TECHNICAL SPECIFICATION

ISO/TS 16973

First edition
2016-04-01

Respiratory protective devices — Classification for respiratory protective device (RPD), excluding RPD for underwater application

Appareils de protection respiratoire — Classification pour les APR, à l'exclusion des APR pour application sous-marine

Reference number
ISO/TS 16973:2016(E)

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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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

ISO/TS 16973 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 15, *Respiratory protective devices*.

Introduction

This Technical Specification contains the classification of Respiratory Protective Devices (RPD) and the related marking in accordance with the requirements of the performance standards.

The basic classification, which applies to all RPD, will be marked in the following order:

a) protection class;

b) work rate class;

c) respiratory interface class.

Some examples for marking of commonly known RPD are included in Annex B.

For Supplied Breathable Gas RPD, the classification also includes gas capacity class.

For Filtering RPD, the classification also includes a particle filter class and/or the gas filter types and classes.

RPD designated to be used for Special Applications are further classified accordingly.

The special applications identified are

— Firefighting,

— Chemical, Biological, Radiological and Nuclear (CBRN),

— Marine,

— Mining,

— Abrasive blasting,

— Welding, and

— Escape.

Each RPD will have an individual classification based on its performance specified in the relevant performance standards.

Explanations of the classification and examples of the classification of RPD are given in the Annexes.

The following definitions apply in understanding how to implement an ISO International Standard and other normative ISO deliverables (TS, PAS, IWA):

— “shall” indicates a requirement;

— “should” indicates a recommendation;

— “may” is used to indicate that something is permitted;

— “can” is used to indicate that something is possible, for example, that an organization or individual is able to do something.

3.3.1 of the ISO/IEC Directives, Part 2 (sixth edition, 2011) defines a requirement as an “expression in the content of a document conveying criteria to be fulfilled if compliance with the document is to be claimed and from which no deviation is permitted.”

3.3.2 of the ISO/IEC Directives, Part 2 (sixth edition, 2011) defines a recommendation as an “expression in the content of a document conveying that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.”

Respiratory protective devices — Classification for respiratory protective device (RPD), excluding RPD for underwater application

1 Scope

This Technical Specification specifies the classification of Respiratory Protective Devices based on their performance. The performance requirements are given in the relevant performance standards.

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 16900-3, *Respiratory protective devices — Methods of test and test equipment — Part 3: Determination of particle filter penetration*

ISO 16900-12, *Respiratory protective devices — Methods of test and test equipment — Part 12: Determination of volume-averaged work of breathing and peak respiratory pressures*

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

ISO/TS 16976-1, *Respiratory protective devices — Human factors — Part 1: Metabolic rates and respiratory flow rates*

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 apply.

4 Mode of operation

There are two modes of operation that RPD may employ to supply breathable gas to the wearer. These modes are specified in Table 1.

Table 1 — Mode of operation

Mode of operation	Means of providing breathable gas to the wearer	Typical examples of RPD
Breathable gas supply	The RPD supplies the wearer with breathable gas from a remote supply of breathable gas or from breathable gas stored in, or regenerated by, the RPD.	Compressed airline breathing apparatus, self-contained breathing apparatus (SCBA)
Filtration	The RPD removes gases, vapours and/or particles from the ambient air depending on the air-purifying element (filter) used. These can be assisted or unassisted devices.	Half mask with gas filter(s) Filtering facepiece

Combined RPD are devices which have both filtration and breathable gas supply modes. Combined RPD can have different classes depending on the operating method being used. An example will be an RPD which can operate as a compressed airline breathing apparatus and has an auxiliary filter.

Multi-functional RPD are RPD which have different methods of operation within either filtration or breathable gas supply modes.

Multi-functional RPD can have different classes depending on the operating method being used.

An example would be an RPD which can operate as a compressed airline breathing apparatus with an auxiliary self-contained breathing apparatus. Another example is an assisted filtering RPD which can operate as an unassisted filtering RPD when not powered.

The performance requirements for breathable gas supply RPD and filtering RPD are specified in the relevant performance standards.

5 Protection classes (PC)

RPD shall be classified by Protection Class.

The Protection classes are derived from the results of a laboratory Total Inward Leakage (TIL) test in accordance with ISO 16900-1 and the relevant performance standards. These classes are provided in Table 2.

Table 2 — Protection classes

Protection Class	TIL_{MAX} %
PC1	20
PC2	5
PC3	1
PC4	0,1
PC5	0,01
PC6	0,001

NOTE TIL is the ratio of the concentration of a test agent in the breathing zone inside the RPD compared with the concentration outside the RPD, expressed as a percentage. This is the level of total inward leakage of the RPD as measured in the laboratory under standard defined conditions. TIL levels used in RPD evaluation are given in Table 2 and Figure A.1.

6 Work rate

RPD shall be classified by Work rate class, as determined by the RPD manufacturer. The Work rate classes are derived from the results of a laboratory test, Work of breathing, and the related performance requirement, in accordance with ISO 16900-12 and the relevant performance standards.

These classes are

— W4, which is equivalent to ISO/TS 16976-1 work class 8 (maximal),

— W3, which encompasses ISO/TS 16976-1 work classes 7 and 6 (extremely heavy and very-very heavy),

— W2 which encompasses ISO/TS 16976-1 work classes 5 and 4 (very heavy and heavy), and

— W1, which encompasses ISO/TS 16976-1 work classes 3, 2 and 1 (moderate and light).

For further information, see Annex D. RPD designated for special applications may have performance requirements with minimum work rate classes.

7 Respiratory interface class

Respiratory interfaces shall be classified by coverage area [see Figure E.1, a) to e)].

Respiratory interfaces shall be further classified by type: tight fitting; those that form a seal with the wearer's skin, and loose fitting, those that have a partial seal or no seal with the skin of the wearer. See Table 3, Figure A.1 and Figure E.1.

Table 3 — Respiratory interface classes

RI Class	RI area	Type
eL	e - more than head, up to complete body	L-Loose fitting
eT	e - more than head, up to complete body	T-Tight fitting
dL	d - Head	L-Loose fitting
dT	d - Head	T-Tight fitting
cL	c - Face	L-Loose fitting
cT	c - Face	T-Tight fitting
bL	b - Nose and mouth	L-Loose fitting
bT	b - Nose and mouth	T-Tight fitting
aL	a - Mouth only	L-Loose fitting
aT	a - Mouth only	T-Tight fitting

8 Supplied breathable gas RPD capacity class

Supplied breathable gas RPD that have a fixed volume of breathable gas (self-contained) shall be classified by the volume of breathable gas available for respiration and shall be designated by the letter "S" followed by the gas capacity in litres rounded down to increments of 150 l up to 900 l and increments of 300 l above 900 l.

Supplied breathable gas RPD that have an external supply of breathable gas shall be classified and marked "SY".

Gas Capacity classification of these devices is shown in Table 4 and Figure A.2.

