TECHNICAL SPECIFICATION

ISO/TS 17420-8

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Respiratory protective devices — Performance requirements —

Part 8: Special application chemical, biological, radiological and nuclear (CBRN) filtering and radiological-nuclear (RN) filtering RPD

Appareils de protection respiratoire — Exigences de performances —

Partie 8: Appareils d'application spéciale de filtrage nucléaire-radiologique, biologique, chimique (NRBC) et de filtrage nucléaire-radiologique (NR)

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Foreword

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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 of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 94, *Personal safety — Personal protective equipment*, Subcommittee SC 15, *Respiratory protective devices*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The personal protection requirements of personnel who respond to emergencies are recognised as being different from those of the regular workforce. With respect to response to incidents involving release of chemical, biological or radiological materials, or after nuclear events (CBRN events), specific requirements have to be established. The hazardous exposures occurring in such incidents can result in severe consequences for an improperly protected responder.

Specifically, for the types of protection required:

a) Protection levels need to be high for those in the vicinity of an incident.

b) Materials used in construction of the equipment shall withstand permeation by highly aggressive chemicals.

c) The range of chemical protection offered by filtering systems needs to be very broad, as the opportunity for assessment of the nature of the hazard ahead of the time of use of the equipment may be limited.

d) The efficiency of particle filtration needs to be high to protect the equipment wearer against ingress of radioactive particulate matter or biological agents.

These requirements in the ISO system are summarized in this document covering the special application CBRN. This document is an adjunct to other parts of ISO 17420 and should be read together with them.

This document provides classification of equipment, performance requirements and specific test methods for respiratory protective devices (RPD) for use in CBRN response. Selection requirements are addressed in separate documents.

NOTE The performance requirements included in this document refer to laboratory testing using specified test agents under specified conditions which might not indicate the performance of the device in actual usage.

Respiratory protective devices — Performance requirements —

Part 8: Special application chemical, biological, radiological and nuclear (CBRN) filtering and radiological-nuclear (RN) filtering RPD

1 Scope

This document specifies the requirements for respiratory protective devices for use by workers during response to incidents involving chemical, biological radiological or nuclear (CBRN) materials used with intent to cause harm or in cases of accidental release outside traditional hazardous materials response categories. For the purposes of this document, all incidents described here are named CBRN incidents.

This document is applicable to RPD for use by personnel in the following roles:

— First responders: including police, fire service, emergency medical, search and rescue, sampling and detection teams.

— Workers needed for specific roles during response (utility, transportation, service continuity).

— Medical personnel working with casualties of CBRN incidents.

— Responders to release incidents involving nuclear materials.

— Non-emergency but CBRN-related roles.

— Workers in need of protection during escape from a CBRN or radiological release incident.

— Workers in need of protection from nuclear materials.

The requirements for RPD use by the following groups are not addressed by this document:

— Military personnel outside of first responder roles.

— Children.

— Animals.

Requirements for the following are not covered by this document:

— Collective protection systems including ventilated casualty/body bags.

— Methods of and criteria for decontamination of RPD.

— Disposal of used equipment.

This document is focused on respiratory protection requirements, but it is recognised that CBRN RPD are always used as part of an ensemble with protective clothing. The total ensemble effectiveness is not covered by this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 16900-2, *Respiratory protective devices — Methods of test and test equipment — Part 2: Determination of breathing resistance*

ISO 16900-4, *Respiratory protective devices — Methods of test and test equipment — Part 4: Determination of gas filter capacity and migration, desorption and carbon monoxide dynamic testing*

ISO 16900-5, *Respiratory protective devices — Methods of test and test equipment — Part 5: Breathing machine, metabolic simulator, RPD headforms and torso, tools and verification tools*

ISO 16900-8:2015, *Respiratory protective devices — Methods of test and test equipment — Part 8: Measurement of RPD air flow rates of assisted filtering RPD*

ISO 16972, *Respiratory protective devices — Vocabulary and graphical symbols*

ISO/TS 16973, *Respiratory protective devices — Classification for respiratory protective device (RPD), excluding RPD for underwater application*

ISO 17420-1:2021, *Respiratory protective devices — Performance requirements — Part 1: General*

ISO 17420-2:2021, *Respiratory protective devices — Performance requirements — Part 2: Requirements for filtering RPD*

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

ISO 17420-4:2021, *Respiratory protective devices — Performance requirements — Part 4: Requirements for supplied breathable gas RPD*

ISO 17420-5:2021, *Respiratory Protective Devices — Performance Requirements — Part 5: Special application fire services - Supplied breathable gas RPD and filtering RPD*

ISO 17420-6:2021, *Respiratory protective devices — Performance requirements — Part 6: Special application escape - Filtering RPD and supplied breathable gas RPD*

ISO/TS 17420-9:2021, *Respiratory Protective Devices — Performance Requirements — Part 9: Special application Chemical, Biological, Radiological and Nuclear (CBRN) supplied breathable gas devices*

IEC 60721-1, *Classification of Environmental Conditions - Part 1: Environmental Parameters and their Severities*

ASTM D2854, *Standard Test Method for Apparent Density of Activated Carbon*

ASTM D3803-91, *Standard Test Method for Nuclear-Grade Activated Carbon*

ASTM E300, *Standard Practice for Sampling Industrial Chemicals*

3 Terms, definitions and abbreviations

For the purposes of this document, the terms and definitions given in ISO 16972, other parts of ISO 17420 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Terms and definitions

3.1.1
chemical material
substance that can be disseminated to cause harm, including chemical warfare agents and toxic industrial chemicals

3.1.2
biological material
micro-organism that is a pathogen and that has the potential to be used intentionally to cause harm

Note 1 to entry: Human pathogens are relevant to RPD selection.

3.1.3
radiological material
substance that emits ionizing radiation that can be disseminated to cause harm or released from a nuclear facility

3.1.4
nuclear material
radioactive matter resulting from fissile activity

3.1.5
decontamination
physical and/or chemical process of removing as much contamination as possible from people or equipment

3.1.6
gaseous
material in the gaseous state may either be present as a gas or vapour

3.1.7
hydration system
system, usually consisting of a connector and tube attached to a reservoir, that when attached to an RPD permits the user to drink water or other liquids specified by the manufacturer while wearing the RPD

3.1.8
joint
place at which two or more components or materials are connected or united, either rigidly or flexibly, separably or inseparably

3.1.9
manifold
component which accommodates two or more filters connected to inlets with a single outlet

3.1.10
manufacturer
entity that directs and controls product design, product manufacturing, or product quality assurance; can also refer to the entity that assumes the liability for the product or provides the warranty for the product

3.1.11
penetration
movement of a substance through closures, seams, pinholes, or other imperfections of a protective item, or the movement of a substance through an air-purifying element without being removed

3.1.12
permeation
process by which a substance migrates through a given material on a molecular level

3.1.13
responder
person who intervenes in an emergency

3.1.14
receiver
medical professional who works remotely from an incident

3.1.15
sarin
GB
extremely toxic chemical warfare agent

Note 1 to entry: Isopropyl methyl phosphonofluoridate [IUPAC: (RS)-propan-2-yl methylphosphonofluoridate, CAS Number: 107-44-8], classified as a nerve agent

3.1.16
shelf life
life expectancy of CBRN RPD under proper storage, care, and maintenance conditions

3.1.17
sulphur mustard
HD
extremely toxic chemical warfare agent

Note 1 to entry: [IUPAC: bis(2-chloroethyl) sulphide, CAS Number: 505-60-2] classified as a vesicant (blister agent).

3.1.18
non pre-conditioned state
without pre-conditioning but possibly modified to carry out tests or already used in non-destructive tests

Note 1 to entry: This includes e.g., cleaning and disinfection.

3.1.19
RPD in as worn state
RPD where all components are connected and assembled in the way that it is intended to be used (e.g. worn by the wearer, adapted to an RPD headform or RPD headform and torso or suitable holder)

Note 1 to entry: All of the various components [e.g. for an assisted filtering device: blower unit, battery, respiratory interface (RI), filters, etc.] have been completely assembled and then connected (RI connected to the hose of the blower unit) together in accordance with the information supplied by the manufacturer..

3.1.20
RPD in ready for use state
RPD ready to be donned as described by the *manufacturer* (3.1.7)

Note 1 to entry: In line with the information supplied by the manufacturer for donning the RPD, further actions can be necessary.

3.1.21
ready for assembly state
RPD or components with seals, plugs or other environmental protective means, still in place ready to be assembled and/or donned

Note 1 to entry: RPD or components can remain sealed and plugged until donning if so stated in the information supplied by the manufacturer.

3.2 Abbreviated terms

CBRN	Chemical, Biological, Radiological, Nuclear
ES CBRN	Escape CBRN RPD operating in the filtering mode
GB	Sarin
HD	Sulphur mustard
RH	Relative Humidity
RI	Respiratory Interface
RN	Radiological, Nuclear

4 Designation and classification

4.1 General

CBRN filtering RPD are classified as CBRN1 or CBRN2.

RPD classified as CBRN3 are restricted to supplied breathable gas mode only, with requirements in accordance with ISO/TS 17420-9, and no requirements in this document apply.

The following classifications shall be used for RPD under special application CBRN, special application Escape CBRN.

4.2 Special application CBRN1

CBRN1 “Receiver” RPD shall:

— incorporate RIs of classes cL, cT, dL, dT, eL or eT in accordance with ISO/TS 16973;

— provide a minimum protection class PC4 in accordance with ISO/TS 16973;

— provide protection against gaseous chemical agent permeation;

— provide a minimum particle filter efficiency class F4.

4.3 Special application CBRN2

CBRN2 “Responder in known threat environment” RPD shall:

— incorporate RIs of classes cL, cT, dL, dT, eL or eT in accordance with ISO/TS 16973;

— provide a minimum protection class PC5 in accordance with ISO/TS 16973;

— provide protection against liquid and gaseous chemical agent permeation and penetration;

— provide a minimum particle filter efficiency class F5.

4.4 Special application Escape CBRN

Escape CBRN filtering RPD shall:

— incorporate RIs of classes cL, cT, dL, dT, eL or eT in accordance with ISO/TS 16973;

— provide a minimum protection class PC4 in accordance with ISO/TS 16973;

— provide protection against liquid and vapour chemical agent permeation and penetration.

— provide a minimum particle filter efficiency class F4.

Escape CBRN RPD operating in the filtering mode is designated ES CBRN.

4.5 CBRN RPD summary of capabilities

Table 1 provides a matrix description of the minimum capabilities for CBRN RPD.

Table 1 — Summary of minimum capabilities for CBRN filtering RPD and filters

Capability	CBRN1	CBRN2	ES CBRN
Permeation and penetration test	Gaseous[a] only	Gaseous[a] and liquid	Gaseous[a] and liquid
RI type	T[b] or L[c]	T or L	T or L
Particle filter efficiency class	≥F4	F5	≥F4
Protection class	≥PC4	≥PC5	≥PC4
Work rate	≥W1	≥W1	Escape flow rate[d]

[a] "Gaseous" refers to both gas and vapour states.

