BSI Standards Publication

Respiratory protective devices — Performance requirements

Part 9: Special application chemical, biological, radiological and nuclear (CBRN) supplied breathable RPD

Documents
Document Sharing Hub

Full document details: PD ISO/TS 17420-9:2021

National foreword

This Published Document is the UK implementation of ISO/TS 17420-9:2021.

The UK participation in its preparation was entrusted to Technical Committee PH/4, Respiratory protection.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

This publication is not to be regarded as a British Standard.

© The British Standards Institution 2021
Published by BSI Standards Limited 2021

ISBN 978 0 539 05393 7

ICS 13.340.30

Compliance with a Published Document cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 November 2021.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: PD ISO/TS 17420-9:2021

TECHNICAL SPECIFICATION

ISO/TS 17420-9

First edition
2021-10

Respiratory protective devices — Performance requirements —

Part 9: Special application chemical, biological, radiological and nuclear (CBRN) supplied breathable RPD

Appareils de protection respiratoire — Exigences de performances —

Partie 9: Appareils d'application spéciale de gaz respiratoire nucléaire-radiologique, biologique, chimique (NRBC)

Reference number
ISO/TS 17420-9:2021(E)

Documents
Document Sharing Hub

© ISO 2021

Full document details: PD ISO/TS 17420-9:2021

COPYRIGHT PROTECTED DOCUMENT

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO 2021 – All rights reserved

Documents
Document Sharing Hub

Full document details: PD ISO/TS 17420-9:2021

Contents

Page

Foreword ... **v**

Introduction ... **vi**

1 Scope ... **1**

2 Normative references ... **2**

3 Terms, definitions and abbreviations ... **2**
3.1 Terms and definitions ... 2
3.2 Abbreviated terms ... 4

4 Designation and classification ... **4**
4.1 General ... 4
4.2 CBRN RPD ... 5
4.2.1 Special application CBRN1 ... 5
4.2.2 Special application CBRN2 ... 5
4.2.3 Special application CBRN3 ... 5
4.3 Special application Escape CBRN ... 5
4.4 CBRN RPD summary of capabilities ... 6
4.5 CBRN RPD Classes ... 6
4.5.1 General ... 6
4.5.2 CBRN supplied breathable gas RPD ... 6
4.5.3 Escape CBRN supplied breathable gas RPD ... 6

5 Requirements ... **7**
5.1 General ... 7
5.2 Test samples ... 7
5.3 CBRN RPD requirements ... 7
5.3.1 CBRN RPD operation ... 7
5.3.2 CBRN supplied breathable gas RPD ... 7
5.3.3 Escape CBRN supplied breathable gas RPD ... 9

6 Pre-conditioning ... **10**
6.1 General ... 10
6.2 Sample preparation for pre-conditioning ... 10
6.3 Components excluded from pre-conditioning ... 11
6.4 CBRN RPD — Specific temperature and humidity pre-conditioning ... 11

7 CBRN supplied breathable gas RPD ... **12**
7.1 Requirements for supplied breathable gas CBRN RPD ... 12
7.1.1 General ... 12
7.1.2 Protection Class ... 13
7.1.3 Correspondence with hazardous materials firefighting RPD ... 13
7.1.4 Provision of breathable gas ... 13
7.1.5 Temperature of operation ... 13
7.1.6 Chemical agent resistance ... 14
7.1.7 Practical performance testing ... 15
7.2 Requirements for supplied breathable gas CBRN RPD components ... 15
7.2.1 Connections ... 15
7.2.2 Resistance to permeation of breathable gas cylinders by liquid HD ... 15

8 Escape CBRN supplied breathable gas RPD ... **16**
8.1 General ... 16
8.2 Requirements for Escape CBRN supplied breathable gas RPD ... 16
8.2.1 Determination of Escape CBRN supplied breathable gas RPD duration, *t* ... 16
8.2.2 Escape RPD performance requirements ... 17
8.2.3 Protection class ... 17
8.2.4 Chemical agent resistance for Escape CBRN supplied breathable gas RPD ... 17
8.2.5 Breathable gas cylinder permeation ... 18

AVA Documents
Document Sharing Hub

© ISO 2021 – All rights reserved

Full document details: PD ISO/TS 17420-9:2021

8.2.6 Practical performance testing ... 18

9 Combined and multi-functional RPD ... 18
9.1 General ... 18
9.2 Combined RPD ... 19
9.3 Multi-functional RPD ... 19
9.4 Requirements – Escape CBRN combined with other RPD classes ... 19

