TECHNICAL SPECIFICATION

ISO/TS 16973

First edition

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

PROOF/ÉPREUVE

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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).

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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 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.

For further information, see informative Annex D.

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 E. 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 F.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 F.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 are 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. Gas filter work rate class.

Gas filters are 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.

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)

Table 6 *(continued)*

Type	Classes	Type description	Typical contaminants
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)

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

