, which enclose the ears, may reduce hearing. Hearing may also be impaired by noise generated by airflow in some RPD. Communication can be improved by selecting RPD with effective speech transmitters and models incorporating microphones or radios. These should be considered where effective verbal communication is required in order to ensure the safety of workers and others.

D.2.5 Compatibility

In many work environments, there will be multiple hazards and more than one item of personal protection is needed. It is important that such equipment is mutually compatible and continues to be effective against the risks.

Where industrial safety helmets, hearing protectors, eye protectors and protective clothing are required to be worn with RPD, it is important that the protection from any of these is not reduced by any possible interaction. These interactions include head harnesses passing under the hearing protector ear-muff seals, goggles dislodging respiratory interfaces, protective suits interfering with the RPD or its face seal. Preference is to be given to RPD which are intended by the manufacturer or manufacturers to be worn together.

RPDs are available for special applications, e.g. welding and abrasive blasting, which provide integrated head and/or face and eye and hearing protection.

Where more than one item of personal protection is needed, the sequence of doffing should be considered to ensure that respiratory protection is maintained where required, e.g. decontamination following asbestos abatement.

D.3 Task

D.3.1 Considerations for vision

Most RPD impede vision to some degree, either through a reduced effective field of vision or through imperfect optical quality of the eye covering/visor. RPD shall 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 respiratory interfaces class a or class b so that vision is unimpeded.

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

D.3.2 Mobility

The mobility required to perform the task should be assessed to see how the RPD selection may be affected. Location of the hazardous area may limit the type of RPD that can be used safely.

For example, if entry into the hazardous area requires movement over several metres, movement between floors or levels within a building or transit through very small openings or tunnels/ducts using ladders or crossing railroad tracks, then class SY RPD may not be suitable because of the possibility of tangling or severing the supplied air hoses. The maximum length of hose permitted by standards may also limit the travel distance of airline respirator wearers. Also, when using class S or combination class SY/S, the distance from the hazardous area to the nearest staging area containing a breathable atmosphere should be known to ensure that the RPD selected will have an adequate supply of breathable gas or that the service life of the auxiliary escape cylinder of the combination class SY/S is adequate for emergency escape.

Confined spaces require special considerations such as hazard and exposure assessment, space limitations, and a means of communication between the respirator wearer and standby personnel.

Where significant body movements are envisaged, e.g. bending, stretching, crawling and manual handling tasks, 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 RPD and the possibility that movements may affect the fit and protection of the RPD. The RPD 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 RPD can be selected to minimize the risk of protection failure or damage. Mobility limitations caused by RPD having encapsulating suits because of their size or construction shall be considered.

D.3.3 Enhanced communication

D.3.3.1 General

Verbal communications in a noisy environment can be difficult. It is important to ensure that an RPD wearer can communicate effectively when necessary. This may be especially important where safety is concerned, e.g. during confined space entry.

There are several options to improve communications when wearing an RPD given in D.3.3.2 to D.3.3.6.

D.3.3.2 Speech transmitters (diaphragm)

A speech transmitter consists of a resonating surface and cavity that vibrates during speech, thereby transmitting the wearer's voice outside of the respiratory interface.

D.3.3.3 RPD microphone

A microphone is mounted inside, or connected to the RPD. The microphone may be connected to a radio, telephone, loudspeaker or other means of electronic voice transmission.

D.3.3.4 Cranial, throat, or ear microphone

A cranial and throat microphone is held in place with a harness against the wearer's head or larynx. An ear microphone is worn in the same manner as a radio earphone and functions as both a microphone and speaker. Use of these devices does not require penetration of or attachment to the RPD. They may be used with a radio, telephone, loudspeaker or other means of electronic voice transmission.

D.3.3.5 Use of telephone handset

Since a person exhales while speaking, the exhalation valve in an RPD is partially open. This is a suitable location to place a handset or hand-held microphone to obtain the clearest voice transmission.

D.3.3.6 Hand or coded signal

A predetermined set of signals may be useful in communicating.

D.3.4 Tools

Tools used during the course of a task can influence the performance of the RPD. These influences should be considered as part of the selection process.

Examples are as follows.

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

Sometimes the breathable gas required by supplied breathable gas RPD and the compressed air required for air tools is generated and delivered from the same breathable gas source. If air-powered tools and RPD are being connected to the same air supply, it is important that the compressor can supply enough breathable gas for both at the same time. This is not good practice, but where it does occur, the selection of the RPD should include consideration of how the breathable gas supply to the RPD can be maintained at correct levels at all times.

For spraying operations with paints, coatings, adhesives, insecticides, etc., consideration of possible damage to and contamination of the RPD from overspray should be considered. Cleaning of the RPD may be difficult and it may be appropriate to consider the use of adequate and suitable disposable RPD, or disposable visor covers or other protective covers. Cleaning of RPD with solvents can lead to damage. Advice from the RPD manufacturer should be sought as to the best cleaning agent to use. Adhesives and other sprays can render valves ineffective if they are not cleaned or replaced regularly. RPD with well-protected valves would be preferred in this case. Power tools can adversely affect RPD performance. This may be through transmitted vibration, impact of air jets emanating from tools, or particles impacting on the RPD. This can cause a significant reduction in protection afforded 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 RPD in these sensitive areas.

D.3.5 Duration

Frequency and duration of the work process are of primary concern that shall be considered. RPD use time is critical for class S RPD because of their finite capacity of breathable gas. Duration of use is also an important consideration for filtering RPD as worker acceptance and comfort are essential to ensure proper use of the RPD. Also, for filtering RPD, filter change schedules which depend on duration of use, as well as on contaminant concentrations, shall be established and implemented.