[b] Tight-fitting.

[c] Loose-fitting.

[d] In accordance with 9.2.2.

4.6 CBRN filtering RPD classes

4.6.1 General

CBRN filtering RPD and ES CBRN filtering RPD shall follow the system classification in 4.6.2 and 4.6.3 specific to CBRN requirements.

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

4.6.2 CBRN filtering RPD

CBRN filter performance class is defined in Table 7. CBRN filtering RPD shall follow the classification:

For RPD: (protection class) (work rate class) (RI class) (particle filter efficiency class) (CBRN class)/(CBRN filter performance class).

EXAMPLE For a RPD: PC5 W1 cT F5 CBRN2/C.

For a filter: (optional standardized connector symbol) (optional ISO 17420-2 gas filter performance class) (particle filter efficiency class) (CBRN class)/(CBRN filter performance class) (work rate class).

EXAMPLE For a filter with a non-standardized connector: OV1 F4 CBRN1/B W2.

EXAMPLE For a filter with a standardized connector: ⊙ OV1 F5 CBRN2/A W1.

4.6.3 Escape CBRN filtering RPD

ES CBRN filtering RPD shall follow a classification incorporating the applicable designated duration *t* in accordance with 9.1.

For ES CBRN filtering RPD: (protection class) (RI class) (particle filter efficiency class) ES CBRN (duration).

EXAMPLE PC4 dL F5 ES CBRN 15.

RPD may have combined capability for CBRN and escape in other classes in ISO 17420-6 and the classification shall indicate this, with CBRN being the first type listed.

EXAMPLE PC4 *c*T F4 ES CBRN ES FF 20 – RPD for escape from CBRN incidents and from fire.

5 RN filters - Designation and classification

5.1 General

The designation "RN" applies only to filters. These are used with other RPD components in configurations specified in ISO 17420-2.

5.2 RN filters

Filters designated RN "Radiological-Nuclear" shall:

— satisfy the requirements for particle filter efficiency class F5;

— satisfy the requirements for organic vapour performance, as a minimum class OV1, as specified in ISO 17420-2;

— provide protection against radioactive iodine and radioactive organoiodides.

5.3 RN filter classification

RN filters shall follow the classification (particle filter efficiency class) (ISO 17420-2 gas filter performance class) (RN) (work rate class).

EXAMPLE F5 OV1 RN w1.

NOTE Class RN can be added to filters meeting other gas filter performance classes under ISO 17420-2, so that combined capability is provided. OV classes 2, 3, and 4 are permitted.

EXAMPLE F5 OV2 AC1 RN w2.

6 Requirements

6.1 General

Unless specified in the individual clauses, CBRN filtering RPD shall be tested as a system. Although it may be possible to use components of the same design in more than one configuration of RPD, the following shall apply:

— every configuration shall meet the requirements of this document;

— components shall be marked appropriately in accordance with Clause 17;

— information supplied by the manufacturer shall provide proper guidance on designed configurations and the protection provided.

The requirements specified in Clauses 8 to 11 shall be fulfilled by all RPD or components in accordance with their class.

Unless otherwise specified in the individual requirement clauses,

— testing shall be performed on test samples without pre-conditioning,

— each sample shall pass the test, and

— testing shall be performed at ambient laboratory conditions between 16 °C and 32 °C and a relative humidity of (50 ± 30) %.

If no tolerances are given, ±10 % shall be used.

For determination of pass/fail, conformity of quantitative test measurements with specification limits may be determined in accordance with Annex C.

6.2 Test samples

Sample schemes are provided in relevant clauses and Annex A.

6.3 CBRN filtering RPD

6.3.1 CBRN filtering RPD operation

Where the RPD has the capability to be used with more than one mode of operation (see Clause 11) only one can be actively used at any one time.

Testing shall be performed in accordance with Clause 15 and ISO 17420-2:2021, 6.12.

6.3.2 CBRN filtering RPD

CBRN filtering RPD shall meet the requirements of:

— ISO 17420-1:2021, all clauses;

— ISO 17420-2:2021, Clause 5;

— ISO 17420-2:2021, Clause 6, except 6.9, 6.10.1.3 to 6.10.1.5 and 6.11;

— ISO 17420-2:2021, Clauses 7, 8 and 9;

unless superseded by this document and indicated in the relevant clauses.

Table 2 gives an overview about requirements and pre-conditioning of special application CBRN filtering RPD.

In the first column the requirements are listed and in the third and fourth columns, the required pre-conditionings for different CBRN classes are listed, to be completed in the order specified (where "&" is used) before testing is performed, with the pre-conditioning details explained further in Table 5.

For each requirement the pre-conditioning is given by abbreviations, with a guide to these shown at the end of the table. One sample per pre-conditioning is to be tested except where a number or reference in parentheses follows the abbreviation, in which case that number applies.

EXAMPLE For the requirement 8.2.2 and class CBRN2 the following applies.

One sample shall be tested without pre-conditioning.

At least two further samples shall be pre-conditioned to requirement VS2 (Exposure to vibration and shock – CBRN) followed by requirement CE (exposure to a continuous corrosive environment).

NOTE 1 Optional features are also given in ISO 17420-2.

NOTE 2 Unless requirements are superseded by those in Clause 8 of this document, the test schedules given in ISO 17420-2:2021, Annex C can be used as a guideline for testing.

Table 2 — Special application requirement overview —CBRN filtering RPD

Requirement	Title	Receiver	Responder in Known Hazard Environment
		CBRN1	**CBRN2**
		Protection class ≥PC4	Protection class ≥PC5
		Work rate class ≥W1	Work rate class ≥W1
		Pre-conditioning of samples[a]	
ISO 17420-5: 2021, 7.2.5.2	Chemical resistance of materials	—[b]	AR/NP
ISO 17420-5: 2021, 7.2.8	Avoidance of frictional sparks	—[b]	AR/NP
ISO 17420-5: 2021, 7.2.9	Visor after chemical exposure	—[b]	AR/NP
8.1.2.1	Validation of work of breathing/breathing resistance/elastance – unassisted RPD	THC & VS1[c]	THC & VS2[c]
8.1.2.2	Validation of work of breathing/breathing resistance/elastance – assisted RPD	THC & VS1[c]	THC & VS2[c]
8.1.2.3	Interactive flow rate	THC & VS1[c]	THC & VS2[c]
8.1.3	Protection class	AR/NP	AR/NP
8.1.4.2	Temperature of operation	VS1 & CE	VS2 & CE
8.1.4.3	Optional temperature of operation	VS1 & CE	VS2 & CE
8.2.2	CBRN chemical resistance	AR/NP	AR/NP
		THC & VS1 (2)	THC & VS2 (2)
8.3.1	RIs	AR/NP	AR/NP
8.3.2	Connectors	AR/NP	AR/NP
8.3.2.4	Connector conformance after pre-conditioning[d]	THC & VS1 & DRC (6)	THC & VS2 & DRC (6)
8.3.3.3	Airflow resistance for filters used in multiples on RPD	AR	AR
8.3.3.4	Particle filter efficiency[c]	THC & VS1 & DRC (6)	THC & VS2 & DRC (6)

[a] Minimum number of samples is indicated in parentheses, otherwise it is one or as specified in the referenced clause in ISO 17420-2 or ISO 17420-5.

[b] Means that a test is not required for this combination of requirement and special application class.

[c] Sample quantities depend on the number of interface sizes offered.

[d] Same samples may be used.

AR/NP As received (not previously used for other tests) or in non pre-conditioned state.

THCTemperature and humidity for CBRN filters.

VS1 Exposure to vibration and shock CBRN1.

VS2 Exposure to vibration and shock CBRN2.

DRCExposure to impact from drop.

CE Enhanced resistance to corrosion – constant exposure.

HR Radiological gas test pre-humidification.

Table 2 *(continued)*

Requirement	Title	Receiver	Responder in Known Hazard Environment
		CBRN1	**CBRN2**
		Protection class ≥PC4	Protection class ≥PC5
		Work rate class ≥W1	Work rate class ≥W1
		Pre-conditioning of samples[a]	
8.3.3.5	Non-radiological gas FILTER capacity for CBRN filtering RPD	THC & VS1 & DRC (60)	THC & VS2 & DRC (60)
8.3.3.6	Non-radiological gas filter performance requirements at specified work rates	THC & VS1 & DRC (30)	THC & VS2 & DRC (30)
8.3.3.7	Radiological gas filtration by CBRN and RN filters	THC & VS1 & DRC (2)	THC & VS2 & DRC (2)
		THC & VS1 & DRC & HR (2)	THC & VS2 & DRC & HR (2)
8.4.1	CBRN filtering RPD with standardized connector - General	Not Permitted	AR/NP
8.4.2.1.2	Breathing resistance of RI with standardized connector	Not Permitted	AR
8.4.2.1.3	Carbon dioxide concentration limits for CBRN filtering RPD with standardized connectors	Not Permitted	AR/NP
8.4.2.1.4	Inward leakage of RI with standardized connectors	Not Permitted	AR/NP
8.4.2.2	CBRN Filters with standardized connector	Not Permitted	AR/NP
8.4.2.2.4	Airflow resistance of filters with standardized connector	Not Permitted	THC & VS2 (2)
8.4.2.4	Low pressure hoses with standardized connector	Not Permitted	AR/NP
8.4.2.5	Manifolds with low pressure hoses with standardized connector	Not Permitted	AR/NP
8.4.3	Assisted devices with a standardized connector with a tight-fitting RI	Not Permitted	AR/NP
8.4.4	Assisted devices with standardized connector with a loose-fitting RI	Not Permitted	AR/NP

[a] Minimum number of samples is indicated in parentheses, otherwise it is one or as specified in the referenced clause in ISO 17420-2 or ISO 17420-5.

[b] Means that a test is not required for this combination of requirement and special application class.

[c] Sample quantities depend on the number of interface sizes offered.

[d] Same samples may be used.

AR/NP As received (not previously used for other tests) or in non pre-conditioned state.

THCTemperature and humidity for CBRN filters.

VS1 Exposure to vibration and shock CBRN1.

VS2 Exposure to vibration and shock CBRN2.

DRCExposure to impact from drop.

CE Enhanced resistance to corrosion – constant exposure.

HR Radiological gas test pre-humidification.

6.3.3 Escape CBRN filtering RPD

ES CBRN filtering RPD shall meet the filtering RPD-related requirements of:

— ISO 17420-1:2021, all clauses;

— ISO 17420-6:2021, Clause 5;

— ISO 17420-6:2021, Clause 6;

— ISO 17420-6:2021, Clause 7 for filtering escape general;

unless superseded by this document and indicated in the relevant clauses.

Table 3 gives an overview about requirements and pre-conditioning of special application Escape CBRN filtering RPD.

In the first column the requirements are listed and in the third column, the required pre-conditionings for different CBRN classes are listed.