Table 4 — Supplied breathable gas capacity

Class	Gas capacity l
Sxxxx	Where xxxx is the available breathable gas volume for respiration
SY	Air supply from an external source (air line supplied)

9 Filter class

9.1 Particle filter class

Particle filters shall be classified by their efficiency and work rate.

9.1.1 Particle filter efficiency

Five classes of particle filter efficiency are defined ranging from very low efficiency to extremely high efficiency. Table 5 and Figure A.3 list the filter classes and their minimum filter efficiency as determined in laboratory filter efficiency tests in accordance with ISO 16900-3 by testing at the relevant flowrate in accordance with the work rate class.

Table 5 — Particle filter class

Class	Particle filter efficiency %
F1	≥80,00
F2	≥95,00
F3	≥99,00
F4	≥99,90
F5	≥99,99

9.1.2 Particle filter work rate class

Particle filters shall be additionally classified by work rate and are also marked with a lower case “w” and the work rate class number, i.e. “w1”, “w2”, “w3” or “w4” after the efficiency and/or capacity class.

9.2 Gas filter class

9.2.1 General

A gas filter shall be classified by type (kind of gases), class (based on gas capacity) and work rate.

A given gas filter can be of one type only or a multiple type.

9.2.2 Gas filter capacity

A gas filter is classified by its capacity to remove the contaminants and is tested at different concentrations depending on the class (1, 2, 3, and 4) and different flows depending on the work rate. Some filters are for many contaminants within a category, e.g. organic vapours, and others for specific gases or vapours, e.g. Arsine. Up to four capacity classes are defined depending on the filter type as shown in Table 6, Table 7 and Figure A.3.

Table 6 — Gas filter types and classes

Type	Classes	Type description	Typical contaminants
OV	1, 2, 3 or 4	Organic vapour	C_7H_8 (Toluene) C_6H_{12} (Cyclohexane)
OG	1	Organic gas (low boiling, i.e. below 65 °C)	C_3H_6O (Acetone) C_4H_{10} (Isobutane) C_2H_6O (Dimethylether)
AC	1, 2, 3 or 4	Acidic compounds	Cl_2 (Chlorine) H_2S (Hydrogen sulphide) HCl (Hydrogen chloride) SO_2 (Sulfur dioxide)
BC	1, 2, 3 or 4	Basic compounds	NH_3, (Ammonia) CH_3NH_2 (Methylamine)
NOX	1, 2, or 3	Nitrogen oxides	NO_x (Nitrogen oxides)

Table 7 — Specific gas filter types and classes

Type	Classes	Gas or vapour
ND	1, 2 or 3	Nitrogen dioxide (NO_2)
HG	1, 2 or 3	Mercury (Hg)
OZ	1	Ozone (O_3)
HCN	1, 2, 3 or 4	Hydrogen Cyanide (HCN)
AH	1	Arsine (AsH_3)
HF	1, 2 or 3	Hydrogen fluoride (HF)
CD	1	Chlorine dioxide (ClO_2)
ETO	1 or 2	Ethylene oxide ($(CH_2)_2O$)
FM	1, 2 or 3	Formaldehyde (CH_2O)
MB	1, 2 or 3	Methylbromide (CH_3Br)
CO	Three classes based on time (20 min, 60 min or 180 min)	Carbon monoxide (CO)
PH	1 or 2	Phosphine (PH_3)

9.2.3 Gas filter work rate class

Gas filters shall be additionally classified by work rate and are also marked with a lower case “w” and the work rate class number, i.e. “w1”, “w2”, ”w3” or “w4”, after the efficiency and/or capacity class.

10 RPD using standardized connector

Some complete RPD include respiratory interfaces and filters with standardized connectors in accordance with ISO 17420-3, to allow interchangeability. Limitations to classes apply as specified in the relevant performance standard.

A respiratory interface and filter with standardized connector is marked with their classification, also as specified in the relevant performance standard. The symbol for Standardized connector, ⊙, is added to the marking. Filters with standardized connectors are validated for work rate class w1 or w2.

11 Special application class

11.1 General

Special applications specify different areas of RPD use with specific performance requirements. Minimum Protection class (PC) and Work rate class (W) are set in accordance with the relevant performance standards and are specified in 11.2 to 11.8. These classes shall be met in order to be classified for the special application. Higher PC and W classes are not excluded.

Special applications include

— Firefighting,

— CBRN,

— Marine,

— Mining,

— Abrasive blasting,

— Welding, and

— Escape.

Special application devices are designated by alpha-numeric designation.

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

11.2 Firefighting class

RPD for Firefighting are designated by the respective RPD classifications followed by FF and the numeric designation for specific firefighting application. These specific applications are wildland firefighting, rescue, hazardous materials and structural firefighting. See Table 8 and Figure A.4.

Table 8 — Firefighting classes

Class	Application	Minimum protection class	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 according to ISO 11999-1.

11.3 Chemical, biological, radiological and nuclear class

RPD for CBRN are designated by the respective RPD classifications followed by and the numeric designation for specific CBRN application. See Table 9 and Figure A.4.

Table 9 — Chemical, biological, radiological and nuclear classes

Class	Application	Minimum protection class	Minimum work rate class
CBRN 3	First on-scene responder	PC5	W3
CBRN 2	Responder (known threat environment)	PC5	W1
CBRN 1	Receiver/first receiver	PC4	W1

11.4 Marine class

RPD for Marine are designated by the respective RPD classifications followed by MA and the numeric designation for specific Marine application. These specific applications are firefighting and hazardous materials. See Table 10 and Figure A.4.

Table 10 — Marine classes

Class	Application	Minimum protection class	Minimum work rate class
MA2	Marine firefighting	PC5	W4
MA1	Hazardous materials		W3

11.5 Mining class

RPD for Mining are designated by the respective RPD classifications followed by MN followed by the numeric designation for specific Mining application. These specific applications are: Underground non-explosive atmosphere, Underground explosive atmosphere and Firefighting. See Table 11 and Figure A.4.

Table 11 — Mining classes

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

[a] Type R2 includes higher level of thermal exposure than Type R1 according to ISO 11999-1.

11.6 Abrasive blasting class

RPD for abrasive blasting are designated by the respective RPD classifications followed by AB followed by the numeric designation for specific abrasive blasting application. Currently, only one numeric designation has been identified. See Table 12 and Figure A.4.

Table 12 — Abrasive blasting class

Class	Application	Minimum protection class	Minimum work rate class
AB	Abrasive blasting	PC3	W1

11.7 Welding class

RPD for welding are designated by the respective RPD classifications followed by WE. See Table 13 and Figure A.4.

Table 13 — Welding class

Class	Application	Minimum protection class	Minimum work rate class
WE	Welding	PC1	W1

11.8 Escape class

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

Escape general Filtering RPD are designated by ES followed the gas filter type, e.g. ES OV (t).

Escape general, supplied breathable gas RPD, are not designated for a specific contaminant. See Table 14, Table 15 and Figure A.4.