Batteries used in RPD have a finite service life which shall be long enough for the task.

D.4 Intended work rate

Work rate influences the service life of RPD with fixed breathable gas volume and of filtering RPD. High breathing rates deplete breathable gas cylinders and sorbent materials faster. Examples of work and activities for different work rate classes are given in Table 2, where work rate classes cover a range of minute volumes.

D.5 Environment

D.5.1 Extreme climatic conditions

D.5.1.1 General

The selection process needs to include an assessment of the likely effects on the RPD and upon the wearer when deployed in extreme temperature or humidity conditions.

D.5.1.2 Effects on the RPD

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

D.5.1.2.1 Extreme low temperatures

Extreme low temperatures can affect the performance of RPD in a number of ways some of which could result in a reduction or even loss of respiratory protection. It is therefore essential that users consult the RPD manufacturer where RPD is to be deployed in extreme low temperatures.

Examples of how RPD can be affected by low temperatures are as follows.

— Respiratory interfaces and parts of respiratory interfaces such as sealing surfaces and flexible hoods can become more brittle and crack, or less flexible potentially causing fit or comfort problems.

— Components of the breathable gas supply chain such as hoses and tubes can also become more brittle and crack, or being less flexible, become unwieldy causing comfort and fitting problems.

— Components such as valves may not function effectively under very low temperatures.

— Any moisture in the compressed breathing gas or exhaled breath can condense, causing flow restrictions or other defects. In extreme cold, moisture from exhaled air can freeze in valve assemblies rendering them ineffective.

— Performance of some supplied breathable gas RPD can be adversely affected by low temperature conditions.

— Performance of electrochemical batteries used in RPD and other equipment falls off rapidly with decreasing temperature, potentially affecting airflow and duration.

— Fogging of lenses may be increased at low temperatures.

D.5.1.2.2 Extreme high temperatures

Extreme high temperatures can affect the performance of RPD in a number of ways, some of which could result in a reduction or even loss of respiratory protection. It is therefore essential that users consult the RPD manufacturer where RPD is to be deployed in extreme high temperatures.

Examples of how RPD can be affected by high temperatures are as follows.

— Materials such as plastics commonly used in RPD may melt or soften.

— The performance and service life of gas and vapour filters may be degraded.

D.5.1.3 Effects on the wearers

The thermal comfort of the wearer should be considered in all applications. It may be affected by work rate, by environmental conditions and by other personal protective equipment that is worn.

Excessive sweating can cause the respiratory interface to slip on the face and thus reduce the protection provided by the RPD. In addition, the heat build-up and discomfort can cause the wearer to loosen protective clothing and so nullify the protection afforded to the body by the clothing. It is essential that if high work rates have to be carried out when wearing an RPD and protective clothing, steps are taken to provide suitable work-rest regimes or reduced the time a wearer can work, and if necessary, active cooling or medical surveillance for the worker.

NOTE In some countries, for RPD used in special application Mining (MN3, MN4), a table of the time an RPD worker can work have been developed, taking into account environmental temperature, humidity and their effect on the wearer's core body temperature.

Since RPD may enclose the head and potentially, other parts of the body, natural heat loss from the body is reduced. 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 RPD selected should ideally contribute to the heat loss of the wearer, e.g. RPD with loose-fitting respiratory interfaces where the airflow may have a cooling effect.

In addition, other control measures for heat stress may be needed, such as provision for increased water uptake or the use of cooling devices.

In cold climate or refrigerated work areas, cold strain may become an issue. This may be particularly true if assisted filtering RPD or supplied breathable gas RPD is worn as the cold air flow could increase heat loss from the body and cause localized frostbite. Some RPD provide preheating of the breathable gas.

D.5.2 Other non-respiratory hazards

Identify any other hazards (i.e. potential for splashing, sparks, fire, flammability) associated with the job/process, which may influence the selection and use of the RPD.

D.5.2.1 Oxygen enrichment

An oxygen-enriched atmosphere is unusual, but where it is present, there is a very significantly increased risk of fire or explosion (e.g. welding in confined spaces). For this reason, RPD should be carefully selected, giving consideration to specifying anti-static, non-sparking, non-flammable materials. Only manufacturer’s specified lubricants should be used in the maintenance of these RPD.

D.5.2.2 Potentially corrosive atmospheres

RPD may be required for protection against contaminants which are corrosive in nature. These contaminants may come into contact with the skin, eyes or the RPD, either as gaseous or aerosol contaminants, or by splashing of liquids from the work process. Selection of suitable RPD will need to include consideration of the interaction of the RPD with adequate and suitable chemical protective clothing.

Certain substances are capable of weakening components and parts of RPD. This may lead to a reduction in robustness of components over time. This would be of concern if the performance of the RPD is reduced, e.g. by damage to valves or if other protective elements of the RPD, e.g. helmets or eye protectors, were significantly weakened or rendered opaque. As a result, an enhanced maintenance and/or replacement schedule may be required for the RPD.

Advice from the RPD manufacturer/supplier should be sought on the suitability of the RPD for the environment, and the selection modified if appropriate.

D.5.2.3 Potentially explosive atmospheres

Where RPDs are used in potentially explosive atmospheres, selection will need to include an assessment of the RPD itself as a possible ignition source. Any RPD 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. Cleaning and maintenance of the RPD 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 order to be used in potentially explosive atmospheres, it is essential that the RPD be intrinsically safe, e.g. in accordance with regulations such as ATEX 2014/34/EC or other applicable national programmes. Advice from the RPD manufacturer/supplier should be sought on the suitability of the RPD for the environment.