10 Optional features ... 19
10.1 General ... 19
10.2 Optional connectors ... 19
10.3 Hydration ... 20

11 Training RPD and components ... 20

12 Reliability ... 20

13 Inspection and practical performance testing ... 20

14 Test methods ... 20
14.1 General ... 20
14.2 Chemical agent penetration and permeation tests ... 21
14.2.1 General ... 21
14.2.2 Materials ... 21
14.2.3 Test equipment ... 22
14.2.4 Preparation ... 24
14.2.5 Chemical agent tests ... 26
14.2.6 Test report ... 34
14.3 Mustard (HD) liquid permeation test for cylinder materials ... 34
14.3.1 General ... 34
14.3.2 Cylinder material swatch test method ... 34
14.3.3 Calculation of agent concentration in cylinder from swatch test ... 35
14.3.4 Test report ... 36

15 Marking ... 37
15.1 General ... 37
15.2 CBRN RPD component marking ... 37
15.3 Escape CBRN RPD marking ... 37

16 Information supplied by the manufacturer ... 37
16.1 General ... 37
16.2 CBRN RPD information ... 37

Annex A (informative) **Number of samples and test schedules ... 38**

Annex B (informative) **Application of uncertainty of measurement ... 39**

Bibliography ... 41

© ISO 2021 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 17420-9:2021

Foreword

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

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

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

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

For an explanation 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.

© ISO 2021 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 17420-9:2021

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, 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.

These requirements in the ISO system summarized in this document cover 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.

© ISO 2021 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 17420-9:2021

Respiratory protective devices — Performance requirements —

Part 9: Special application chemical, biological, radiological and nuclear (CBRN) supplied breathable 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 specification, 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 or contaminated 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.

© ISO 2021 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 17420-9:2021

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 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/TS 16975-1:2016, *Respiratory protective devices — Selection, use and maintenance — Part 1: Establishing and implementing a respiratory protective device programme*

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

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 and rescue 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 17420-8, *Respiratory protective devices — Performance requirements — Part 8: Special application chemical, biological, radiological and nuclear (CBRN) filtering and radiological-nuclear (RN) filtering RPD*

EN 388, *Protective gloves against mechanical risks*

IEC 60721-1, *Classification of environmental conditions - Part 1: Environmental parameters and their severities*

3 Terms, definitions and abbreviations

For the purposes of this document, the terms and definitions given in ISO 16972, ISO 17420-1 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 and that could be disseminated to cause harm

© ISO 2021 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 17420-9:2021

3.1.4
nuclear material
radioactive matter resulting a nuclear explosion or accidental release from a nuclear facility

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

3.1.8
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

3.1.9
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

3.1.10
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

3.1.11
permeation
process by which a chemical moves through a given material on a molecular level

3.1.12
responder
personnel who intervene in an emergency

3.1.13
receiver
medical professional who will normally remain in their place of work (rather than attending the incident)

3.1.14
sarin
GB
extremely toxic and potentially lethal human-made chemical warfare agent, isopropyl methyl phosphonofluoridate [IUPAC: (RS)-propan-2-yl methylphosphonofluoridate], classified as a nerve agent

3.1.15
sulphur mustard
HD
extremely toxic and potentially lethal human-made chemical warfare agent, IUPAC: bis(2-chloroethyl) sulphide, classified as a vesicant (blister agent)

Documents
Document Sharing Hub

© ISO 2021 – All rights reserved

Full document details: PD ISO/TS 17420-9:2021

3.1.16
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.

3.1.17
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 SCBA: cylinder, Respiratory Interface (RI), demand valve, harness etc.) have been completely assembled and then connected (RI connected to the demand valve) together in accordance with the information supplied by the manufacturer.

3.1.18
RPD in ready for use state
RPD ready to be donned as described by the manufacturer

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

3.1.19
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, and Nuclear
FMEA	Failure Modes Effects Analysis
PPE	Personal Protective Equipment
GB	Sarin
HD	Sulphur mustard
RH	Relative Humidity
RN	Radiological and Nuclear
RI	Respiratory Interface

4 Designation and classification

4.1 General

The following classifications for RPD under special application CBRN and special application escape CBRN shall be used.