Table 14 — Escape classes

Class	Application	Duration	Minimum protection class	Minimum work rate class
ES MN t	Mining Escape	t[b]	PC3	W1
ES MA t	Marine Escape			
ES CBRN t	CBRN Escape			
ES FF t	Escape from fire			
ES XX[a] t	Escape general filtering RPD			
ES t	Escape general supplied breathable gas RPD			

[a] XX is the type of gas filter.

[b] The “t” values in the table above are listed in Table 15.

Table 15 — Designated durations

“t” - Designated duration (minutes)	Steps
5 to 30 (5, 10,15, 20, 25, 30)	5 min
30 to 60 (40, 50, 60)	10 min
60 to 120 (90, 120)	30 min
120 and above (180, 240...)	60 min

12 Sequence of marking information

12.1 Sequence of marking-supplied breathable gas RPD

The sequence of classification marking is as follows:

— protection class;

— work rate;

— respiratory interface;

— supplied breathable gas capacity;

— special application.

For examples of marking, see Annex B.

12.2 Sequence of marking-filtering RPD

The sequence of classification marking is as follows:

— protection class;

— work rate;

— respiratory interface;

— particle filter, if applicable;

— gas filter, if applicable;

— special application, if applicable.

For examples of marking, see Annex B.

12.3 Sequence of marking-filter

The sequence of classification marking is as follows:

— particle filter, if applicable;

— gas filter, if applicable;

— work rate in lower case w;

— special application, if applicable.

For examples of marking, see Annex B.

12.4 Sequence of marking-respiratory interface using standardized connector

The sequence of classification marking is as follows:

— standardized connector symbol;

— protection class;

— work rate;

— respiratory interface.

For examples of marking, see Annex B.

12.5 Sequence of marking-filters using standardized connector

The sequence of classification marking is as follows:

— standardized connector symbol;

— particle filter, if applicable;

— gas filter, if applicable;

— work rate class in lower case w.

For examples of marking, see Annex B.

Annex A
(normative)

Classification and related marking scheme overview

Each RPD shall have an individual classification based on its performance specified in the relevant performance standards. Figure A.1 to Figure A.4 give an overview of all the possible RPD classes.

All RPD shall have a basic classification consisting of a Protection Class, Work rate class, and Respiratory interface class in accordance with Figure A.1

Supplied Breathable gas RPD shall be classified in accordance with Figure A.1 followed by the supplied breathable gas capacity class in accordance with Figure A.2.

Filtering RPD shall be classified in accordance with Figure A.1 followed by the filter type and class classification in accordance with Figure A.3.

RPD designated for Special Application shall be classified in accordance with Figure A.1 and Figure A.2 or Figure A.3, followed by the Special applications classification in accordance with Figure A.4.