D.5.2.4 Potentially permeating contaminants

Certain contaminants are capable of permeating through RPD materials in the event that the contaminant comes into contact with the RPD. This can result in re-evaporation of the contaminant into the RPD potentially over-exposing the wearer. Selection of RPD may need to include consideration of use of more permeation resistant materials. This is particularly of concern if components such as respiratory interfaces, breathing hoses or compressed breathable gas supply hoses may be immersed in liquid contaminant. It should be noted that permeation could occur even against a positive pressure differential.

Care should be taken with components, particularly trailing breathable gas supply hoses, as various hazardous chemical substances may penetrate through the tube and contaminate the breathing air.

D.5.2.5 Radiant heat

High temperatures resulting from radiant heat can have a number of adverse effects on RPD. At the extreme, for example, in foundry applications, radiant heat can melt or soften plastics used in RPD. RPD that are classified for use in high temperature/radiant heat conditions should be considered. (For further information, see D.5.1)

D.5.2.6 Wind velocity

Winds in excess of 2 m/s velocity may have an adverse effect on the protection of some designs of RPD, particularly loose-fitting respiratory interfaces, since contamination can be blown into the breathing zone against the RPD air flow. Selection of RPD for use in windy areas should therefore consider this possibility. The RPD manufacturer should be consulted for additional information.

Annex E
(informative)

Medium and high pressure compressed air for RPD

E.1 General

A compressed breathable air system may be used for filling individual pressure cylinders or to supply air directly to the RPD.

Contaminants can mix with the compressed air at various stages of its generation and supply. Any presence of contaminants in unacceptable quantities will render the air unsuitable as “breathable gas” and can threaten the health and safety of the RPD wearer. For this reason, quality assured compressed air should be supplied to an RPD. 7.6.4.2 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.

E.2 Compressed breathable air system

E.2.1 General

A competent person should be consulted when planning or installing a compressed breathable air system. Table E.1 provides a summary of the main elements associated with a compressor breathable air system. 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 as 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 downstream of the outlets or near vehicle exhaust emission points).

E.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.

E.2.3 Testing and inspection

The volume flow or pressure, and quality of the supplied air, should be thoroughly tested at intervals as specified by a competent person (after risk assessment), and at least at the minimum frequency as specified by national or local regulations.

Table E.1 — Summary of main elements associated with a compressor system for producing breathable air

<table>
<tr><th>Order</th><th>Element</th><th colspan="2">Description/Purpose</th></tr>
<tr><td>1</td><td>Atmospheric air</td><td colspan="2">Typical composition of natural air is given in Reference [1].</td></tr>
<tr><td>2</td><td>Air intake filter</td><td colspan="2">The air intake filter is to remove coarse particles to protect the compressor.
The intake should be located in natural air, upwind and as far away as possible, both vertically and horizontally from sources of contamination.</td></tr>
<tr><td>3</td><td>Compressor</td><td colspan="2">With system controls and alarms or monitoring for pressure, temperature and oil level.</td></tr>
<tr><td>4</td><td>Aftercooler</td><td colspan="2">With condensate drain facility.</td></tr>
<tr><td>5</td><td>Separator</td><td colspan="2">To remove large water and oil droplets — with condensate drain facility.</td></tr>
<tr><td>6</td><td>Compressed air receiver</td><td colspan="2">For pressure stabilization and compressor load control — with condensate drain facility.</td></tr>
<tr><td rowspan="6">7</td><td rowspan="6">Breathable air purifier</td><td colspan="2">A combination of components, to remove unwanted solids, gases and vapours, as well as oil and water in liquid and aerosol form, together with odour and taste from the compressed air source, to ensure the breathable air complies with the requirements of this part of ISO 16975.
Comprising:</td></tr>
<tr><td>7.1 Coalescing filter</td><td>To remove small water droplets, oil mist and particles — with condensate drain facility. Elements become blocked and should be monitored for pressure drop.</td></tr>
<tr><td>7.2 Dryer stage</td><td>To remove water vapour to ensure the water content remains below the limits specified in Table 3 of this part of ISO 16975.</td></tr>
<tr><td>7.3 Gas filtration stage(s)</td><td>To remove carbon dioxide and other gaseous contaminants, including odour and taste.</td></tr>
<tr><td>7.4 Catalytic stage</td><td>To remove carbon monoxide and ozone.</td></tr>
<tr><td>7.5 Particulate filter stage</td><td>To remove dust particles generated by previous stages.</td></tr>
<tr><td>8</td><td>Compressor system non-return valve</td><td colspan="2">To prevent compressed breathable air from leaking back through the compressor system.</td></tr>
<tr><td>9</td><td>Breathable air receiver</td><td colspan="2">To provide enough breathable air for all RPD wearers.</td></tr>
<tr><td>10</td><td>Breathable air distribution system</td><td colspan="2">Flow control units, monitoring facilities, couplings and distribution tubes.</td></tr>
<tr><td colspan="4">Compressed breathable air system should be capable of delivering breathable air to every RPD wearer in the quantity and at the pressure required for the RPD during use. Use of equipment that may place an additional demand on the compressed breathable air system should be taken into account.</td></tr>
</table>

Annex F
(informative)

Maintenance

F.1 Inspection

Regular inspection of RPD should be carried out in accordance with the manufacturer's instructions. These could include a check for integrity of connections — for the condition of the respiratory interfaces, head harness, valves, harness assemblies, hoses, filters, end-of-service life indicator (if present), electrical components and shelf-life date(s) and for the proper function of regulators, alarms and other warning systems. Each rubber or other elastomeric part should be inspected for continuing pliability and any signs of deterioration. Cylinders containing breathable air/gas will require inspection to ensure that they are fully charged according to the manufacturer's instructions.