This table can be interpreted as described in 6.3.2.

Table 3 — Special application requirement overview — ES CBRN Filtering RPD

Requirement	Title	**ES CBRN** Protection class ≥PC4
		Pre-conditioning of samples[a]
9.1	General (includes permitted designated duration range)	AR/NP
9.2.1	Specification of duration, *t*, of escape RPD	THC & VSE
		DRE
9.2.2	Validation of escape RPD performance requirements	THC & VSE & IE[b]
		DRE
9.2.3	Protection class	AR/NP
9.2.4	Chemical resistance CBRN hazardous materials	AR/NP
		THC & VSE (2)
9.2.5	Practical performance	AR/NP
9.3.1	RI	AR/NP
9.3.2	Connectors	AR/NP
9.3.3.1	Particle filter efficiency	THC & VSE & DRE (6)
9.3.3.2	Gas filter capacity for ES CBRN filtering RPD	THC&VSE&DRE (60)
9.3.3.3	Gas filter performance requirements at specified work rates	THC & VSE & DRE (30)

[a] Minimum number of samples is indicated in parentheses, otherwise it is one.

[b] Sample quantities depend on the number of interface sizes offered.

AR/NP As received (not previously used for other tests) or in non pre-conditioned state.

THCTemperature and Humidity for CBRN filters.

VSE Exposure to vibration and shock ES CBRN.

IE Enhanced resistance to corrosion - intermittent exposure.

DRE Exposure to impact from drop.

6.4 RN filters

RN Filters shall meet the requirements of the following as applicable to filters:

— ISO 17420-2:2021, 6.10.1.1 and 6.10.1.2;

unless superseded by this document and indicated in the relevant clauses.

Table 4 gives an overview about requirements and pre-conditioning of RN Filters.

In the first column the requirements are listed and in the third column, the required pre-conditionings for different CBRN classes are listed.

This table can be interpreted as described in 6.3.2.

Table 4 — Special application requirement overview — RN Filters

Requirement	Title	RN Filter
		Pre-conditioning of samples[a]
10.2	Particle filter efficiency	THR & MS (6)
10.3.1	Radioactive iodomethane retention requirements	THR & MS (2)
		THR & MS & HR (2)
10.3.2	Organic vapour capacity requirements	THR & MS (6)
10.4	RN filters with standardized connector	AR/NP
10.4.3	Airflow resistance of RN filters with standardized connector	THR & MS (2)

[a] Minimum number of samples is indicated in parentheses, otherwise it is one.

AR/NP As received (not previously used for other tests) or in non pre-conditioned state.

THR Temperature and humidity for RN filters.

MS Mechanical stress testing for RN filters.

HR Radiological gas test pre-humidification.

7 Pre-conditioning

7.1 General

Pre-conditioning exposure conditions applied to different RPD classes and required RPD configuration or packaging states are indicated in Table 5. These are referenced in Tables 2, 3 or 4 using the abbreviations indicated.

RPD testing in accordance with the clauses in in Tables 2, 3 or 4 shall follow the corresponding pre-conditioning sequences given. Each stage is separated by an "&" sign.

RPD shall be inspected after each stage of pre-conditioning exposure in accordance with 15.

At inspection steps after exposure, there shall be no obvious distortion.

The number of samples is given in Tables 2, 3 or 4.

7.2 Components excluded from pre-conditioning – Exposure to vibration

The following components may be excluded from the exposure to vibration:

— RIs, if separable;

— hoses and other breathable gas supply chain components without control function; and

— body harness (without carrying plate).

7.3 CBRN filtering RPD pre-conditioning

7.3.1 Temperature and humidity pre-conditioning

7.3.1.1 RPD, filter and component configurations for temperature and humidity pre-conditioning

RPD with detachable filters shall be pre-conditioned as specified in 7.3.1.2 in its ready for use state, and in its carrying case if provided for this state.

RPD with integral/permanently attached filters shall be pre-conditioned as specified in 7.3.1.2 in its ready for assembly state and in its carrying case if provided for this state.

NOTE Table 5 provides a summary of configurations.

7.3.1.2 Temperature and humidity pre-conditioning requirements

Temperature and humidity pre-conditioning shall be conducted in the following order:

— dry heat cyclic conditioning comprising 12 h at (35 ± 2) °C followed by 12 h at (70 ± 2) °C repeatedly for 21 d;

— cold constant conditioning comprising constant (–30 ± 2) °C for 3 d;

— humidity conditioning comprising 12 h at (30 ± 2) °C, RH 90^{+2}_{-1} % followed by 12 h at (40 ± 2) °C, RH (60 ± 2) % repeatedly for 5 d;

— stabilization to ambient temperature and humidity until temperature is equilibrated.

In order to ensure that there is no temperature shock during the conditioning of the samples, the temperature gradient shall not be greater than 3 °C/min between phases at different temperatures, and between the beginning and the end of a thermal cycle.

7.3.2 Humidity pre-conditioning of filters for radioactive iodomethane test

Filters are pre-humidified with a continuous flow of air at the applicable test flow rate in Table 10 according to RPD type at temperature (25 ± 1) °C and relative humidity of 90^{+2}_{-1} % with flow rate according to RPD type and work rate.

The minimum duration of pre-humidification shall be 16 h.

Table 5 — References to Pre-Conditioning Requirements and Applicability for CBRN and ES CBRN filtering RPD and RN Filters

Type of Pre-Conditioning	Abbreviation[a]	Application				Reference	Configuration/ Packaging[b]					
		CBRN1	CBRN2	ES CBRN	RN Filter		CC	RA[c]	RU	AW	CA	CU
Temperature and humidity	THC	X	X	X		As specified in 7.3.1.	X	X	X		X	
	THR				X	As specified in ISO 17420-2:2021 6.9.2.2.					X	
Vibration and shock[d]	VS1	X				Vibration as specified in ISO 17420-4:2021, 6.11.1.1.3.1; shock as specified in ISO 17420-4:2021, 6.11.1.1.3.2.			X		X	
	VS2		X			As specified in ISO 17420-5:2021, 7.3.2 (IEC 60721-1) excluding temperature & humidity stage.			X		X	
	VSE			X		As specified in ISO 17420-5:2021, 7.3.2 (IEC 60721-1) excluding temperature & humidity stage.			X			
Drop	DRC	X	X			Filter only (if separable) as specified in ISO 17420-5:2021, 7.3.3.						X
	DRE			X		RPD as specified in ISO 17420-6:2021, 7.3.1.		X				
Corrosive environment	CE		X			If RPD contains electronics, as specified in ISO 17420-2:2021, 6.9.3.2.		X				
	IE			X		As specified in ISO 17420-6:2021, 7.3.3.				X		
CH_3I test pre-humid-ification	HR	X	X		X	As specified in 7.3.2.						X
Mechanical stress	MS				X	As specified in ISO 17420-2:2021 6.9.2.					X	

[a] Abbreviation key:

CE Enhanced resistance to corrosion – constant exposure;

DRC Exposure to impact from drop;

HR Radiological gas test pre-humidification;

IE Enhanced resistance to corrosion - intermittent exposure;

MS Mechanical stress testing for RN filters;

THC Temperature and Humidity for CBRN filters;

THR Temperature and Humidity for RN filters;

VS1 Exposure to vibration and shock CBRN1;

VS2 Exposure to vibration and shock CBRN2.

[b] RPD configuration or packaging states – refer to definitions in 3.1.

CC In carrying case, if applicable.

RA RPD in ready for assembly state.

RU RPD in ready for use state.

AW RPD in as worn state.

CA components/filters in ready for assembly state.

CU omponents/filters in ready for use state.

[c] RPD in ready for assembly state applies for non-separable filters.

[d] See excluded components in 7.2.

8 CBRN filtering RPD

8.1 Requirements for complete CBRN filtering RPD

8.1.1 General

CBRN filtering RPD shall meet RPD requirements specified in Clause 4

CBRN filtering RPD with standardized connectors providing work rates >W1 shall be assisted devices.

Where requirements from other parts of ISO 17420 are referenced, applicable test methods are defined in that document, and they are not reproduced here.

8.1.2 Airflow

8.1.2.1 Validation of work of breathing/breathing resistance/elastance — Unassisted CBRN filtering RPD

Unassisted CBRN filtering RPD not incorporating a standardized connector shall meet the requirements of ISO 17420-2:2021, 6.3.1 except that:

— pre-conditioning shall be to the requirements of Table 2;

— requirements for RI or filters with standardized connectors shall meet the requirements of 8.4.

8.1.2.2 Validation of work of breathing/breathing resistance/elastance — Assisted CBRN filtering RPD

Assisted CBRN filtering RPD not incorporating a standardized connector, shall meet requirements of ISO 17420-2:2021, 6.3.2 except that:

— pre-conditioning shall be to the requirements of Table 2;

— RI or filters with standardized connectors shall meet the requirements of 8.4.

8.1.2.3 Interactive flow rate

The average and peak interactive flow shall be measured where needed at the appropriate work rate in accordance with ISO 16900-8:2015, 7.3 after pre-conditioning to the requirements of Table 2.

8.1.3 Protection class

Each CBRN class shall meet the following minimum requirements

CBRN1 PC4

CBRN2 PC5

Where optional features are offered, the minimum protection class required by their classification shall be achieved when the optional features are included in the test.

NOTE Protection classes are defined in ISO/TS 16973.

The protection class for CBRN filtering RPD shall be derived from testing in accordance with ISO 17420-1:2021, 5.7.

Assisted CBRN Filtering RPD with a RI of type L (Loose fitting) shall be tested in the “power on” mode.

For CBRN filtering RPD where it is intended for one size to fit all, there shall be representation of all RPD headform sizes in the test panel in accordance with the guidelines given in ISO 16900-1.

When the airflow into the breathing zone does not pass directly through the ocular zone, the protection class shall also be measured in the ocular zone and shall achieve the minimum protection above in accordance with their classification.

8.1.4 Temperature of operation

8.1.4.1 General

The information supplied by the manufacturer shall indicate the temperature of operation of the RPD as selected from 8.1.4.2 and 8.1.4.3.

8.1.4.2 Temperature of operation

Unless indicated in succeeding clauses, where test temperature criteria are indicated, CBRN filtering RPD shall be tested according to ISO 17420-4:2021, 6.1, at the values of 35^{0}_{-2} °C as the upper temperature requirement and -5^{+2}_{0} °C as the lower temperature requirement.

8.1.4.3 Optional extended temperature of operation

RPD can be evaluated to an optional extended temperature range in accordance with ISO 17420-5:2021, 7.2.1.3, at the values of 60^{0}_{-2} °C as the upper temperature requirement and -32^{+2}_{0} °C as the lower temperature requirement.

A manufacturer may offer a wider temperature range extending beyond these upper and lower limits as an optional feature. These shall meet requirements according to either:

— manufacturer-selected ranges in ISO 17420-4:2021, 6.16.5 and ISO 17420-4:2021, 6.16.6, or

— specified levels in ISO 17420-5:2021, 7.2.1.