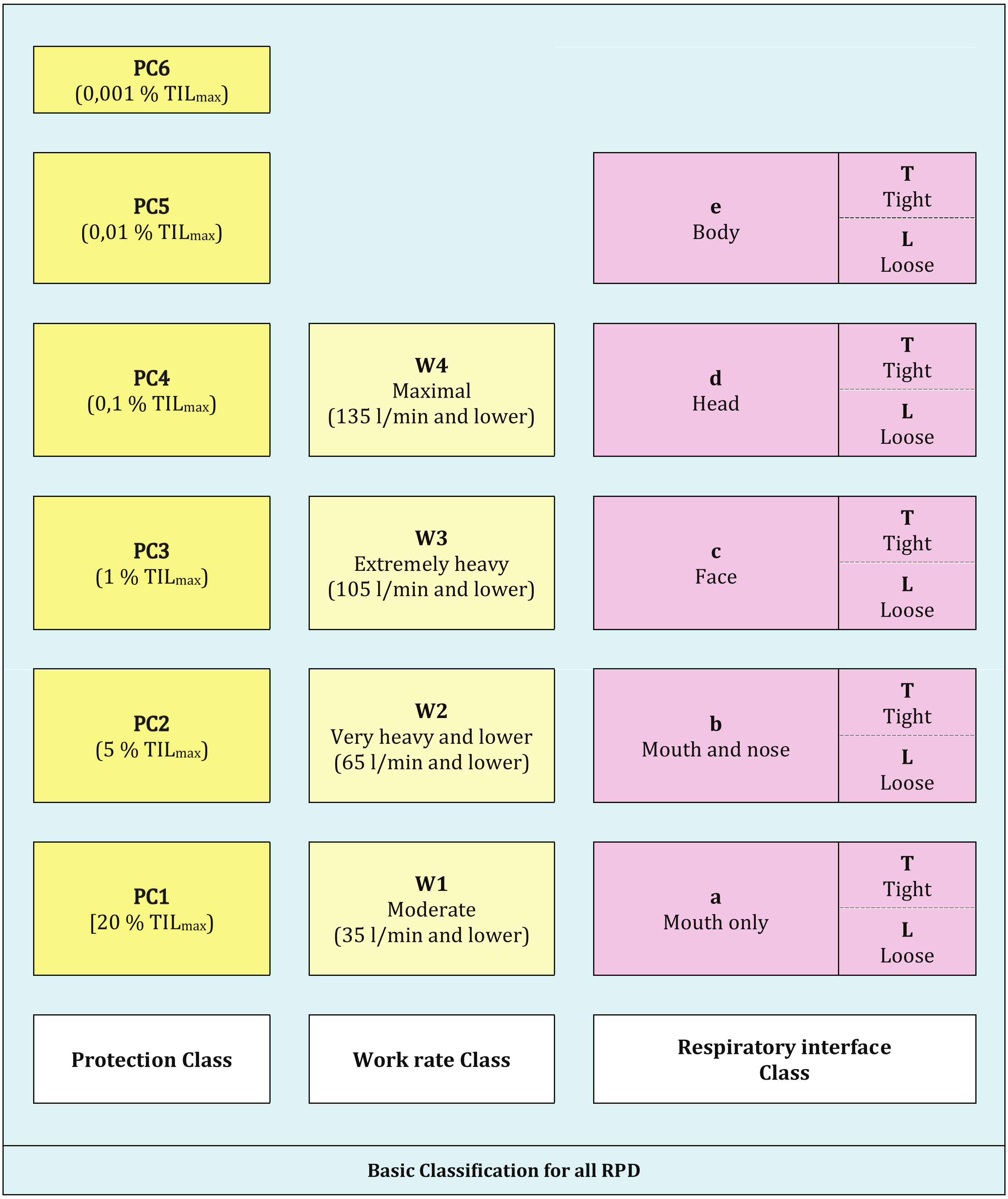


Figure A.1 — Basic classification for all RPD

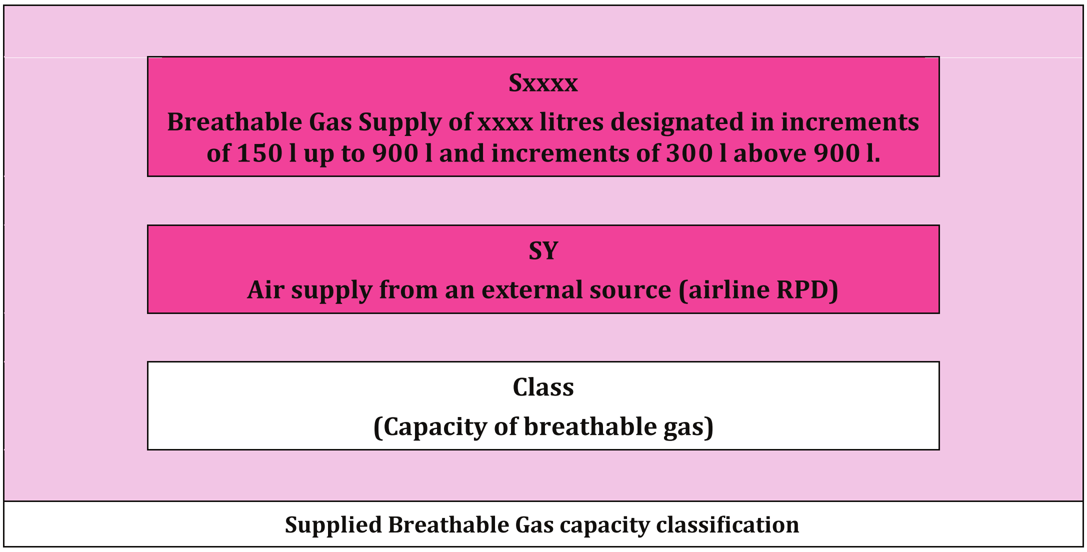
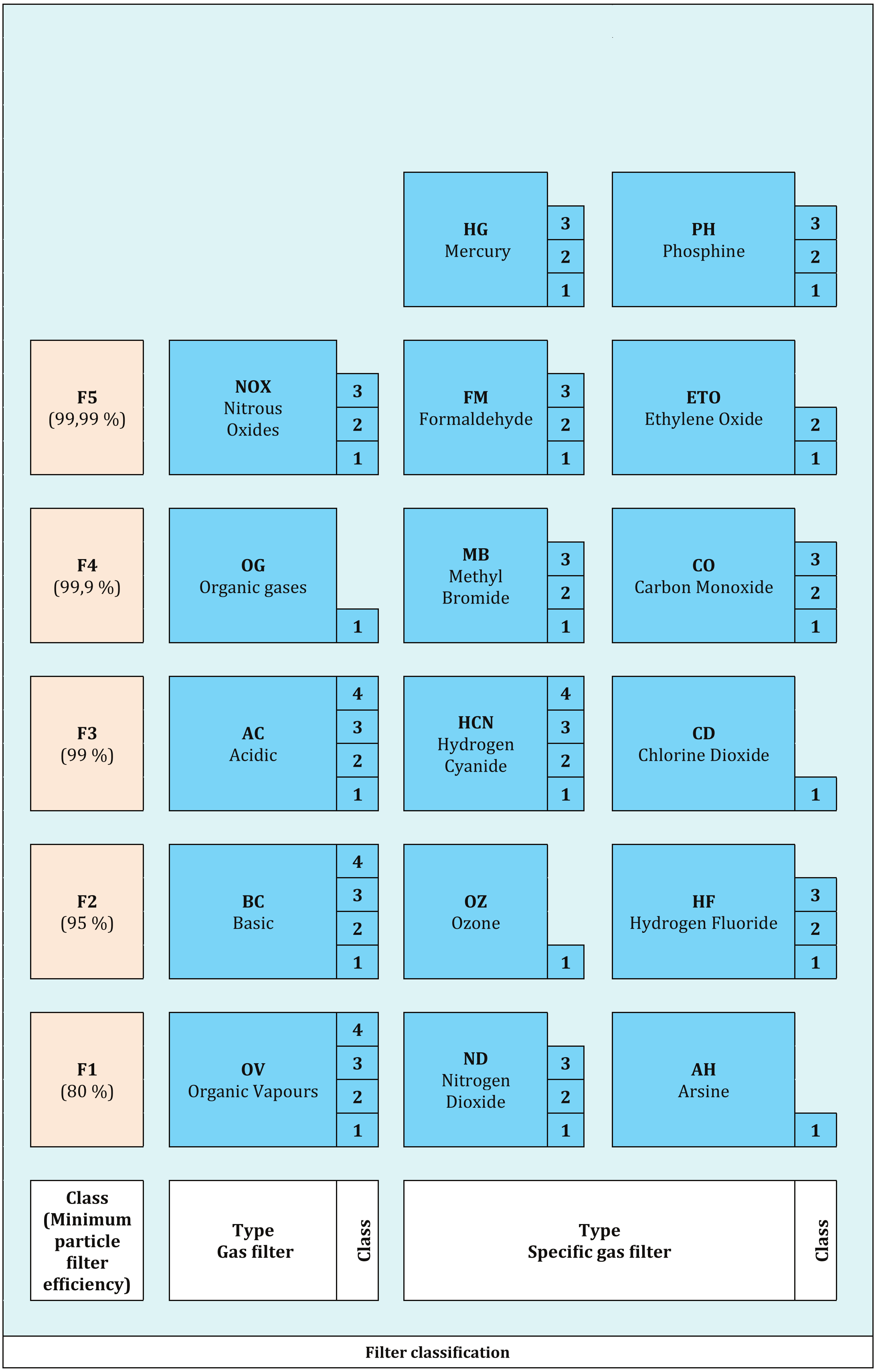
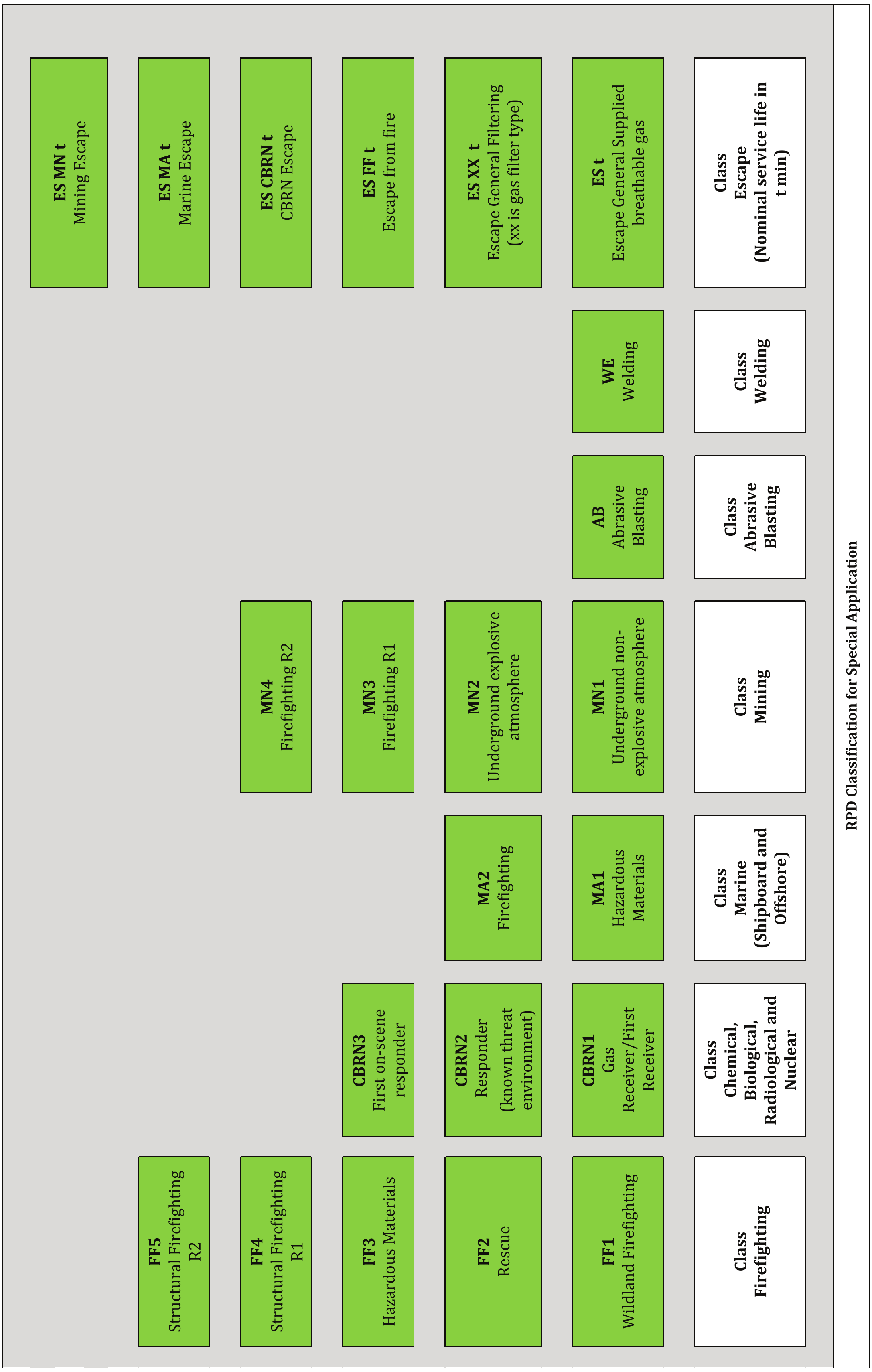