F.2 Decontamination

RPD may become contaminated with toxic materials. If the contamination is light, then normal cleaning procedures should provide satisfactory decontamination; otherwise, separate decontamination steps may be required before doffing or cleaning.

National or local guidance that describes suitable decontamination methods for specific toxic materials may exist.

F.3 Cleaning and disinfecting

RPD should be thoroughly cleaned and disinfected following the manufacturer's instructions.

RPD should be appropriately disassembled and non-reusable parts should be disposed. Delicate parts, e.g. exhalation valves, require particular care and attention during cleaning.

F.4 Routine maintenance and repair

The maintenance and repair procedures should be designed to ensure that the RPD will continue to perform as intended by the manufacturer.

A thorough maintenance programme should include

— fault-finding routines,

— replacement of parts, as necessary,

— performance checking, and

— servicing as recommended by the manufacturer.

F.5 Disposal

Arrangements will need to be made for safe disposal of contaminated filters and other parts which cannot be safely decontaminated. Relevant national or local regulations should be followed.

Annex G
(informative)

Programme review

G.1 General

The RPD programme should include mechanisms to routinely re-assess and review the effectiveness of the programme.

A programme review may range from an informal evaluation to a formal audit and accompanying report, depending on the level of workplace risk that can be present and the scope and depth of the evaluation desired.

G.2 Key elements

Key elements should include

a) a review of programme elements against regulatory requirements,

b) identification of management processes which include the clear definition of roles and responsibilities and adequate resources,

c) a review of documented programme procedures,

d) examination of records to verify that documented procedures are being followed,

e) confirmation that workplace practices comply with programme requirements,

f) documentation of programme problems and subsequent corrective actions,

g) user interviews to verify wearer acceptance (comfort, ease of breathing, fatigue, vision, mobility, job interference, utility),

h) correct selection and use of RPD,

i) effective training of all users,

j) effective inspection of RPD, and

k) correct storage and maintenance of RPD.

Annex H
(informative)

RPD selection for bioaerosols

An effective RPD protection programme is an essential element in preventing or limiting employee exposures to bioaerosols, and it is the responsibility of employers to assess this risk and decide on the acceptable level of protection as it relates to a specific use.

Where national or local regulations, best practices, or infection prevention and control guidance exist, they shall be adhered to during the RPD selection process.

When RPD to protect against bioaerosols are being selected, airborne transmissibility shall be confirmed or suspected and the infectivity of the bioaerosol shall be taken into consideration.

Reference [10] addresses selection of RPD for bioaerosols that are capable of causing infection or adverse or allergic response but for which no occupational exposure limits have been established.

Only exposures through inhalation are covered in this selection process, and appropriate selection of PPE for other routes of transmission shall be undertaken if applicable.

Annex I
(informative)

Classification overview

The detailed classification and examples are described in ISO/TS 16973. The following gives an informative overview.

All RPDs are classified based on their performance and the characteristic of the respiratory interface, as given in Table I.1

Table I.1 — Classification of RPD

Classification	Classes (range)
Protection class	PC6[a] PC5 PC4 PC3 PC2 PC1[b]
Work rate class	W4[a] W3 W2 W1[b]
Respiratory interface class	
Area of coverage (barrier lines)	a (mouth only) b (mouth and nose) c (face) d (head) e (more than head, up to complete body)
Type	T (tight-fitting) L (loose-fitting)
Supplied breathable gas capacity class	Sxxxx[c] SY[d]
Filter performance	
Particle filter efficiency class	F5[a] F4 F3 F2 F1[b]
Gas filter type and class	Several types based on test gas(es) with up to 4 classes, with class 1 being the lowest

[a] Highest.

[b] Lowest.

[c] xxxx equals the amount of breathable gas available for respiration, in litres.

[d] Y is the indication for air line RPD.

Additionally, RPD may be classified for one or more special applications, as given in Table I.2 or Table I.3, respectively.

Table I.2 — Special application of supplied breathable gas RPD

Special application	Classes
Firefighting	
Wildland firefighting	FF1
Rescue	FF2
Hazardous material	FF3
Structural firefighting type R1	FF4
Structural firefighting type R2	FF5
CBRN	CBRN1 CBRN2 CBRN3
Marine	
Hazardous material	MA1
Marine firefighting	MA2
Mining	
Underground mining non-explosive	MN1
Underground mining explosive	MN2
Mining firefighting type R1	MN3
Mining firefighting type R2	MN4
Abrasive blasting	AB1
Welding	WE1
Escape	
Escape general filtering	ES t[a]
Escape from fire	ES FF t[a]
CBRN Escape	ES CBRN t[a]
Marine Escape	ES MA t[a]
Mining Escape	ES MN t[a]

[a] Nominal service live, in minutes.

The classification of a supplied breathable gas RPD is determined by the appropriate combination of the classes shown in Table I.1 and Table I.2:

Protection class, work rate class, respiratory interface class, supplied breathable gas capacity class and special application class.