8.2 Chemical resistance

8.2.1 General

CBRN filtering RPD shall be resistant to the permeation and penetration effects of chemical warfare agents. Distilled sulphur mustard (HD) and sarin (GB) as the test agents shall be used.

CBRN1 RPD shall be resistant to the permeation and penetration of chemical warfare agent vapour.

CBRN2 RPD shall be resistant to the permeation and penetration of chemical agents in liquid and vapour form.

Where the design of the RD provides separate zones for breathable gas supply, these requirements apply in all zones.

8.2.2 CBRN1 and CBRN2 chemical resistance requirements

For CBRN1 RPD, a minimum of three CBRN filtering RPD shall be tested for permeation with HD vapour and a minimum of three RPD shall be tested for GB vapour penetration in accordance with the test methods specified in 16.2.

For CBRN2 RPD, a minimum of three CBRN filtering RPD shall be tested for permeation HD vapour and liquid, and a minimum of three RPD shall be tested for GB vapour penetration in accordance with the test methods specified in 16.2.

For each test agent, a minimum of one RPD shall be tested without pre-conditioning, and a minimum of two tested after pre-conditioning as applicable in Table 2.

All components and accessories claimed as part of the RPD by the manufacturer shall be tested in the ready for use state. This may result in the need to test more than three systems if the submitted systems represent more than one completely assembled individual RPD.

Testing shall be performed in accordance with 16.2.

8.2.3 Pass/fail criteria

The maximum levels of permeation in Table 6 shall not be exceeded.

Either of the following criteria shall constitute a failure

— three consecutive sequential instantaneous concentration data points during execution of the test at or exceeding the value in Table 6, or

— exceeding the maximum breakthrough dosage (concentration integrated over test duration) as shown in Table 6 calculated after completion of the test.

Table 6 — Liquid and vapour test requirements for CBRN filtering RPD

RPD type	Agent	Challenge	Challenge duration min	Breathing machine airflow rate[a] l/min	Maximum peak excursion mg/m³	Maximum breakthrough (concentration integrated over test duration) mg-min/m³	Test duration h	Number of RPD tested
CBRN1	GB Vapour	210 mg/m³	30	40	0,087	2,1	8	3
	HD Vapour	50 mg/m³	30	40	0,60	6,0	8	3
CBRN2	GB Vapour	210 mg/m³	30	40	0,087	2,1	8	3
	HD Vapour	50 mg/m³	30	40	0,60	6,0	8	3
	HD Liquid	≥0,64 ml[b]	120	40	0,60	6,0	8	

[a] Sinusoidal flow: The setting of the breathing machine shall be (36 × 1,1) l/min

[b] This volume depends on the minimum number of droplets for this class specified in 16.2.3, but more droplets may be applied based on RPD design where necessary.

8.3 Requirements for filters and components of CBRN filtering RPD

8.3.1 Respiratory interfaces

8.3.1.1 General

RIs for CBRN filtering RPD shall incorporate air management such that passage of exhaled air through the filter is prevented.

8.3.1.2 CBRN1 RI

RIs shall be type c, d or e as defined in ISO 16973.

Standardized connectors conforming to ISO 17420-3 shall not be used on CBRN1 RIs.

8.3.1.3 CBRN2 RI

RIs shall be type c, d or e as defined in ISO 16973.

Standardized connectors shall only be used on class cT RI which shall additionally meet the requirements of 8.4.2.1.

8.3.2 Connectors

8.3.2.1 Connectors for CBRN1 RPD

CBRN filters and RIs intended for use only on CBRN1 shall not use a standardized connector.

Check in accordance with Clause 15.

8.3.2.2 Connectors for CBRN2 RPD

CBRN filters capable of directly fitting to the RI for devices meeting CBRN2 may use a standardized connector.

Standardized connectors shall be marked in accordance with ISO 17420-2:2021, 3.3.5.

Check in accordance with Clause 15.

8.3.2.3 Alternative connectors

Alternative connectors not conforming to ISO 17420-3 may be used, provided they cannot be connected to a standardized connector.

8.3.2.4 Connector conformance after pre-conditioning

Connectors shall retain conformance after RPD pre-conditioning in accordance with Table 2.

Check in accordance with Clause 15.

8.3.3 Filters

8.3.3.1 General

CBRN filters shall meet the requirements for airflow resistance, particle filter efficiency, gas capacity and performance at specific work rate for non-radiological and radiological gases as specified in 8.3.3.3 to 8.3.3.7.

Prior to testing filters shall be pre-conditioned in accordance with Table 2.

Where a filter with non-standardized connector on both RPD Class CBRN1 and CBRN2 may be used, it shall meet the permeation and penetration requirements corresponding to CBRN2 in accordance with 8.2.

When one filter of a multiple filter device is tested separately, the flow specified for a test shall be divided by the number of filters through which the flow is proportioned. If, however, it is possible that one filter of a multiple filter device may be used alone, then the full flow rate shall be used for testing.

8.3.3.2 Particle filter location

CBRN and RN filters shall have the particle filter element conforming to 8.3.3.4 located upstream of the gas/vapour filter element which conforms to 8.3.3.5 or 8.3.3.7.

8.3.3.3 Airflow resistance for filters used in multiples on RPD

Where filters may be used in multiples on RPD, they shall be tested in accordance with ISO 17420-2:2021, 6.10.1.1.

If the breathing resistances of the filters do not meet the equation in ISO 17420-2:2021, 6.10.1.1, the filters shall be tested in the configuration that the filters are intended to be assembled in as in the complete RPD at full flow rate.

8.3.3.4 Particle filter efficiency

The particle filter efficiency shall be determined in accordance with ISO 17420-2:2021, 6.10.1.2., with the exception that the particle filter efficiency class shall conform to F4 or F5 in accordance with the requirements in Table 1 according to work rate and class.

Three samples shall be tested with each aerosol type.

8.3.3.5 Non-radiological gas filter capacity for CBRN filtering RPD

8.3.3.5.1 Requirements

8.3.3.5.1.1 Performance class and breakthrough times for CBRN filters

Filters for CBRN filtering RPD shall demonstrate a minimum capability to achieve the duration in accordance with the selected capacity in Table 7 as applicable to their class. Test conditions are given in Table 8, and test flow is determined according to unassisted or assisted operating mode.

For all requirements, individual testing on new filters shall be performed with each of the agents and conditions in Table 8 after pre-conditioning as specified in Table 2.

Test results shall be assessed in accordance with ISO 16900-4 for determination of pass or fail.

Table 7 — Performance class and breakthrough times for CBRN filters

Performance class	Breakthrough time min
A	15
B	30
C	45
D	60
E	90
F	120

The claimed capacity value for the filter shall correspond with the shortest service life of any of the test agents.

8.3.3.5.1.2 Test quantities

The capacity test shall be performed with ten gases and for each there are two humidity conditions.

For each test agent in Table 8 and each humidity in accordance with the conditions in 8.3.3.5.2.2 or 8.3.3.5.2.3, test quantities shall be as follows.

A maximum of three filters shall be tested.

— If the first two results exceed the duration requirement corresponding with the claimed capacity level (A to F) in Table 7 by ≥30 %, the capacity requirements are met, and a third test is not required;

— If the first two results exceed the duration requirement corresponding with the claimed capacity level (A to F) in Table 7, but one both do not exceed it by ≥30 %, a third test shall be made and shall pass the duration requirement.

8.3.3.5.2 Test conditions

8.3.3.5.2.1 Concentration and breakthrough for filtering CBRN filtering RPD

The duration in accordance with the selected performance class (A to F) in Table 7 shall be achieved for individual tests with every test agent in Table 8 at the indicated test and breakthrough concentrations, according to the test conditions in 8.3.3.5.2.2 or 8.3.3.5.2.3.

Gas/vapour testing shall be performed in accordance with the method specified in ISO 16900-4, recognising the test concentration tolerances of ±10 % therein.

Table 8 — Filter test challenge and breakthrough concentrations for CBRN filtering RPD

Test agent	Test concentration ml/m³	Breakthrough concentration ml/m³	Comment
Ammonia [7664-41-7][a]	2 500	12,5	
Cyanogen chloride [506-77-4]	300	2	
Cyclohexane [110-82-7]	2 600	10	
Formaldehyde [50-00-0]	500	1	
Hydrogen cyanide [74-90-8]	940	4,7 ml/m³ $(CN)_2$ + HCN	Breakthrough time is taken when the sum of hydrogen cyanide (HCN) and cyanogen ($(CN)_2$, [460-19-5]) concentrations reaches the indicated concentration
Hydrogen sulphide [7783-06-4]	1 000	5	
Nitrogen dioxide [10102-44-0]	200	1 ml/m³ NO_2 or 25 ml/m³ NO	Breakthrough time is taken for the first gas of the pair nitrogen dioxide (NO_2) or nitric oxide (NO, [10102-43-9]) to reach the indicated concentration
Phosgene [75-44-5]	250	1,25	
Phosphine [7803-51-2]	300	0,3	
Sulphur dioxide [7446-09-5]	1 500	5	

[a] Chemical Abstracts Service (CAS) numbers given in brackets

8.3.3.5.2.2 Flow, temperature and humidity for unassisted filtering CBRN filtering RPD and any filter with a standardized connector

Common conditions for all filter capacity tests are as follows.

Temperature (25 ± 2,5) °C

Relative humidity (25 ± 5) % and (80 ± 5) %

Flow rate (64 ± 1) l/min (continuous flow).

8.3.3.5.2.3 Flow, temperature and humidity for assisted filtering CBRN filtering RPD, non-standardized connector

Common conditions for all filter capacity tests are as follows.

Temperature	(25 ± 2,5) °C
Relative humidity	(25 ± 5) % and (80 ± 5) %
Flow rate	Average interactive flow according to 8.1.2.3.

8.3.3.6 Non-Radiological gas filter performance requirements at specified work rates

8.3.3.6.1 Non-radiological gas performance tests — Unassisted RPD and any filter with a standardized connector

Filters shall be tested in accordance with the concentration and breakthrough conditions applied to individual tests with each of the test agents and criteria given in Table 8 with the flow, temperature and humidity conditions given in Table 9. The test flow rate shall be selected in accordance with the work rate of the system.

Two filters shall be tested after pre-conditioning in accordance with Table 2.

The breakthrough time shall exceed 3 min for all classes and capacity levels.

Table 9 — CBRN unassisted filtering RPD test conditions at test flow rates

Requirement	Validation condition
Flow rate for W1	110 l/min
Flow rate for W2	180 l/min
Flow rate for W3	270 l/min
Flow rate for W4	340 l/min
Temperature	(25 ± 2,5) °C
Relative humidity	(50 ± 5) %

8.3.3.6.2 Non-radiological gas performance tests at specified work rates — Assisted RPD, non-standardized connector

Measure the peak interactive flow rate in accordance with ISO 16900-8 by setting the breathing machine to the specified work rate.