Figure A.2 — Supplied breathable gas capacity classification



NOTE Filters are also classified by work rate and are marked with a lower case w and the work rate class number, i.e. “w1”, “w2”, ”w3” or “w4”, after the efficiency and/or capacity class.

Figure A.3 — Filter classification



NOTE Each Special Application RPD may have a minimum Protection Class (PC) and minimum Work rate Class (W).

Figure A.4 — RPD classification for Special application

Annex B
(informative)

Examples for ISO classification and related marking

B.1 General

The following are examples of today's RPD converted into the corresponding ISO terminology.

B.1.1 Example A

A positive pressure compressed air breathing apparatus with a full face mask with a total inward leakage <0,001 % and validated for ISO work rate 4. Available breathable gas capacity: 1 260 l. See Table B.1.

Table B.1 — Example A

Performance	Class
Protection class	PC6
Work rate	W4
Respiratory Interface	cT
Supplied breathable gas capacity	S1200

ISO RPD classification and marking: PC6 W4 cT S1200

B.1.2 Example B

A filtering facepiece protecting the wearer against harmful particles, with a total inward leakage of <20 %, being validated for ISO work rate 1 and having a minimum filter efficiency of 99 %. See Table B.2.

Table B.2 — Example B

Performance	Class
Protection class	PC1
Work rate	W1
Respiratory Interface	bT
Particle Filter Efficiency	F3w1

ISO RPD classification and marking: PC1 W1 bT F3

B.1.3 Example C

A powered air purifying respirator with a respiratory interface (loose fitting hood) and organic vapour filters with class I capacity tested and validated at ISO work rate 2. The RPD protects the wearer against contaminants with a total inward leakage of <1 %. See Table B.3.

Table B.3 — Example C

Performance	Class
Protection class	PC3
Work rate	W2
Respiratory Interface	dL
Gas filter type/class	OV1 w2

ISO RPD classification and marking: PC3 W2 dL OV1

B.1.4 Example D

A tight fitting full face mask air purifying respirator with organic vapours, acidic gas, basic gas, Class 3 and particle filters with >99,99 % efficiency, which is validated at ISO work rate 1 with a total inward leakage of <0,1 %. The example in Table B.4 includes a combination filter.

Table B.4 — Example D

Performance	Class
Protection class	PC4
Work rate	W1
Respiratory interface	cT
Combination filter type/class	F5 OV3 AC3 BC3 w1

ISO RPD classification and marking: PC4 W1 cT F5 OV3 AC3 BC3

B.1.5 Example E

A tight fitting half face mask air purifying respirator with organic vapours, Class 2 gas filters and particle filters with >95 % efficiency, which is validated at ISO work rate 1 with a total inward leakage of <5,0 %. The example in Table B.5 includes individual particle and gas filters.

Table B.5 — Example E

Performance	Class
Protection class	PC2
Work rate	W1
Respiratory Interface	bT
Particle filter class	F2 w1
Gas filter type/class	OV2 w1

ISO RPD classification and marking: PC2 W1 bT F2 OV2

B.1.6 Example F

Particle filter with >99,99 % efficiency and a standardized connector tested and validated at the work rate given in the information supplied by the RPD manufacturer, ISO work rate 2. See Table B.6.

NOTE Filters and respiratory interfaces using a connector in accordance with ISO 17420-3, include the marking by this symbol (◎).

Table B.6 — Example F

Performance	Class
Particle filter class	F5 w2

ISO filter marking: ◎ F5 w2

B.1.7 Example G

Replaceable gas filter organic vapours, class 3 without a standardized connector tested and validated at the work rate given in the information supplied by the RPD manufacturer, ISO work rate 2. See Table B.7.

Table B.7 — Example G

Performance	Class
Gas filter class	OV3 w2

ISO filter marking: OV3 w2

B.1.8 Example H

Combination filter with >99 % efficiency particle filter and a basic gas filter, class 2, with a standardized connector tested and validated at the work rate given in the information supplied by the RPD manufacturer, ISO work rate 1. See Table B.8.

Table B.8 — Example H

Performance	Class
Combination filter class	F3 BC2 w1

Combination filter marking: ◎ F3 BC2 w1

B.1.9 Example I

A tight fitting full face mask with a Standardized Connector tested and validated for ISO work rate 2 having an inward leakage of <0,01 %. See Table B.9.