EXAMPLE PC5 W3 cT S1800 FF4

Multifunctional supplied breathable gas RPDs have separate classifications for each function, e.g. one classification as a class SY RPD and one classification as a class Sxxxx RPD.

Table I.3 — Special application of filtering RPD

Special application	Classes
Firefighting	
Wildland firefighting Rescue Hazardous material	FF1 FF2 FF3
Marine	
Hazardous material	MA1
Mining	
Underground mining non-explosive Underground mining explosive	MN1 MN2
Abrasive blasting	AB1
Welding	WE1
Escape	
Escape general filtering Escape from fire CBRN Escape Mining Escape	ES XX[a] t[b] ES FF t[b] ES CBRN t[b] ES MN t[b]

[a] XX is the type of gas filter.

[b] Nominal service live in minutes.

The classification of a filtering RPD is determined by the appropriate combination of the classes shown in Table I.1 and Table I.3:

Protection class, work rate class, respiratory interface class, filter performance class and special application class.

EXAMPLE PC3 W2 bT F3 MN1

Multifunctional filtering RPDs have separate classifications for each function, i.e. one classification for the unassisted mode and one classification for the assisted mode.

Combined RPD work in both filtering and supplied breathable gas mode are classified separately for each mode.

Annex J
(informative)

Example of Selection Record Form

The following form summarizes and records the risk assessment and selection of respiratory protective devices.

This form can be used as a record od RPD selection.

Step 1	**Organization information**
Organization:	**Location:**
Details of the person completing the form **Name:** **Job title:**	**Name of wearer(s):**

Step 2	**Description of the task**
Is the task any of the following? Firefighting, CBRN, marine, mining, escape — Use the selection procedure in ISO 16975-1. **If the task is not any of the above, describe the task and the working environment** (e.g. motor vehicle paint spraying inside a spray booth, kerb stone cutting outdoors, welding, abrasive blasting)	
(a) How long does the task take? **(e.g. spraying a motor vehicle: 20 min; sanding a wood panel: 10 min; cutting stone: 5 min)** **____ h ____ min** **How many times a shift? ______ times a shift**	**(b) What are the working conditions?** **(Include the range)** **Temperature: _____ °C** **Humidity: _____ %RH**

Step 3	Define the hazards	
Is the work area deficient in oxygen or the potential to become oxygen-deficient?	**Yes**	Follow national regulations if they exist. If there are no national regulations, use the selection procedure in ISO 16975-1.
	No	**Continue to next question**
Is the contaminant known?	**Yes**	**Continue to next question**
	No	I. Seek professional advice to identify the contaminant, or refer to national regulations or industry guidance related to the task. II. If the contaminant cannot be identified, then select supplied breathable gas RPD with the highest protection class. **Go to Step 5**
Is the concentration of the contaminant known (i.e. by measurement or estimation)?	**Yes**	**Continue — Complete the table below**
	No	I. Refer to national regulations or industry guidance to establish the required protection level. — **Go to Step 5**, or II. Refer to national regulations or industry guidance to establish the specific RPD type and classification. — **Go to Step 6**, or III. Refer to ISO 16975-1 or seek professional advice to measure or estimate the concentration. — **Continue — Complete the table below**, or IV. Select supplied breathable gas RPD with the highest protection class. — **Go to Step 5**

Complete the boxes below for particulate contaminants (dust, fibre, fume, smoke, mist, fog)

Contaminant Name/CAS number (if applicable)	**(A) Concentration** Measured or estimated concentration in air [mg/m^3 or fibres/ml]	**(B) IDLH Level (if applicable)** Immediately dangerous to life or health [mg/m^3 or fibres/ml]	**(C) OEL** Occupational exposure limit value should be the same unit as in (A). If no OEL, what is the safe exposure value?	**(D)** Calculate the hazard ratio (HR) $\text{HR} = \frac{(A)}{(C)}$
(i)				
(ii)				
(iii)				
(iv)[a]				

Complete the boxes below for gas/vapour contaminants

Contaminant Name/CAS number (if applicable)	**(A) Concentration** Measured or estimated concentration in air [ppm or mg/m^3]	**(B) IDLH Level (if applicable)** Immediately dangerous to life or health [ppm or mg/m^3]	**(C) OEL** Occupational exposure limit value should be the same unit as in (A). If no OEL, what is the safe exposure value?	**(D)** Calculate the hazard ratio (HR) $\text{HR} = \frac{(A)}{(C)}$
(i)				
(ii)				
(iii)				
(iv)[a]				

Result of Step 3

Which one of the contaminant(s) from the above tables (and separate sheet) has the highest hazard ratio in (D)? Record it in (E). If the hazard ratio is <1, then RPD is not required, UNLESS national or local regulations apply to the contaminant.	**(E) Highest hazard ratio:**

Are any of the contaminant concentrations in (A) higher than the IDLH value (B)? **(if applicable)**	**Yes**	Select supplied breathable gas RPD (When class SY RPD is selected, it has to be combined with an escape class ES or class S RPD.)
	No	**Continue to Step 4**

[a] If more than four contaminants are present, continue on a separate sheet.