Use the measured peak interactive flow rate to conduct the gas performance tests to the criteria given in Table 8 at (25 ± 2,5) °C and (50 ± 5) % relative humidity.

The breakthrough time shall exceed 3 min for all classes and capacity levels.

8.3.3.7 Radiological gas filtration by CBRN and RN filters

8.3.3.7.1 General

CBRN and RN filters shall be tested for their radioactive iodomethane [methyl iodide, CH_3I, (CAS:74-88-4)] filtration capability. This test uses a low concentration of iodomethane containing a proportion of iodine as the radioactive ^{131}I isotope. The performance criterion is a defined ratio of radioiodine activity retained on the filter compared with total challenge activity at the end of the test.

The same radioactive iodomethane test applies to CBRN and RN filters.

Filters shall meet the requirements in 8.3.3.7.2 when tested in accordance with 8.3.3.7.3.

8.3.3.7.2 Requirements

Filters shall be tested after pre-conditioning in accordance with Table 2 or Table 4 as applicable.

Pre-conditioning comprises pre-humidification in accordance with 7.3.2, which is specific to the iodomethane test. The iodomethane test shall be performed within 18 h of completion of this conditioning.

The retention of the filter for radioactive iodomethane removal is defined as:

— Radioactivity retained on filter/total radioactive dose applied, expressed as a percentage.

For filters without pre-conditioning: a minimum retention of 99,00 % shall be exceeded over the exposure and post-exposure (continued airflow) period of testing in accordance with the conditions in 16.2.4.

For pre-conditioned filters: a minimum retention of 98,00 % shall be exceeded over the exposure and post-exposure (continued airflow) period of testing in accordance with the conditions in 16.2.4.

8.3.3.7.3 Radioactive iodomethane test

8.3.3.7.3.1 Requirements

The test shall comprise exposure to radioactive iodomethane for 2 h followed by continued airflow for 2 h.

The iodomethane mass and activity and check bed configuration shall be selected such that the performance range specified in 8.3.3.7.2 can satisfactorily be resolved and these values shall be provided in the test report.

The total mass of radioactive and non-radioactive iodomethane delivered shall be as indicated in Table 10, according to RPD type and work rate.

NOTE A total mass limit is applicable for appropriate representation of reactor incident exposures.

Testing shall be performed in accordance with 16.2.4.

8.3.3.7.3.2 Temperature and humidity

Filter tests shall be conducted with air at (25 ± 1) °C and 90^{+2}_{-1} % RH.

8.3.3.7.3.3 Flow rate and total iodomethane delivery

Flow rates and total iodomethane mass delivery for filter tests are given in Table 10.

Table 10 — Flow rate and iodomethane delivery limits

Type/Class	Continuous flow rate with a toleance of ±2 %	Total iodomethane delivery
Unassisted/ W1	64 l/min	≤15 mg
Unassisted/ W2	120 /min	≤28 mg
Unassisted/ W3	190 l/min	≤45 mg
Unassisted/ W4	245 l/min	≤58 mg
Assisted RPD	Average interactive flow as specified in 8.1.2.3[a]	≤(Flow used [l/min] × 0,234) mg

[a] Where a single filter from the set of filters used on an assisted device is tested, the test flow rate and iodomethane delivery limit shall be divided by the number of filters in the set .

8.4 CBRN filtering RPD with standardized connector

8.4.1 General

The standardized connector on CBRN filtering RPD shall meet the requirements of ISO 17420-3.

RPD using a standardized connector shall have the male thread connector on the filter outlet and the female thread connector on the RI or blower unit inlet.

CBRN RIs with standardized connectors shall be class cT (see ISO/TS 16973).

CBRN RIs Type L (see ISO/TS 16973) shall not incorporate a standardized connector.

Standardized connectors shall not be used on CBRN1 filtering RPD with the exception that filters with standardized connectors may be used on manifolds or assisted device blowers. Refer to Annex B for permitted CBRN filtering RPD combinations.

Standardized connectors may be used on CBRN2 filtering RPD, subject to the requirements of 8.4.2.

Filter simulators with specified resistance values are required for testing CBRN RPD with standardized connectors. The simulators shall be in accordance with filter simulators specified in ISO 16900-5 with the resistance adjusted to requirements in the subsequent clauses as appropriate.

8.4.2 Components of CBRN filtering RPD with standardized connector

8.4.2.1 CBRN RI with standardized connector

8.4.2.1.1 General

Standardized connectors shall only be used on class cT RI.

If the RI has more than one standardized connector, only one shall be operable at a time. All necessary information about the allowed configuration of RPD shall be in the information provided by the manufacturer.

Marking of the RI shall be in accordance with 17.

Testing shall be performed in accordance with 15.

8.4.2.1.2 Breathing Resistance of RIs with standardized connector

The breathing resistance requirements for RIs with standardized connectors of ISO 17420-2:2021, 6.11.3.2 shall be met.

— Pre-conditioning is completed in accordance with Table 2.

— Measurements are made using filter simulators of resistance 700 Pa at 110 l/min.

8.4.2.1.3 Carbon dioxide concentration limits for CBRN filtering RPD with standardized connectors

RPD shall meet the requirements of ISO 17420-2:2021, 6.4.2 according to its designated work rate except that measurements shall be made using filter simulators of resistance 700 Pa at 110 l/min.

8.4.2.1.4 Inward Leakage of RI with standardized connectors

RIs using a standardized connector shall meet 0,01 % inward leakage when tested in accordance with ISO 17420-2:2021, 6.11.3.3.

8.4.2.2 CBRN filters with standardized connector

8.4.2.2.1 Applicability

The requirements of this clause apply to CBRN filters only.

NOTE For corresponding requirements for RN filters see Clause 10.

8.4.2.2.2 Work rate of filters with a standardized connector

Filters with a standardized connector shall only be work rate W1.

8.4.2.2.3 Mass and size of filters with a standardized connector

The mass and size of a filter (including any holder and accessories) with a standardized connector shall be in accordance with ISO 17420-2:2021, 6.11.2.2.

8.4.2.2.4 Airflow resistance of filters with standardized connector

The resistance shall be measured with any filter accessory in place. Testing shall be at a constant flow rate of 110 l/min.

The resistance of filters shall not be less than 500 Pa.

The resistance of filters shall not exceed 700 Pa.

The airflow resistance of filters shall be determined on two filters after pre-conditioning in accordance with Table 2.

Filters shall be tested in accordance with ISO 16900-2.

8.4.2.3 Particle filter efficiency and non-radiological gas filter capacity for CBRN filtering RPD using standardized connectors

Filters with standardized connectors shall meet the requirements of 8.3.3.4 and 8.3.3.5 in accordance with their classification.

8.4.2.4 Low pressure hoses with standardized connector

Low pressure hoses with a standardized connector used with manifolds or assisted CBRN filtering RPD shall have a standardized connector at the outlet only.

8.4.2.5 Manifolds with low pressure hoses with standardized connector

A manifold connected to a RI shall have a work rate class ≤W2.

For testing, the manifold shall be fitted with:

— a low pressure hose;

— filter simulators attached to all inlets, specified in accordance with ISO 16900-5, but with resistance 700 Pa at constant flow rate of 110 l/min.

The airflow resistance of this assembly shall be ≤800 Pa at the flow corresponding with the RPD work rate (110 l/min for W1, 180 l/min for W2).

Testing shall be performed in accordance with ISO 16900-2.

8.4.3 Assisted CBRN filtering RPD with a standardized connector with a tight-fitting RI

8.4.3.1 General

Assisted devices shall comply with the assisted device requirements in 8.4.3.2, 8.4.3.3 and in ISO 17420-2:2021, 6.3.2, 6.4.1, 6.5, when fitted with:

— filter simulators specified in accordance with ISO 16900-5, with resistance 500 Pa at a constant flow rate of 110 l/min on all inlets;

— filter simulators specified in accordance with ISO 16900-5, with resistance 700 Pa at a constant flow rate of 110 l/min on all inlets.

8.4.3.2 Acceptable and unacceptable Configurations

The configuration shall be:

— a standardized connector(s) on the inlet(s) of the blower unit; and/or

— a standardized connector at the connection to the RI;

— where the low pressure hose is removable, the connection to the blower unit shall not be a standardized connector;

— if the blower unit is mounted directly on the RI, the mass including the filter and any accessories shall not exceed 500 g.

The work rate shall be ≤W2.

Refer to Annex B for permitted CBRN filtering RPD combinations.

8.4.3.3 Modes of operation

8.4.3.3.1 Power-on operation

The RPD shall be fitted with filter simulators specified in accordance with ISO 16900-5, with a resistance of 500 Pa at a constant flow rate of 110 l/min on all inlets. At the work rate designated by the manufacturer, the following requirements shall be met:

— the average interactive flow shall be ≤64 l/min multiplied by the number of filters;

— the peak interactive flow shall be ≤110 l/min multiplied by the number of filters.

RPD shall be tested in the power-on condition according to ISO 16900-8.

8.4.3.3.2 Power-off operation

The RPD shall be fitted with filter simulators specified in accordance with ISO 16900-5 with a resistance of 700 Pa at constant flow rate of 110 l/min. At the work rate designated by the manufacturer, the following requirements shall be met:

— the airflow resistance of a blower unit with filter simulators attached to all the inlets, in power off mode, including the low-pressure hose shall be ≤800 Pa at the flow corresponding with the RPD work rate;

— the inward leakage shall meet the requirements of 8.4.2.1.4.

RPD shall be tested in the power-off condition in accordance with ISO 16900-8.

8.4.4 Assisted CBRN filtering RPD with standardized connector with a loose-fitting RI

8.4.4.1 Acceptable and unacceptable configurations

The configuration shall be

— standardized connector(s) on the inlet(s) of the blower unit, and

— the connection to the RI shall not be a standardized connector.

Where the low pressure hose is removable, the connection to the blower unit shall not be a standardized connector.

Refer to Annex B for permitted CBRN filtering RPD combinations.

8.4.4.2 Determination of minimum flow rate

When tested in the power-on condition according to ISO 16900-8 at zero back pressure, the flow shall be ≤64 l/min multiplied by the number of filters at the work rate designated by the manufacturer under the following conditions:

— with all inlets of the RPD fitted with filter simulators specified in accordance with ISO 16900-5, with resistance 700 Pa at a constant flow rate of 110 l/min;

— with all inlets of the RPD fitted with filter simulators specified in accordance with ISO 16900-5, with resistance 500 Pa at a constant flow rate of 110 l/min.

9 Escape CBRN filtering RPD

9.1 General

Escape CBRN Filtering RPD shall conform to Class ES CBRN. Escape filtering RPD designated as ES CBRN (*t*) shall have a minimum protection class of PC4 and shall perform at the designated flow rate for the class Escape RPD.

NOTE For brevity, Escape CBRN Filtering RPD are termed ES CBRN filtering RPD in the text.

ES CBRN filtering RPD shall meet the requirements in 9.2.