Table B.9 — Example I

Performance	Class
Protection class	PC5
Work rate	W2
Respiratory interface	cT
Full face mask class	PC5 W1 cT

Full face mask marking: ◎ PC5 W2 cT

B.1.10 Example J

A tight-fitting full face mask air purifying respirator with standardized connector and organic vapours, acidic gas, basic gas, class 3 and particle filters with >99,99 % efficiency, which is validated at ISO work rate 2 with a total inward leakage of <0,1 %. Since the respiratory interface and filter with standardized connector shall be marked with their classification and this symbol (◎) for standardized connector, it is included and precedes the filter classification mark. See Table B.10.

Table B.10 — Example J

Basic Performance Characteristic	Class
Protection class	PC4
Work rate	W2
Respiratory Interface	cT
Combination Filter Class	F5 OV3 AC3 BC3 w2

ISO RPD classification: PC4 W2 cT F5 OV3 AC3 BC3

ISO Respiratory Interface marking: ◎ PC4 W2 cT

ISO Filter marking: ◎ F5 OV3 AC3 BC3 w2

B.1.11 Example K

Supplied airline continuous flow with respiratory interface (loose fitting, more than head covering, up to complete body, a suit) with combination filter organic vapour, acidic gas class 2 and >95 % particle filter validated at ISO work rate 1 and an inward leakage <0,001 % in the supplied air mode and <0,1 % in the filtering mode. See Table B.11.

Table B.11 — Example K

Basic Performance Characteristic	Breathable gas supply Class	Filtering Class
Protection class	PC6	PC4
Work rate	W1	W1
Respiratory Interface	eL	eL
Supplied breathable gas capacity	SY	—
Combination Filter	—	F2 OV2 AC2 w1

ISO RPD classification and marking: PC6 W1 eL SY / PC4 W1 eL F2 OV2 AC2

B.1.12 Example L

A general escape hood (respirator interface tight fitting, 20 min duration, with combination filter for Organic Vapours, Acidic gases, Carbon monoxide, hydrogen cyanide gas filter, all class 1 and >95 % efficient particle filter with a total inward leakage of <5 % validated at a ISO work rate 1. See Table B.12.

Table B.12 — Example L

Basic Performance Characteristic	Class
Protection class	PC2
Work rate	W1
Respiratory interface	dT
Combination Filter	F2 OV1 AC1 HCN1 CO20 w1
Special application - Escape	ES20

ISO RPD classification and marking: PC2 W1 dT F2 OV1 AC1 HCN1 CO20 ES20

B.1.13 Example M

A tight-fitting full face mask combined device for general escape including a supplied airline validated at ISO work rate 4 and an inward leakage <0,001 % with a 5 min escape cylinder. See Table B.13.

Table B.13 — Example M

Basic Performance Characteristic	Breathable gas supply class	Escape class
Protection class	PC6	PC6
Work rate	W4	W1
Respiratory interface	cT	cT
Supplied breathable gas capacity	SY	
Special application - Escape	-	ES5

ISO RPD classification and marking: PC6 W4 cT SY/PC6 W1 cT ES5

B.1.14 Example N

An escape device with respiratory interface (tight fitting hood) for marine escape a duration of 15 min (validated at ISO work rate 1), having a total inward leakage of <0,01 % and validated at ISO work rate 2. See Table B.14.

Table B.14 — Example P

Basic Performance Characteristic	Breathable gas supply class
Protection class	PC5
Work rate	W2
Respiratory interface	dT
Special application - Escape Marine	ES MA15

ISO RPD classification and marking: PC5 W2 dT ES MA15

B.1.15 Example O

A mouth bit escape device for mining escape with a duration of 180 min validated at ISO work rate 2, having a total inward leakage of <0,01 % See Table B.15.

Table B.15 — Example O

Basic Performance Characteristic	Class
Protection class	PC5
Work rate	W2
Respiratory Interface	aT
Gas filter	CO180
Special application -Escape mining	ES MN180

ISO RPD classification and marking: PC5 W2 aT CO180 ES MN180

Examples B.1.16 and B.1.17 are typical of the information that a manufacturer may provide with RPD or with RPD components in case of multiple configurations.

B.1.16 Example P

In case of assisted filtering RPD using various respiratory interfaces and various filters, Table B.16 shows a typical configuration to address multiple markings.

Table B.16 — Typical configuration matrix assisted filtering RPD

		CONFIGURATION MATRIX ASSISTED FILTERING RPD																			
		1		2						3			4		5		6				9
	SELECTABLE COMPONENT	BASIC UNIT		RESPIRATORY INTERFACES (RI)						PARTICLE FILTERS			GAS FILTERS		COMBINATION FILTERS		HOSES				OPTIONAL ACCESSORIES
	DESCRIPTION[a]	Turbo Blower A (400 l/min)	Turbo Blower B (200 l/min)	HM 3300 medium	HM 3300 small	FFM 3300 large	FFM 3500 medium	Helmet LF 3100 small	Hood TF 5000 fit for all sizes	F2	F3	F4	OV3	AC2 OV3 AC3	F4OV3	F4 AC2 OV3 AC2	EPDM-Hose RI	IIR-Hose Hood	EPDM-Hose Helmet	IIR-Hose Helmet	Pre-filter
Classification[b]	**Identification No.[a]**	2345703	2345704	2345678	2345679	2345680	2345681	2345682	2345683	2345695	2345696	2345697	2345684	2345685	2345687	2345686	2345699	2345700	2345701	2345702	2345707
PC2 W4 bT F2		X		X	X					X							X				
PC2 W4 cT F2		X				X	X			X							X				
PC3 W4 bT F3		X		X	X						X						X				X
PC3 W4 cT F3		X				X	X			X							X				X
PC2 W4 dL F2		X						X	X		X							X	X	X	
PC2 W4 dL F3		X						X	X			X						X	X	X	X
PC5 W2 cT F4			X			X	X					X					X				
PC3 W4 bT F4		X		X	X							X					X				
PC5 W2 cT OV3			X			X	X						X				X				
PC4 W2 cT OV3			X			X	X						X				X		X	X	X
PC4 W2 dL OV3			X					X					X				X		X	X	X
PC3 W2 bT OV3			X	X	X								X				X	X	X	X	
PC3 W2 cT OV3			X			X	X						X				X	X	X	X	
PC3 W2 dL OV3			X					X	X				X				X	X	X	X	
PC4 W3 F4 OV3		X				X	X					X	X				X				
PC4 W2 F4 OV3			X			X	X					X			X		X				X
PC3 W3 bT AC2 OV3 AG3		X		X	X									X			X	X	X	X	
PC3 W3 cT AC2 OV3 AG3		X				X	X							X			X	X	X	X	

[a] The identification number and descriptions used in this example are fictitious and are used for illustration purpose only.

[b] Complete classification is given in the left column and the marking = PC W , where is the symbol for "See information supplied by the manufacturer" from ISO 16972.