Step 4	Determination of the protection class					
a) Do national regulations specify the type of RPD?	Yes	**Follow the regulations.**				
	No	**Continue 4 b).**				
b) Do national regulations specify the use of APF?	Yes	**Choose an RPD with an APF that is greater than the HR.**				
	No	**Continue 4 c)**				
c) Circle the number to the right that is greater than the hazard ratio as given in (E).	4	10	30	250	2 000	10 000
d) Choose the PC below the circled number and record in the lower right box.*	PC1	PC2	PC3	PC4	PC5	PC6
Minimum protection class required	**PC***					

Step 5	Work rate assessment		
There are four work rate classes — W1, W2, W3 and W4:	**W1**	From light manual work to sustained hand and arm work such as bench work, standing, drilling	Select RPD with at least work rate class W1.
	W2	From intense arm and trunk work to intensive shovelling or digging	Select RPD with at least work rate class W2.
Choose the work rate class that best matches the task to be undertaken.	**W3**	From walking quickly or running with protective equipment and/or heavy tools and goods to crawling under and climbing over obstacles. Work that cannot be sustained for more than 15 minutes	Select RPD with at least work rate class W3.
	W4	Climbing stairs and ladders at high speed. Work that cannot be sustained for more than 5 minutes	Select RPD with at least work rate class W4.
Minimum work rate class required			**W**

Step 6	Filter identification		
Using the information in Step 2 (a and b), Step 4 and Step 5, seek professional advice to identify the type and class of filter(s) suitable for the hazard, including their relevant service life(s) applicable to your task. Alternatively, if you wish to use a supplied breathable gas RPD, go to Step 7.			
Has a suitable filter been identified?	**Yes**	**Filter type and class:**	**Recommendation received from:**
		Go to Step 8	
	No	Select supplied breathable gas RPD	**Go to Step 7**

<table>
<tr><th>Step 7</th><th colspan="2">Supplied breathable gas RPD capacity</th></tr>
<tr><td colspan="3">Calculate the volume of the breathable gas needed for the duration of the task, including entry and exit, by using the information in Step 3 and Step 5, using the calculations below.
Changing the work rate will change the useable duration of the breathable gas volume.</td></tr>
<tr><td colspan="2">Calculation</td><td>Minimum capacity</td></tr>
<tr><td colspan="2">Duration of task (min) × 30 L/min for W1 (e.g. 20 min × 30 L/min = 600 L)</td><td rowspan="4">Litres (L)</td></tr>
<tr><td colspan="2">Duration of task (min) × 40 L/min for W2</td></tr>
<tr><td colspan="2">Duration of task (min) × 50 L/min for W3</td></tr>
<tr><td colspan="2">Duration of task (min) × 65 L/min for W4</td></tr>
<tr><td colspan="3">Classification options for class S RPD: The minimum classification necessary in litres is the calculated capacity, rounded up in increments of 150 L if less than 900 L, and in increments of 300 L if above 900 L. If the calculated capacity for the task duration is greater than any available class Sxxxx RPD capacity, then use class SY RPD.</td></tr>
<tr><td colspan="2">Minimum class S</td><td>S</td></tr>
</table>

<table>
<tr><th>Step 8</th><th colspan="2">Task-related factors</th></tr>
<tr><td colspan="3">Answer all of the following questions for each wearer (circle Yes/No)</td></tr>
<tr><td rowspan="2">Is the task carried out in a confined space (e.g. vat, pit, chambers, tanks, trenches, pipes, sewers, flues or wells)?</td><td>Yes</td><td>Requires special considerations in accordance with national regulations. Seek professional advice.</td></tr>
<tr><td>No</td><td>Continue</td></tr>
<tr><td rowspan="2">Is the duration of RPD continuous wear >1 hour before it is taken off?</td><td>Yes</td><td>Consider assisted filtering RPD or supplied breathable gas RPD or seek guidance from national or local regulations.</td></tr>
<tr><td>No</td><td>Continue</td></tr>
<tr><td rowspan="2">Is the contaminant an eye irritant?</td><td>Yes</td><td>Consider selecting RPD which covers the entire face or head (respiratory interfaces class c, d or e).</td></tr>
<tr><td>No</td><td>Continue</td></tr>
<tr><td rowspan="2">Does the task require mobility, such that the use of air supply hoses is impractical?</td><td>Yes</td><td>Do not select type SY RPD.</td></tr>
<tr><td>No</td><td>Continue</td></tr>
<tr><td rowspan="2">Is precise communication needed to give safety critical instructions when RPD is worn?</td><td>Yes</td><td>Select RPDs that are fitted with a speech diaphragm or additional communication means.</td></tr>
<tr><td>No</td><td>Continue</td></tr>
<tr><td rowspan="2">Does the task create sparks, molten metal or UV radiation?</td><td>Yes</td><td>Seek RPD manufacturer/supplier advice as specialized RPD may be required.</td></tr>
<tr><td>No</td><td>Continue</td></tr>
<tr><td rowspan="2">Is the work area atmosphere potentially explosive or flammable?</td><td>Yes</td><td>Seek RPD manufacturer/supplier advice as specialized RPD, e.g. intrinsically safe RPD, may be required.</td></tr>
<tr><td>No</td><td>Continue</td></tr>
<tr><td rowspan="2">Is the work area atmosphere corrosive?</td><td>Yes</td><td>Seek RPD manufacturer/supplier advice as specialized RPD may be required.</td></tr>
<tr><td>No</td><td>Continue</td></tr>
</table>

Step 9		**Wearer-related factors**
Answer the following questions for each wearer (circle Yes / No)		
Are any of these present in the sealing area of the respiratory interface — stubble, beards, moustache, side burns, deep facial marking or facial jewellery?	**Yes**	Select loose fitting RPD (class L). **Continue**
	No	**Continue**
Are corrective lenses worn?	**Yes**	Select RPDs that do not interfere with the corrective lenses or RPDs that have facilities for wearing corrective lenses. **Continue**
	No	**Continue**
Are other types of personal protective equipment (PPE) worn (e.g. head, eye and hearing protection, protective clothing, etc.)?	**Yes**	Ensure that the selected RPD and other PPE required for the task do not interfere with each other. Consider RPDs that provide integrated head and/or face and eye and hearing protection. **Continue**
	No	**Continue**
Has the potential wearer been medically cleared to wear an RPD?	**Yes**	**Continue**
	No	**See note below — seek professional advice**
Medical conditions. Some pre-existing medical conditions (examples include breathing disorders such as asthma, or skin allergies or heart problems) may restrict or prevent some workers wearing any RPD or certain types of RPD. Ensure that workers are medically able to wear the selected and required RPD. Seek medical advice. Where national or local regulations exist, these should be followed.		