The designated duration "*t*" in minutes follows the increments of:

— 5 min between 15 min and 30 min (15 min, 20 min, 25 min, 30 min);

— 10 min between 30 min and 60 min (40 min, 50 min, 60 min);

— 30 min between 60 min and 120 min (90 min, 120 min) and

— 60 min between 120 min and 240 min (180 min, 240 min).

The maximum designated duration for class ES CBRN shall be 240 min.

The minimum duration of air supply and times for chemical agent protection are defined according to the designated duration.

The minimum and maximum durations are not the same as for escape RPD in ISO 17420-6.

The particulate efficiency of ES CBRN filtering RPD shall meet the requirements of 9.3.3.1.

Where ES CBRN filtering RPD are designated for additional capabilities under ISO 17420-6, requirements in ISO 17420-6 and in this document shall be met, respecting the following:

— minimum protection class and filtration efficiency requirements of this document shall apply;

— pre-conditioning requirements of this document shall apply;

— the designated duration values of this document shall apply;

and the RPD shall be marked accordingly.

9.2 Requirements

9.2.1 Specification of duration, *t*, of escape CBRN filtering RPD

The filter performance is tested in accordance with the capacity determination with a minimum breakthrough time which is given by the designated duration, *t*, designated by the manufacturer.

9.2.2 Validation of Escape CBRN filtering RPD performance

Two ES CBRN filtering RPD of each RI size shall be pre-conditioned in accordance with Table 3, prior to ES CBRN filtering RPD validation testing.

Each size of RI shall be tested at least once.

9.2.2.1 Unassisted Escape CBRN filtering RPD

ES CBRN filtering RPD shall meet the requirements for work of breathing/breathing resistance and elastance, when tested according to ISO 17420-6:2021, 7.2.10.2.1.

9.2.2.2 Assisted Escape CBRN filtering RPD

ES CBRN filtering RPD shall meet the requirements for work of breathing/breathing resistance and elastance, when tested according to ISO 17420-6:2021, 7.2.10.2.2.

9.2.2.3 Flow rate – Assisted Escape CBRN filtering RPD

The average and peak interactive flow shall be measured at the appropriate work rate in accordance with ISO 16900-8:2015, 7.3. The values are used for performance testing in 9.3.3.

9.2.3 Protection class

ES CBRN filtering RPD shall have a minimum protection class of PC4.

Where optional features are offered, the minimum protection class shall be achieved with optional features attached.

NOTE Protection classes are defined in ISO/TS 16973.

The protection class for CBRN RPD shall be derived from testing in accordance with ISO 17420-1:2021, 5.7.

Assisted CBRN Filtering RPD with a RI of type L (Loose fitting) shall be tested in the “power on” mode.

For ES CBRN filtering RPD where it is intended for one size to fit all, there shall be representation of all headform sizes in the test panel in accordance with the guidelines given in ISO 16900-1.

When the airflow into the breathing zone does not pass directly through the ocular zone, the protection class shall also be measured in the ocular zone and shall achieve the minimum protection above in accordance with their classification.

9.2.4 CBRN chemical resistance

9.2.4.1 General

ES CBRN filtering RPD shall be resistant to the permeation and penetration effects of chemical warfare agents. Distilled Sulphur Mustard (HD) and Sarin (GB) shall be used as the test agents. ES CBRN filtering RPD shall be resistant to the permeation and penetration of chemical agents in liquid and vapour form.

Where the design of the RI provides separate zones for breathable gas supply, these levels apply in all zones.

The defined duration (t min) controls the selection of test requirements.

Testing shall be performed in accordance with 16.2.

9.2.4.2 Escape CBRN filtering RPD chemical resistance requirements

A minimum of three ES CBRN filtering RPD shall be tested for permeation with HD vapour and a minimum of three RPD shall be tested for GB vapour penetration in accordance with the test methods in 16.2.

For each test agent, a minimum of one RPD shall be tested without pre-conditioning, and a minimum of two tested after pre-conditioning as applicable in Table 3.

The maximum levels of permeation in Table 11 shall not be exceeded.

All components and accessories claimed as part of the RPD by the manufacturer shall be tested in the ready for use state. This may result in the need to test more than three systems if the submitted systems represent more than one completely assembled individual respirator.

Testing shall be performed in accordance with 16.2.

9.2.4.3 Pass/Fail criteria

The maximum levels of permeation in Table 11 shall not be exceeded.

Either of the following criteria shall constitute a failure:

— three consecutive sequential instantaneous concentration data points during execution of the test at or exceeding the value in Table 11; or

— exceeding the maximum breakthrough dosage (concentration integrated over test duration) as shown in Table 11 calculated after completion of the test.

Table 11 — Liquid and vapour test requirements for Escape CBRN filtering RPD

RPD class	Agent	Challenge	Challenge duration[a] min	Breathing machine airflow rate[b] l/min	Maximum peak excursion mg/m³	Maximum breakthrough (concentration integrated over test duration) mg-min/m³	Test duration	Number of RPD tested
ES CBRN with $t \leq 30$	GB Vapour	210 mg/m³	*t*	40	0,087	0,9	2*t*	3
	HD Vapour	50 mg/m³	*t*	40	0,60	6,0	2*t*	3
	HD Liquid	≥0,50 ml[c]	2*t*	40	0,60	6,0	2*t*	
ES CBRN with $t \geq 40$	GB Vapour	210 mg/m³	30	40	0,087	2,1	2*t*	3
	HD Vapour	50 mg/m³	30	40	0,60	6,0	2*t*	3
	HD Liquid	≥0,50 ml[c]	2*t*	40	0,60	6,0	2*t*	

[a] *t* = designated duration as specified in 9.1.

[b] Sinusoidal flow: the setting of the breathing machine shall be (36 × 1,1) l/min.

[c] This volume depends on the minimum number of droplets for this class specified in 16.2.3, but more droplets may be applied based on RPD design where necessary.

9.2.5 Practical performance testing

ES CBRN filtering RPD without pre-conditioning shall undergo practical performance tests as specified in ISO 17420-1:2021, 5.8, except for donning and doffing where ISO 17420-6:2021, 7.2.10.4 replaces ISO 17420-1:2021, 5.8.2.

9.3 Requirements for filters and components of Escape CBRN filtering RPD

9.3.1 Respiratory interface

ES CBRN filtering RPD RIs shall incorporate air management such that passage of exhaled air through the filter is prevented.

9.3.2 Connectors

Connectors in accordance with ISO 17420-3 are not permitted except if permanently joined.

9.3.3 Filter

9.3.3.1 Particle filter efficiency

The filter efficiency class shall be greater than or equal to class F4 following pre-conditioning as in Table 3.

Testing shall be performed in accordance with ISO 17420-2:2021, 6.10.1.2.

Three samples shall be tested with each aerosol type.

9.3.3.2 Gas filter capacity for Escape CBRN filtering RPD

9.3.3.2.1 Gas capacity requirements for Escape CBRN filtering RPD

ES CBRN filtering RPD shall demonstrate a minimum capability to achieve the designated duration *t* in accordance with test conditions in Table 12, determined by unassisted or assisted operating mode.

The breakthrough concentration requirements shall be selected according to the designated duration *t* as indicated in the third or fourth columns of Table 12.

For all requirements in 9.3.3.2 and 9.3.3.3, individual testing on new filters with each of the agents and conditions shall be performed on RPD after pre-conditioning as in Table 3.

For each test agent in Table 12 and each humidity in accordance with conditions in 9.3.3.2.2 or 9.3.3.2.3, test quantities shall be as follows:

A maximum of three filters shall be tested per test condition.

— If the first two results exceed the duration requirement, *t*, by ≥30 %, the capacity requirements are met, and a third test is not required.

— if one or both results pass but do not exceed the duration requirement, *t*, by ≥30 %, a third test shall be made and shall pass the duration requirement.

Results shall be assessed in accordance with ISO 16900-4 and pass or fail determined.

Table 12 — Test conditions — Concentration and breakthrough for Escape CBRN filtering RPD

Test agent[a]	Test concentration ml/m³	Breakthrough concentration 15 min to 60 min duration ES CBRN filtering RPD ml/m³	Breakthrough concentration 90 min to 240 min duration ES CBRN filtering RPD ml/m³
Ammonia [7664-41-7]	1 250	25	12,5
Cyanogen Chloride [506-77-4]	150	2	2
Cyclohexane [110-82-7]	1 300	10	10
Formaldehyde [50-00-0]	250	10	1
Hydrogen Cyanide [74-90-8]	470	10 ml/m³ $(CN)_2$ + HCN[b]	4,7 ml/m³ (CN)2 + HCN[b]
Hydrogen Sulphide [7783-06-4]	500	30	5
Nitrogen Dioxide [10102-44-0]	100	1	1 ml/m³ NO_2 or 25 ml/m³ NO[c]
Phosgene [75-44-5]	125	1,25	1,25
Phosphine [7803-51-2]	150	0,5	0,3
Sulphur Dioxide [7446-09-5]	750	5	5

[a] Chemical Abstracts Service [CAS] numbers given in brackets.

[b] Breakthrough time is taken when the sum of hydrogen cyanide (HCN) and cyanogen ($(CN)_2$, [460-19-5]) concentrations reaches the indicated value.

[c] Breakthrough time is taken for the first gas of the pair nitrogen dioxide (NO_2) or nitric oxide (NO, [10102-43-9]) to reach the indicated concentration.

9.3.3.2.2 Flow, temperature and humidity for unassisted escape CBRN filtering RPD

Conditions for all filter capacity tests are as follows:

Temperature	(25 ± 2,5) °C
Relative humidity	(25 ± 5) % and (80 ± 5) %
Flow rate	(64 ± 1) l/min (continuous flow)

9.3.3.2.3 Flow, temperature and humidity for assisted escape CBRN filtering RPD

Conditions for all filter capacity tests are:

Temperature	(25 ± 2,5) °C
Relative humidity	(25 ± 5) % and (80 ± 5) %
Flow rate	Average interactive flow from 9.2.2.2.

9.3.3.3 ES CBRN gas filter performance tests at designated work rate

9.3.3.3.1 Unassisted escape CBRN filtering RPD

All ES CBRN filtering RPD shall meet all the requirements at their designated work rate.

Airflow, temperature and humidity conditions for filter tests at designated work rate are given in Table 9.

Filters shall be tested under these conditions to the concentration and breakthrough criteria in column 3 in Table 12 with each of the test agents. The breakthrough time shall exceed 3 min.

9.3.3.4 Assisted Escape CBRN filtering RPD

Filters shall be tested at the peak interactive airflow in accordance with ISO 16900-8 by setting the breathing machine to the designated work rate class. The temperature of testing shall be (25 ± 2,5) °C and (50 ± 5) % RH.

Filters shall be tested under these conditions applied to individual tests with each of the test agents and breakthrough criteria in column 3 in Table 12. The breakthrough time shall exceed 3 min.

10 RN Filters — Requirements and testing

10.1 General

An overview of requirements for RN filters is given in Clause 5.