Table B.16 *(continued)*

		CONFIGURATION MATRIX ASSISTED FILTERING RPD																			
		1		2						3			4		5		6				9
	SELECTABLE COMPONENT	BASIC UNIT		RESPIRATORY INTERFACES (RI)						PARTICLE FILTERS			GAS FILTERS		COMBINATION FILTERS		HOSES				OPTIONAL ACCESSORIES
	DESCRIPTION[a]	Turbo Blower A (400 l/min)	Turbo Blower B (200 l/min)	HM 3300 medium	HM 3300 small	FFM 3300 large	FFM 3500 medium	Helmet LF 3100 small	Hood TF 5000 fit for all sizes	F2	F3	F4	OV3	AC2 OV3 AC3	F4OV3	F4 AC2 OV3 AC2	EPDM-Hose RI	IIR-Hose Hood	EPDM-Hose Helmet	IIR-Hose Helmet	Pre-filter
Classification[b]	**Identification No.**[a]	234 570 3	234 570 4	234 567 8	234 567 9	234 568 0	234 568 1	234 568 2	234 568 3	234 569 5	234 569 6	234 569 7	234 568 4	234 568 5	234 568 7	234 568 6	234 569 9	234 570 0	234 570 1	234 570 2	234 570 7
PC3 W3 dL AC2 OV3 AG3		X						X	X					X			X	X	X	X	
PC4 W3 cT F4 AC2 OV3 AG3		X				X	X					X		X			X				
PC4 W3 cT F4 AC2 OV3 AG2		X				X	X									X	X				

[a] The identification number and descriptions used in this example are fictitious and are used for illustration purpose only.

[b] Complete classification is given in the left column and the marking = PC W , where is the symbol for "See information supplied by the manufacturer" from ISO 16972.

B.1.17 Example Q

In case of assisted filtering RPD using various respiratory interfaces and various filters, Table B.17 shows a typical configuration to address multiple markings.

Table B.17 — Typical configuration matrix supplied breathable gas RPD

		CONFIGURATION MATRIX SUPPLIED BRATHABLE GAS RPD																			
		1		2						3			4		5		6				7
	SELECTABLE COMPONENT	BASIC UNIT		RESPIRATORY INTERFACES (RI)						DEMAND VALVE (including hose)			GAUGE		PRESSURE REDUCER		CYLINDERS				OPTIONAL ACCESSORIES
	DESCRIPTION[a]	Backplate (single cylinder strap)	Backplate (universal strap)	HM 4400 thread medium	FFM 4400 thread small	FFM 4500 bayonet large	FFM 4600 plugin medium	Mask-Helmet MH 6600 large	Hood TF 6000 fit for all sizes	DV 4400 thread	DV 4500 bayonet	DV 4600 plugin	PNG pneumatic	ETG electronic	PR G5/8 200B/ 300B	PR quick 300B	Steel 6 l 200 bar	Steel 6,8 l 300B	Composite 6,8 l 300B	Composite 9 l 300B	Tool pouch
Classification[b]	**Identification No.**[a]	434 577 6	434 577 7	434 564 0	434 565 0	434 566 0	434 567 0	434 568 0	434 568 1	434 569 3	434 569 5	434 569 8	434 568 2	434 568 3	434 568 6	434 568 7	434 570 0	434 570 1	434 570 2	434 570 3	434 570 6
PC3 W4 bT S900		X		X						X			X		X		X				
PC4 W4 cT S900		X			X	X	X			X	X	X	X		X		X				X
PC3 W2 dL S900		X							X	X			X		X		X				
PC5 W3 cT S1700		X				X	X				X	X		X	X						X
PC6 W4 cT S1700		X					X	X			X	X		X	X	X		X	X		X
PC3 W3 dL S900		X							X		X		X		X			X	X		
PC5 W3 cT S3400			X			X	X	X			X	X		X	X		X				X
PC3 W3 bT S900		X		X						X			X		X			X	X		
PC4 W4 cT S2200		X				X	X				X	X	X		X		X			X	X
PC5 W4 cT S2200		X					X					X		X	X					X	X
PC5 W4 cT S1700 FF5		X					X	X				X		X	X	X		X	X		X
PC4 W2 cT S1700 FF4		X			X		X	X		X		X	X		X	X		X	X		X

a The identification number and descriptions used in this example are fictitious and are used for illustration purpose only.

b Complete classification is given in the left column and the marking = PCⓘ Wⓘ, where ⓘ is the symbol for "See information supplied by the manufacturer" from ISO 16972.

Annex C
(informative)

Special applications

Table C.1 gives explanations about the special applications where RPD are being used and RPD fulfilling basic requirements are not sufficient.

Table C.1 — Special applications

Application	Explanation[a]
Firefighting	Firefighting is regarded to be a special application due to the extreme conditions that are present. Firefighting tasks encompass structural firefighting (burning houses), hazardous materials (e.g. spilled chemicals), rescue and wildland firefighting. Such diverse activities incorporate a range of different hazards. Therefore, it is necessary that RPDs for firefighting fulfil additional requirements. These include higher resistance to heat and flame, increased mechanical stability and chemical resistance.
CBRN **Chemical Biological Radiological Nuclear**	The increased threat from terrorist activities has led to a need for RPD suitable for emergency responders. The hazards posed by CBRN threats necessitate requirements additional to those of basic RPD. CBRN RPD is intended for rescue, evacuation, escape, hazard containment, decontamination and related activities by emergency responders (fire, ambulance, police and associated civilian agencies and workers) in response to CBRN release events. CBRN is an acronym meaning chemical, biological, radiological, and nuclear. *C- Chemical*: Chemical gases, vapours and particles of chemical warfare agents and toxic industrial materials. *B- Biological*: Biological agent particles such as microorganisms or toxin products. *R- Radiological*: Radioactive particles such as particles carrying alpha or beta radioactive isotopes dispersed by various means such as a radiological dispersive device, also known as a “dirty bomb”. *N- Nuclear*: Radioactive material such as the radioactive particles transported/dispersed from a detonation involving a nuclear reactor/fuel, a nuclear weapon, or a nuclear weapon’s component or component pre-cursor. NOTE Protection afforded against the thermal, blast, and electromagnetic pulse, effects of an improvised nuclear device or a nuclear weapon detonation are beyond the scope of this definition.
Marine	RPD to be used in the off-shore industry located on-board ships and drilling platforms for respiratory protection during firefighting, hazardous materials and for escape purposes. During storage and use, these devices may be exposed to low frequency vibrations with high impact due to high accelerations and rough sea climate (high humidity with high concentration of salt). Confined spaces and oxygen deficiency are likely to be encountered. The donning time and the easy access to the RPD are important.
Mining	In the mining environment, RPD are used for different purposes and may be exposed to rough usage, vibration, quick climatic and pressure changes, corrosive substances, extremes of humidity, water splash, explosive atmospheres and extremely high dust concentrations. RPD used in mine rescue or firefighting need long durations and must support a high work rate.

[a] The examples given in this table are not exhaustive.