Step 10		**Final selection**		
Minimum class of filtering RPD Fill in the boxes below with the information gathered.				
Protection class required (See Step 4)	**Work rate class required** (See Step 5)	**Filter type and class required** (See Step 6)	**Suitable respiratory interface**	**Suitable RPD** Identify examples of suitable RPD
PC	**W**			
Minimum class of supplied breathable gas RPD Fill in the boxes below with the information gathered.				
Protection class required (See Step 4)	**Work rate class required** (See Step 5)	**Breathable gas capacity** (Sxxxx or SY) (See Step 7)	**Suitable respiratory interface**	**Suitable RPD** Identify examples of suitable RPD.
PC	**W**	**S**		
Choose an RPD from the list of suitable RPD meeting the above requirements. If no such option is currently available on the market, select the next higher class and record. If the selected RPD has a tight-fitting respiratory interface, conduct a fit test on the wearer using that RPD.				
Selected RPD:				
Employer statement I understand that it is ultimately the responsibility of the employer, to select adequate and suitable RPD based on a risk assessment, to ensure that fit testing has been carried out with the RPD selected, where applicable, and that each wearer has been trained and is medically cleared. Name of the person providing the information in this form: ________________ Signature: ____ Date: _______________ Company Name: ____				

Annex K
(informative)

Transition from TIL to Protection Level: Safety Factor derivation rationale

K.1 General

This Annex provides the rationales that were used to determine the safety factors (SF) that are used to create the protection levels (PL) from the Maximum-Percentage-Total-Inward-Leakage values for each protection class in the classification of RPD; see Table I.1.

K.2 Overview

ISO/TC 94/SC 15 aimed to make selection use and maintenance standard more user-friendly. One of the criticisms was that the TIL levels given in the classification table was not useful to users and wearers. It was proposed that a system based on the principle of assigned protection factors should be introduced. TC 94/SC 15 concluded that the criticism was valid and could be addressed by including the concept of “protection levels”. Although the term is new, the concept is common, in that both recognizes that the protection likely to be achieved in a real workplace is less than that achieved in a laboratory.

K.3 Definitions

K.3.1 Protection Level (PL)

The PL is the degree of respiratory protection allocated to an RPD for the purposes of selection and use that is expected to be provided to wearers when used within an effective RPD program as described in this part of ISO 16975,

The PL is derived from the maximum percent of Total Inward Leakage (TIL_{max}) of the ISO RPD class with its Protection Class (PC) and the Safety Factor (SF).

It is calculated as given in Formula K.1:

$$PL = \frac{1}{TIL_{max}} \times 100 \times \frac{1}{SF} \quad \text{(K.1)}$$

K.3.2 Safety Factor (SF)

The number used in the calculation of the Protection Level from the maximum %TIL of the ISO RPD Class.

NOTE The safety factor value increases with the protection class. It ranges from SF 1,25 for PC1 to SF 10 for PC6. The SF value has been derived from analysis of previous assigned protection factors (APF), their associated nominal protection factors (NPF) and expert knowledge of differences between laboratory and workplace protection performance.

The nominal protection factor (NPF) permitted for the specific type and ISO RPD class is calculated as given in Formula K.2:

$$NPF = \frac{1}{TIL_{max}} \times 100 \quad \text{(K.2)}$$

K.4 Rationale used when preparing SF numbers

K.4.1 General

This subclause describes the rationale that was used to derive the value of the SF for each ISO RPD class. Each section contains a table of assigned and nominal protection factors for current RPD that fall within the maximum %TIL range of the ISO RPD class.

K.4.2 Derivation of Safety Factor for Protection Class PC1

Class PC1 equals a protection level of 4 **(PC1 = PL4): TIL = 20 % SF = 1,25**

The SF of 1,25 was derived through assessment of European Assigned Protection Factor (APF) existing at the time of preparing this part of ISO 16975. It took European APF and chose the most conservative numbers in the range that related to the new ISO class PC1. The outcome of this assessment concluded that 1,25 was a safe value to use for this level of protection, leading to a protection level of 4, which is equivalent to the most conservative APF in the existing documents.

Table K.1 — Comparison of ISO protection level for PC1 to current European protection factors

ISO				Current CEN[a]				Range of APFs	ISO safety factor	ISO protection level
RPD class	TIL %	PL	NPF	RPD type and class	TIL %	NPF	APF			
PC1	**20**	**4**	**5**						**1,25**	**4**
				FFP1	22	4	4	4		
				HM P1	2 % + 20	4	4	4		
				FM P1	0,05 % + 20	5	4	4		
				FFP2	8	12	10	10		
				HM P2	2 % + 6	12	10	10		
				FM P2	0,05 % + 6	16	10	10 to 15		
				TH1	10 %	10	10	5 to 10		

a Range of current European RPD type and class that fall within the requirement of 20 %TIL. See also Reference [6].