Classification of RN filters is given in 5.3 and includes their designated work rate: all requirements shall be met at the designated work rate.

Filters meeting the requirements for RN can also meet the requirements for other gases as specified in ISO 17420-2. In all cases, RN filter requirements of this document shall be met.

RN filters may incorporate a standardized connector, in which case requirements of 10.4 shall be met.

RN filters shall meet all requirements of ISO 17420-2:2021, 6.10.1 except that:

— the minimum requirements for particle filter efficiency shall be as specified in 10.2;

— the minimum requirements for gas/vapour performance shall be as specified in 10.3;

— additional gas/vapour classifications in accordance with the requirements in ISO 17420-2:2021, 6.10.1.3, can be provided.

10.2 Particle filter efficiency

RN filters shall meet particle efficiency level F5 as specified in ISO 17420-2:2021, 6.10.1.2, at their designated work rate.

10.3 Gas filtration performance

10.3.1 Radioactive iodomethane retention requirements

RN filters shall meet requirements for filtration of radioactive iodomethane (CH_3I) in accordance with 8.3.3.7, with test conditions appropriate to assisted or unassisted operation.

Interactive flow values where applicable shall be according to ISO 16900-8 by setting the breathing machine to the designated work rate. If the RPD has the option for the wearer to select multiple flow settings, it shall be set to the highest flow setting when the interactive flow is measured.

10.3.2 Organic vapour capacity requirements

RN Filters shall meet class OV1 or higher according to ISO 17420-2:2021, 6.10.1.3.2 and 6.10.1.3.4 with test conditions appropriate to assisted or unassisted operation.

10.4 RN Filters with standardized connector

10.4.1 Work rate of filters with a standardized connector

RN Filters with a standardized connector shall only be Work Rate W1.

10.4.2 Mass and size of filters with a standardized connector

The mass and size of a filter (including any holder and accessories) with a standardized connector shall be in accordance with ISO 17420-2:2021, 6.11.2.2.

10.4.3 Airflow resistance of RN filters with standardized connector

The resistance shall be measured with any filter accessory in place.

Testing shall be at a constant flow rate of 110 l/min.

The resistance of filters shall not be less than 500 Pa.

The resistance of filters shall not exceed 700 Pa.

The airflow resistance of filters shall be determined on two filters after pre-conditioning in accordance with Table 4.

Filters shall be tested in accordance with ISO 16900-2.

11 Multi-functional RPD

11.1 General

Multi-functional RPD are devices, which provide capabilities within the unassisted filtering mode and assisted filtering mode.

11.2 CBRN1 and CBRN2 RPD

Multi-functional RPD shall meet one of CBRN1 or CBRN2 requirements in both modes of operation and shall continue to meet those requirements while switching between modes.

The relevant requirements of ISO 17420-2:2021, 6.12 apply in all cases with the exception that pre-conditioning in accordance with the CBRN classification shall replace the sequential pre-conditioning requirement in ISO 17420-2.

The permeation and penetration requirements of 8.2 shall be met in both modes.

11.3 ES CBRN filtering RPD

The relevant requirements of ISO 17420-6:2021, 4.3, apply.

12 Optional features

12.1 General

In the absence or presence of optional features, the RPD shall comply with all requirements of this document appropriate to its classification.

RPD with optional features attached shall conform to the requirements of Table 2 or Table 3. Where applicable, additional provisions are given in 12.2 and 12.3.

12.2 Hydration

In addition to meeting requirements of ISO 17420-2:2021, 6.13.5, the following shall be met:

— the design shall facilitate avoidance of contamination during the connection process – as established through the FMEA;

— the hydration system shall be tested for agent permeation and penetration as part of the chemical resistance test as specified in 8.2 or 9.2.4.

12.3 End of service life indicator for filters (ESLI)

ESLI are not permitted for CBRN RPD filters.

ESLI for RN filters, where provided, shall comply with ISO 17420-1:2021, 5.5, and ISO 17420-1:2021, 5.6.

13 Training components

RPD and components for use in training which do not satisfy the requirements of this document shall

— be physically representative of the related RPD or component, including airflow resistance,

— be clearly identified as for training only, on the RPD or component, and external packaging and carrier if used,

— incorporate a permanent and durable label identifying the component as only for training use, and

— not incorporate lettering indicating CBRN capability.

Unless the component is designated for single-use, guidance shall be included in the information from the manufacturer for cleaning and preparation for re-use.

If the component is a filter with a standardized connector, requirements in 8.4.2.2 shall be met.

It is permitted for a training component representing an item of a specific classification to be designated to a different capability within ISO 17420 to accommodate training activities. In such cases, all requirements in this clause shall be satisfied and the marking and information from the manufacturer shall conform with the requirements applicable to the classification met.

NOTE An example of this is a filter used for training on CBRN RPD in place of a CBRN filter: the training filter can be classified for particle filtration only, to accommodate simulation exercises.

14 Reliability

Requirements for reliability in accordance with ISO 17420-2:2021, Annex A, shall be examined.

The provisions of ISO 17420-2:2021, Annex B, shall be followed in preparation of the failure modes effects analysis (FMEA) to demonstrate capability of specific features of RPD.

Additional considerations for CBRN filtering RPD and RPD with RN filters include, but are not limited to, the toxic and corrosive nature of some of the hazardous materials with which RPD may come into contact.

15 Inspection and practical performance testing

The inspection shall be made prior to laboratory or practical performance tests, or as specified in the specific clauses of this specification.

Inspection shall be conducted in accordance with ISO 17420-1:2021, 6.2.

Additional requirements for marking as specified in Clauses 13 and 17 shall be assessed.

16 Test methods

16.1 General

This clause defines test methods, which are not included in the ISO 16900 series.

Unless otherwise stated, testing shall be performed in accordance with 6.1.

16.2 Toxic agent penetration and permeation tests

16.2.1 General

CAUTION — The tests described in this clause involve use of highly toxic compounds. Appropriate safety precautions and sample disposal practices are required.

This test allows the RPD to be challenged with chemical warfare agents and the permeation of agent into the inhaled air to be measured for an extended period.

RPD, including all components and accessories, which form part of the breathing circuit are tested.

Three RPD shall be tested in an atmosphere containing GB vapour and three shall be tested in an atmosphere containing HD vapour. In each set of three, one shall be tested without pre-conditioning and two pre-conditioned as specified in Table 2 or Table 3.

Test requirements for each CBRN class are given in Table 6 and Table 11.

Values of the maximum peak excursion and concentration integrated over test duration shall be recorded.

Other test equipment designs that are identical in principle but vary in detail to that described in this standard may be used, so long as the conditions described in Table 6 or Table 11 are maintained. Details of the test set up may vary according to the RPD type.

16.2.2 Materials and test methods

Materials and test methods are described in ISO/TS 17420-9:2021, 14.2. This applies to the set-up and conduct of test for filtering devices with the requirements defined in 8.2 and 9.2.4.

NOTE Table 4 in ISO/TS 17420-9:2021 is equivalent to Table 6 in this document, and Table 5 in ISO/TS 17420-9:2021 is equivalent to Table 11 in this document.

16.2.3 Liquid and vapour permeation test

Where testing with liquid agent is called for in Table 6 or Table 11, HD droplets of 20 µl shall be applied using a syringe, or other metered dispensing instrument, on to the RPD.

RPD shall be tested fitted to the manikin in its as-worn state.

Attachments to the RI (for example: a voice amplifier, hydration tube and connector) shall be considered with respect to impact on the integrity of the breathing gas supply chain.

If a hydration tube is connected to the RI via an isolating value, then that valve shall be open during the test. The connector to the hydration reservoir shall be closed.

For assisted RPD, the agent droplet pattern shall include the blower unit, hose and joints.

If a mode-switching means is present, at least one droplet shall be positioned on that means.

For the RI: 25 droplets including the connection to the rest of the RPD (if present) as shown in Figure 1 or Figure 2, according to type.

Where features in the figures are absent from the RI under test, the allocated droplets shall be evenly distributed over the RI surface.

Where one filter is directly attached to the RI, a total of 7 further droplets shall be applied as follows:

— 2 droplets to the body of the filter at the air inlet;

— 4 droplets uniformly over the surface of the filter;

— 1 droplet on the joint between the RI and the filter.

Where two or more filters are directly attached to the RI, the 7 droplets shall be distributed between the filters ensuring that the inlets, external surfaces and interfaces are all challenged.

For the RPD extending beyond the RI, excluding the RI, a minimum of 18 droplets shall be applied.

Working from top to bottom:

— 1 droplet for each non-metallic material exposed to the external environment;

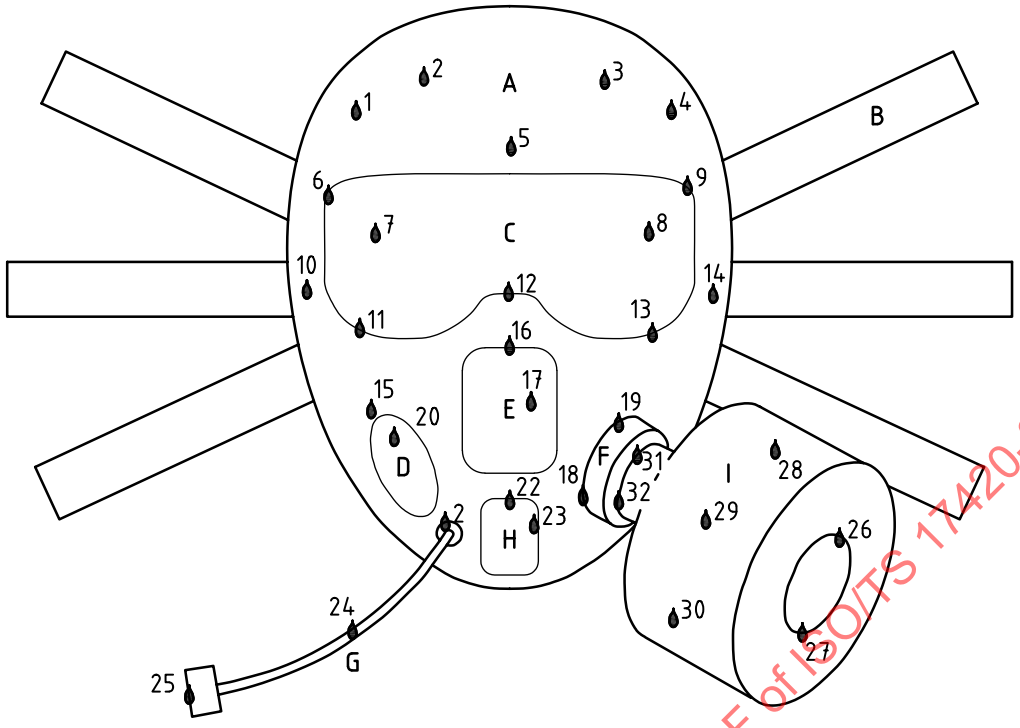
— 1 droplet for each joint;

— a total of 6 droplets allocated uniformly across the filter(s);

— with the remaining droplets distributed uniformly over the RPD excluding the RI.