Table C.1 *(continued)*

Application	Explanation[a]
Abrasive blasting	Abrasive blasting is the use of abrasive material to clean or texturize a surface. Typically used in industries such as construction, shipbuilding, automotive, etc. that involve surface preparation. Abrasive materials may include sand, slags, mineral abrasives, metallic abrasives, water, dry ice and synthetic abrasives. In addition to basic requirements, further requirements such as high impact resistance is required to protect the worker from the physical hazards of rebounding abrasives.
Welding	Welding is a process that joins materials, usually metals, by melting and is commonly used in industries such as construction, shipbuilding and automotive manufacture. Welding processes employed include MIG/MAG, flux core, TIG, MMA and laser welding. High resistance against the hazards introduced in welding is required. These include excessive heat, sparks, and UV radiation, and there is an additional need for electro-magnetic compatibility.
Escape	There are many unpredictable situations where workers have to be protected within seconds against the threat of a contaminated and/or oxygen-deficient atmosphere. These include confined spaces, mining and work on board ships or underground. RPD may be carried on the worker's body or stored at strategic locations close by the work space. Mass, weight distribution, size and ergonomic design are important. RPD need to be easily donned with minimal training. Minimum requirements are different from those of RPD designed for routine use because shorter wear duration and infrequent use is expected. Specific criteria address higher inhalation and exhalation rates, higher permitted CO_2 concentration in inhaled air and different filter capacities. Under certain special applications (fire, CBRN, marine, mining), escape devices shall meet additional specific requirements. For example, those for use on board ships must withstand low frequency/high acceleration vibration conditions as escape devices may be directly mounted on the walls of vessels. Escape RPD for deployment in mines must address the possibility of poor ventilation, restricted escape paths and long exit routes.

[a] The examples given in this table are not exhaustive.

Annex D
(informative)

Work rate class

The work rate is a measure of how hard an, in this case, RPD wearer, is physically working expressed in the demand of breathable gas (by the wearer) per time period. The work rate therefore can be expressed as the breathable gas needed by the wearer for work, expressed in l/min, of inhaled breathable gas (minute volume).

The RPD is fitted to an ISO head form as indicated in the information supplied by the RPD manufacturer, is tested and validated for determination of the work rate class, as indicated in the relevant performance standards.

The breathing machine or metabolic simulator, as applicable, is operated at a combination of tidal volume and breathing frequency in accordance with the relevant performance standard. The work of breathing is calculated from recorded measurements of volume and pressure. These recordings will also provide peak pressures values.

Considering the sinusoidal shape of the ventilation curve, especially during the inhalation period of the Work of breathing laboratory test, the gas volume varies. The maximum and mean value for minute volume are related in the following way:

$$q_{\mathrm{max}} = q_{\mathrm{mean}} \times \pi$$

The explanation of work rate and the associated class descriptions are given in ISO/TS 16976-1. The laboratory test method is specified in ISO 16900-12.

The minute volumes described for each of the four ISO work rate class described in Table D.1 and given in Figure A.1 are based on the mean work rates from ISO/TS 16976-1, plus one standard error, for a 2,1m^2 body surface man.

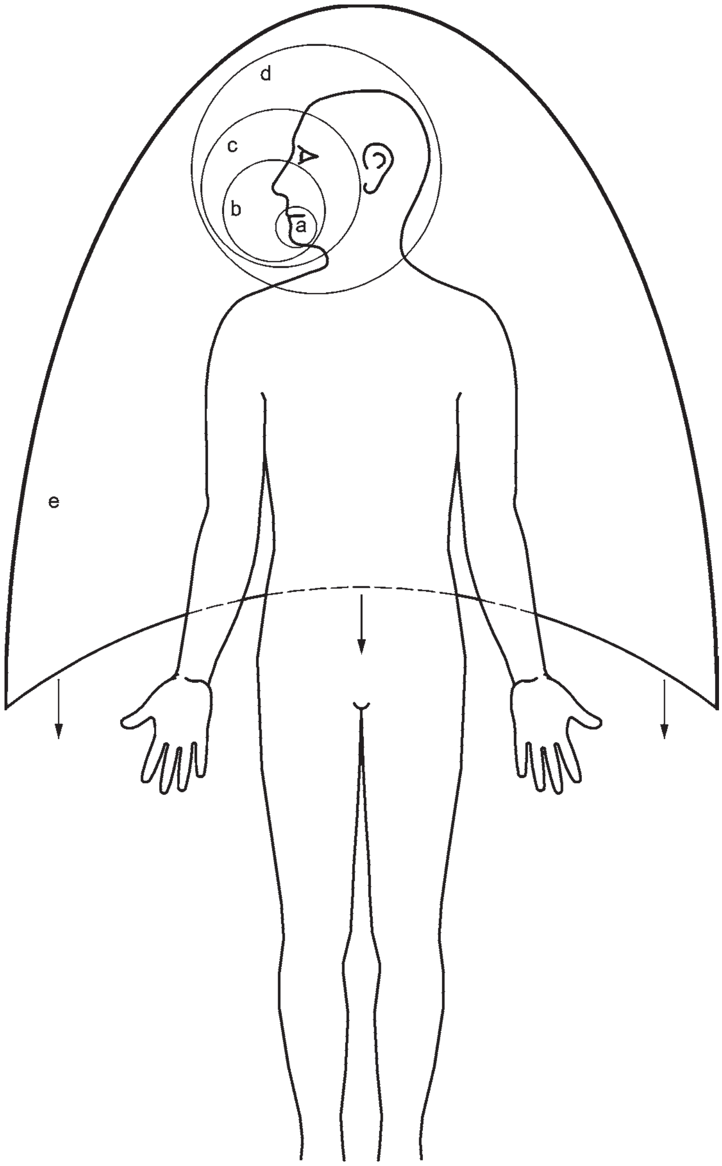
Table D.1 — Work rate class

Work rate class	Minute volume	Examples of work and activities
W1	35 l/min (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	65 l/min (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 shoveling or digging; climbing stairs, ramp or ladder; walking quickly with small forms; running; walking at a speed greater than 5,5 km/h.
W3	85 l/min (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 firefighting 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	135 l/min (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.
Level for testing only	10 l/min	Equivalent to resting

Annex E
(informative)

Respiratory interface class

Respiratory interfaces are described by RI area. See Figure E.1.



Key

a Class a is around the mouth (with nose blocked).

EXAMPLES Mouthbit, and mouthpiece, (with nose clip).

b Class b covers both the nose and mouth.

EXAMPLES Half-mask, quarter-mask and filtering facepiece.

c Class c covers the nose, mouth and eyes.

EXAMPLES Full facepiece (full face mask), visor, loose fitting helmet.

d Class d covers the entire head.

EXAMPLE Hood.

e Class e covers part or all of the body.

EXAMPLES Suit, blouse, overall.

Figure E.1 — Respiratory interface areas

Respiratory interfaces are further classified by type: tight fitting, those that form a seal with the wearer's skin, and loose fitting, those that have a partial seal or no seal with the skin of the wearer.

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