K.4.3 Derivation of Safety Factor for Protection Class PC2

Class PC2 equals a protection level of 10 **(PC2 = PL10): TIL = 5 % SF = 2**

The SF of 2 was derived through assessment of European APFs existing at the time of preparing this part of ISO 16975. It took European Assigned PFs and chose the most conservative numbers in the range that related to the new ISO class PC2. The outcome of this assessment concluded that 2 was a safe value to use for this level of protection, leading to a protection level of 10, which is equivalent to the most conservative APF in the existing documents.

Table K.2 — Comparison of ISO protection level for PC2 to current European protection factors

ISO				Current CEN[a]				Range of APFs	ISO safety factor	ISO protection level
RPD class	TIL %	PL	NPF	RPD type and class	TIL %	NPF	APF			
PC2	**5**	**10**	**20**						**2**	**10**
				TM1	5	20	10	10		
				FFP3	2	50	320	20 to 30		
				HMP3	2 % + 0,05	48	20	20 to 30		
				TH2	2 %	50	20	20		

[a] Range of current European RPD type and class that fall within the requirement of 5 %TIL. See also Reference [6].

K.4.4 Derivation of Safety Factor for Protection Class PC3

Class PC3 equals a protection level of 30 **(PC3 = PL30): TIL = 1 % SF = 3,33**

Instead of using the most conservative APF in the range, which would have resulted in a safety factor of 5, the mean of the range of two most conservative numbers for the types and classes of product in the 1 % maximum TIL range was used, resulting in a safety factor of 3,33. If the most conservative APF had been used, it was considered that the resulting safety factor of 5 was too great a step compared to the differences in the safety factors in the two lower classes.

Table K.3 — Comparison of ISO Protection level for PC3 to current European protection factors

ISO				Current CEN[a]				Range of APFs	ISO safety factor	ISO protection level
RPD class	TIL %	PL	NPF	RPD type and class	TIL %	NPF	APF			
PC3	1	30	100						3,33	30
				TM2	0,50 %	200	20	20 to 100		
				TH3	0,20 %	500	40	40 to 200		

[a] Range of current European RPD type and class that fall within the requirement of 1%TIL. See also Reference [6]

K.4.5 Derivation of Safety Factor for Protection Class PC4

Class PC4 equals a protection level of 250 (**PC4 = PL250): TIL = 0,1% SF = 4**

At the TIL level of 0,1 %, the published APFs ranged from 40 for certain filtering devices to 2 000 for self-contained breathing apparatus (SCBA). In order to achieve a consensus between these two diverse numbers, and to achieve a reasonable step between PC3 and PC4, a safety factor of 4 was selected, leading to the protection level of 250. The consensus of opinion was that existing and future RPD should achieve protection class PC5 (maximum TIL 0,01 %), so that the protection level for PC4 was still conservative, relating to a maximum TIL of 0,1 %.

Table K.4 — Comparison of ISO protection level for PC4 to current European protection factors

ISO				Current CEN[a]				Range of APFs	ISO safety factor	ISO protection level
RPD class	TIL %	PL	NPF	RPD type and class	TIL %	NPF	APF			
PC4	**0,1**	**250**	**1 000**						**4**	**250**
				FM P3	0,05 % + 0,05 %	1 000	40	40 to 500		
				TM3	0,05 %	2 000	40	40 to 1 000		
				SCBA	0,05 %	2 000	2 000	1 000 to 2 000		

[a] Range of current European RPD type and class that fall within the requirement of 0,1 %TIL. See also Reference [6].

K.4.6 Derivation of Safety Factor for Protection Class PC5

Class PC5 equals a protection level of 2 000 **(PC5 = PL 2 000): TIL = 0,01 % SF = 5**

At the maximum TIL level of 0,01 %, there are no published APFs. For that reason and in order to achieve a reasonable step between the protection level for PC4 and PC5, a safety factor of 5 was selected, leading to the protection level of 2 000.

Table K.5 — Comparison of ISO protection level for PC5 to current European protection factors

ISO				Current CEN[a]				Range of APFs	ISO safety factor	ISO protection level
RPD class	TIL %	PL	NPF	RPD type and class	TIL %	NPF	APF			
PC5	0,01	2 000	10 000						5	2 000
None in this category										

[a] Range of current European RPD type and class that fall within the requirement of 0,01 %TIL. See also Reference [6].

K.4.7 Derivation of Safety Factor for Protection Class PC6

Class PC6 equals a protection level of 10 000 **(PC6 = PL10 000): TIL = 0,001 % SF = 10**

At the maximum TIL level of 0,001 %, there are no published European APFs. For that reason, a safety factor of 10 was selected, resulting in the protection level of 10 000. This was selected as this would result in a protection level of 10 000, which is the same as the current OSHA APF for SCBA.

Table K.6 — Comparison of ISO protection level for PC5 to current European protection factors

ISO				Current CEN[a]				Range of APFs	ISO safety factor	ISO protection level
RPD class	TIL %	PL	NPF	RPD type and class	TIL %	NPF	APF			
PC6	**0,001**	**10 000**	**100 000**						**10**	**10 000**
				SCBA			**OSHA**[b] 10 000			

[a] Range of current European RPD type and class that fall within the requirement of 0,001 %TIL — None in this category.

[b] See Reference [12].

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[7] EN 12021, *Respiratory equipment — Compressed gases for breathing apparatus*

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