Additional droplets beyond 18 shall be added if necessary, so that each joint has 1 droplet applied.

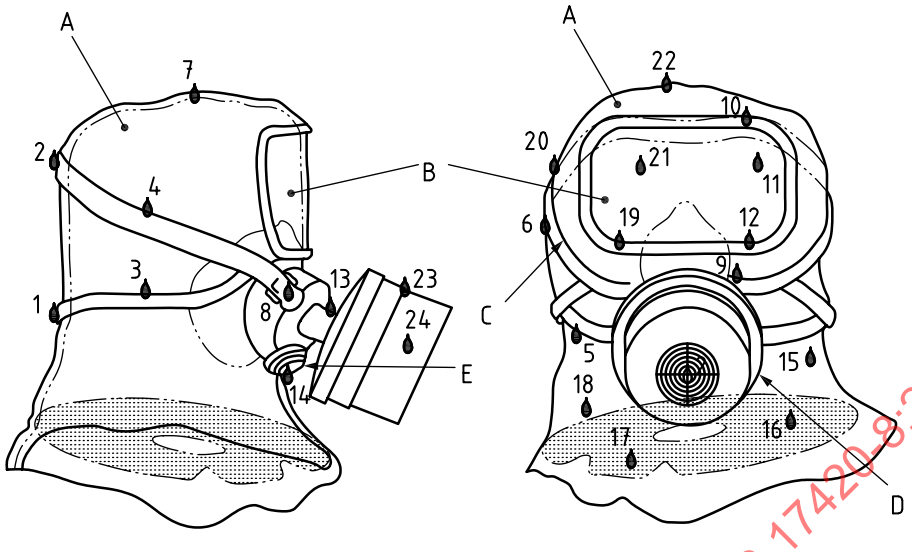
The initial location of the drops shall be markedon a photograph of the RPD.



Key

A	facepiece	F	voice-emitter , filter mount, or housing for second stage regulator, if present
B	head-harness strap	G	drink tube, if present
C	eye lens(es)	H	exhalation valve
D	voice-emitter , filter mount, or housing for second stage regulator, if present	I	filter
E	voice-emitter , filter mount, or housing for second stage regulator, if present		

Figure 1 — Droplet allocation for RI Type cT



Key

A	hood Material	D	filter
B	eye lens(es)	E	exhalation valve
C	strap		

Figure 2 — Droplet allocation for ES CBRN

16.2.4 Test report

The test report shall include at least the following:

a) the type of test performed (GB vapour, HD vapour, HD liquid);

b) a reference to this document, i.e. ISO/TS 17420-8:2021;

c) identification of the RPD;

d) attachments to the RPD present for the test;

e) values of the maximum peak excursion and concentration integrated over test duration;

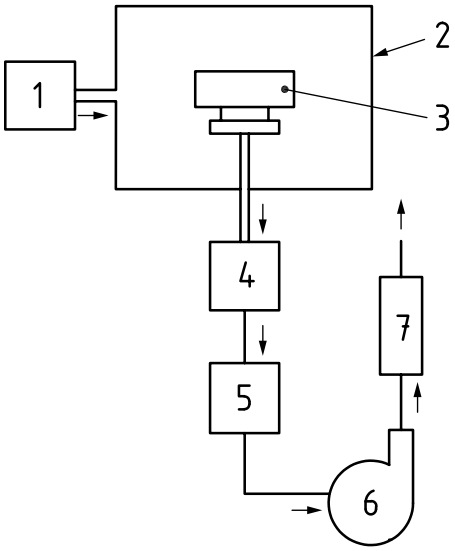
f) the three highest peak excursion concentrations and their times;

g) for HD liquid tests, a digital photograph of the RPD with the droplet positions marked.

16.3 Radioactive Iodomethane gas test

16.3.1 Test apparatus

The test apparatus follows the general principle of the method in ISO 16900-4 noting that for this test the effluent flow from the filter passes through a check bed to facilitate measurement of radioactivity. A test system layout is shown in Figure 3.



Key

1 iodomethane challenge generator
2 test chamber
3 filter under test
4 check bed
5 safety filter
6 vacuum pump
7 flow meter

Figure 3 — Typical test apparatus layout for radioactive iodomethane test

16.3.2 Test agent

The radioactive component shall be $CH_3{}^{131}I$.

NOTE 1 The non-radioactive isotopic form $CH_3{}^{127}I$ can also be present.

The applied test agent dose shall conform with the values in Table 10.

The test equipment shall be designed to deliver the test agent uniformly over the duration of the test.

The iodomethane mass and activity and check bed configuration shall be selected such that the performance range specified in 8.3.3.7.2 can satisfactorily be resolved and these values shall be provided in the test report.

NOTE 2 Improper selection can result in apparent lower performance than the true value due to overloading of the sorbate in the test filter and check bed.

16.3.3 Filter testing

Filters are tested

— without pre-conditioning, and

— after pre-conditioning in accordance with 7.3.2.

16.3.4 Test procedure

A diagrammatical representation of a typical layout of the radioactive iodomethane test system is shown in Figure 3.

The test agent shall be diluted and thoroughly mixed into air at the flow rate specified and passed through the filter for 2 h.

Air, without agent added, shall then be passed through the filter for 2 h at the specified temperature, humidity and flow rate.

The activity on the filter and check bed is determined by the activity of ^{131}I measured at the end of the test. Measurement of the intensity of the 0,36 MeV gamma line is typically used.

The activity measurements for both shall be made as soon as possible after the conclusion of the gas stream exposure in the test to minimize inaccuracy caused by radioactive decay.

Due to the short half-life of ^{131}I, the activities of the test filter and check bed shall be measured as closely together in time as possible. If the activities from the test filter and check bed are measured at significantly different times, corrections for radioactive decay shall be made as described in ASTM D3803.

16.3.5 Radioactivity retention determination

16.3.5.1 General

The retention of the filter for radioactive iodomethane removal is represented by the radioactivity of the iodine retained on the filter as a proportion of the total radioactive dose delivered. This is determined by

Activity on filter/(Activity on filter + Activity on check bed)

expressed as a percentage.

16.3.5.2 Activity measurement

Activity levels for the sorbent in the test filter and check bed shall be determined individually as follows:

— the sorbent shall be removed and homogenized in accordance with ASTM E300 or equivalent national or international standards;

— the volume of the sorbent shall be determined in accordance with ASTM D2854 or equivalent national or international standards;

— a sample of the homogenized sorbent shall be loaded into a test container of standard volume (such that the same volume is used for both and packing density is consistent);

— the activity level of the samples shall be measured.

16.3.5.3 Calculation

Since the same volume is sampled for test filter and check bed sorbent activity measurements, the retention value in test filter (R_{tf}) is calculated as follows:

Total activity on test filter = $A_f V_f$

Total activity on the check bed = $A_c V_c$

$$R_{tf}\,(\%) = \frac{A_f V_f}{A_f V_f + A_c V_c} \cdot 100$$

Where:

A_f is the activity of sorbent sampled from the test filter;

A_c is the activity of sorbent sampled from the check bed;

V_f is the volume of sorbent in the test filter;

V_c is the volume of sorbent in the check bed.

16.3.6 Test report

The test report shall in include at least the following:

a) identification of the filters;

b) a reference to this document, i.e. ISO/TS 17420-8:2021;

c) weight uptake on pre-conditioning where performed;

d) applied concentration, total mass applied and activity of iodomethane;

e) activity of ^{131}I in sorbent sampled from the test filter, A_f;

f) activity of ^{131}I in sorbent sampled from the check bed, A_c;

g) if the activities from the test filter and check bed are measured at significantly different times, corrections for radioactive decay in accordance with ASTM D3803-91;

h) volume of sorbent in the test filter, V_f;

i) volume of sorbent in the check bed, V_c;

i) retention value.

17 Marking

17.1 General

The manufacturer shall provide minimum marking, as required in 17.2 to 17.5, on the RPD as worn by the individual.

Contact information of the manufacturer shall be included on the package. This can be done by a weblink which directly leads to address and telephone number of the manufacturer.

All marking shall be readable, permanent and clearly visible.

NOTE Permanent marking is marking that cannot be removed without evidence of its removal.

Where applicable, marking may be added in order to comply with national or local regulations.

17.2 Marking of CBRN filtering RPD and components

The RPD shall include at least the marking shown in Table 13.

The filter may be any colour.

No colour marking is specified for filters incorporating CBRN in their classification.

The colour requirements specified in ISO 17420-2:2021, 8.4.2, are not mandatory for CBRN filters incorporating other classifications.

For example, a filter classified as OV1 F4 CBRN1/B W2 may be any colour.

Table 13 — Marking of CBRN filtering RPD and components

Marking	RPD[a]	RI	CBRN filter marking	CBRN filter in ready for assembly state[b]	Other components/ replacement parts
Manufacturer name, logo or identifying mark	X	X	X	X	S
Means of traceability in a format chosen by the manufacturer	X	X	X	X	S
Instructions to read the information supplied by the RPD manufacturer, by using the graphical symbol given in ISO 17420-2:2021, 3.3.2	X	X	X	X	S
Reference to this document: [year of publication]	X	X	X	X	
Part number or type identifying mark	X	X	X	X	S
Size designation, if applicable	X	X			S
RPD model number, name	X				
RPD classification in the sequence in accordance with Clause 4	X				
The letter combination "CBRN" in a sans-serif font	X	X	X	X	S
RI class and type		X			
Designation of conformity with other standards (e.g. eye protection) on the RI		A			
Type and class in accordance with 4.6.			X	X	
Indication for "for single shift use only" or with the symbol in ISO 17420-2:2021, 3.3.3			X	X	
If the filter is additionally classified as meeting an ISO 17420-2 gas filter performance class (optional for CBRN devices), additional marking to reference ISO 17420-2			X	X	
Provide shelf life indication, e.g. end of shelf life, by using the graphical symbol given in ISO 17420-2:2021, 3.3.4				X	A
Indicate conformity with other standards or regulations (e.g. intrinsic safety, electromagnetic compatibility, low voltage, etc.)					A
Disposal graphical symbols					A

In this table:

X indicates a mandatory requirement to be included in the marking;

A indicates marking to be included to the RPD or component, if applicable;

S indicates inclusion of the marking if there is sufficient space. If there is not sufficient space, the marking shall be provided on the packaging of the item.

[a] If the RPD is part of a system, where different components can be combined resulting in RPD with different classes, a generic marking can be chosen, giving reference to the information supplied by the RPD manufacturer using the symbol in accordance with ISO 17420-2:2021, 3.3.2 behind the class symbol.

Example PC  W 

[b] See definition 3.1.21.

17.3 Escape CBRN filtering RPD marking

Escape CBRN filtering RPD shall be marked in accordance with 4.6.3 and ISO 17420-6:2021, Clause 9.