© ISO 2021 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 17420-9:2021

4.2 CBRN RPD

4.2.1 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 a minimum flow corresponding work rate W1;

— provide resistance to gaseous chemical agent permeation and penetration;

— provide protection capability against hazardous gases, vapours and particulate matter.

4.2.2 Special application CBRN2

CBRN2 “Responder in known hazard 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 a minimum flow corresponding work rate W1;

— provide resistance to liquid and gaseous chemical agent permeation and penetration;

— provide protection capability against hazardous gases, vapours and particulate matter.

4.2.3 Special application CBRN3

CBRN3 “Responder in unkown hazard environment” RPD shall:

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

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

— provide a minimum flow corresponding work rate W3

— provide an enhanced level of resistance to liquid and gaseous chemical agent permeation and penetration;

— provide protection capability against hazardous gases, vapours and particulate matter;

— meet the requirements of special application FF3 hazardous materials in accordance with ISO 17420-5.

NOTE Supplied breathable gas RPD can be classes CBRN1, CBRN2, or CBRN3, but filtering RPD are restricted to classes CBRN1 and CBRN2.

4.3 Special application Escape CBRN

Escape CBRN RPD shall:

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

— devices shall be self-contained in accordance with ISO 16972;

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

— provide resistance to liquid and gaseous chemical agent permeation and penetration;

AVA Documents
Document Sharing Hub

© ISO 2021 – All rights reserved

Full document details: PD ISO/TS 17420-9:2021

— provide protection capability against gases, vapours and hazardous particulate matter.

Escape CBRN RPD operating in the supplied breathable gas mode is designated ES CBRN.

4.4 CBRN RPD summary of capabilities

Table 1 provides a matrix description of the minimum capabilities for CBRN RPD according to ISO/TS 16973.

Table 1 — Summary of minimum capabilities for CBRN supplied breathable gas RPD classes

Capability	CBRN1	CBRN2	CBRN3	ES CBRN
Permeation and penetration test	Gaseous[a] only	Gaseous[a] and liquid	Gaseous[a] and liquid	Gaseous[a] and liquid
RI Type	T[b] or L[c]	T or L	T	T or L
Protection class	≥PC4	≥PC5	≥PC5	≥PC4
Work rate	≥W1	≥W1	≥W3	Escape flow rate[d]

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

[b] Tight fitting.

[c] Loose fitting.

[d] In accordance with 8.1.

4.5 CBRN RPD Classes

4.5.1 General

CBRN RPD and Escape CBRN RPD shall follow the system classification in 4.5.2 to 4.5.3 as below specific to CBRN requirement.

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

4.5.2 CBRN supplied breathable gas RPD

CBRN supplied breathable gas RPD shall follow the classification (protection class) (work rate class) (RI class) (CBRN class) (supplied breathable gas capacity class).

EXAMPLE PC5 W3 cT CBRN3 S1800.

4.5.3 Escape CBRN supplied breathable gas RPD

Escape CBRN RPD shall follow a classification incorporating the applicable designated duration *t* in accordance with ISO 17420-6:2021, 7.2.9. For ES CBRN, the minimum and maximum durations are superseded by those specified in 8.1.

For Escape CBRN supplied breathable gas RPD (protection class) (RI class) ES CBRN (duration).

EXAMPLE PC4 dL 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 cT ES CBRN ES FF 20.

RPD for escape from CBRN incidents and fire.

© ISO 2021 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 17420-9:2021

5 Requirements

5.1 General

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

— every configuration shall conform to the requirements of this document;

— components shall be marked appropriately in accordance with Clause 15;

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

Testing shall be performed in accordance with Clause 13.

The requirements in Clauses 7 to 11 shall be fulfilled by all RPD and components in accordance with their designated 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 B.

5.2 Test samples

Sample schemes are provided in relevant clauses and Annex A.

5.3 CBRN RPD requirements

5.3.1 CBRN RPD operation

Where the RPD has the capability to be used with more than one mode of operation (see clause 9), only one may be actively used at any one time.

Testing shall be performed in accordance with Clause 13 and ISO 17420-4:2021, 6.15.

5.3.2 CBRN supplied breathable gas RPD

CBRN supplied breathable gas RPD shall meet the requirements of:

— ISO 17420-1:2021, all Clauses;

— ISO 17420-4:2021, Clause 5;

— ISO 17420-4:2021, Clause 6 unless superseded by this document and indicated in the relevant clauses.

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

© ISO 2021 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 17420-9:2021