INTERNATIONAL STANDARD

ISO 16900-12

First edition
2016-05-15

Respiratory protective devices — Methods of test and test equipment —

Part 12: Determination of volume-averaged work of breathing and peak respiratory pressures

Appareils de protection respiratoire — Méthodes d'essai et équipement d'essai —

Partie 12: Détermination du travail respiratoire en fonction du volume respiratoire et détermination des pics de pressions respiratoires

Reference number
ISO 16900-12:2016(E)

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Foreword

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

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

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

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

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

ISO 16900 consists of the following parts, under the general title *Respiratory protective devices — Methods of test and test equipment*:

— *Part 1: Determination of inward leakage*

— *Part 2: Determination of breathing resistance*

— *Part 3: Determination of particle filter penetration*

— *Part 4: Determination of gas filter capacity and migration, desorption and carbon monoxide dynamic testing*

— *Part 5: Breathing machine, metabolic simulator, RPD headforms and torso, tools and verification tools*

— *Part 6: Mechanical resistance/strength of components and connections*

— *Part 7: Practical performance test method*

— *Part 8: Measurement of RPD air flow rates of assisted filtering RPD*

— *Part 9: Determination of carbon dioxide content of the inhaled gas*

— *Part 10: Resistance to ignition, flame, radiant heat and heat*

— *Part 11: Determination of field of vision*

— *Part 12: Determination of volume-averaged work of breathing and peak respiratory pressures*

— *Part 13: RPD using regenerated breathable gas and special application mining escape RPD: Consolidated test for gas concentration, temperature, humidity, work of breathing, breathing resistance, elastance and duration*

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— *Part 14: Measurement of sound level*

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Introduction

This part of ISO 16900 is intended as a supplement to the respiratory protective devices (RPD) performance standard. Test methods are specified for complete devices or parts of devices that are intended to comply with the performance standards. If deviations from the test method given in this part of ISO 16900 are necessary, these deviations will be specified in the performance standards.

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

— "shall" indicates a requirement;

— "should" indicates a recommendation;

— "may" is used to indicate that something is permitted;

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

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

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

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Respiratory protective devices — Methods of test and test equipment —

Part 12: Determination of volume-averaged work of breathing and peak respiratory pressures

1 Scope

This part of ISO 16900 specifies the test methods for determining the volume-averaged work of breathing and peak respiratory pressures imposed by the respiratory protective device (RPD).

Elastic work, elastic physiological effects, and information on physiological effects of work of breathing (WOB) are specified in ISO 16976-4 and are not included in this test method.

2 Normative references

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

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

ISO 16900-5,[1)] *Respiratory protective devices — Methods of test and test equipment — Part 5: Breathing machine, metabolic simulator, RPD headforms and torso, tools and verification tools*

3 Terms and definitions

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

3.1
breathing frequency
number of breaths taken in a minute

Note 1 to entry: Expressed in breaths per minute.

3.2
elastance
E
pressure change resulting from a volume change

Note 1 to entry: Expressed in kPa/l.

3.3
tidal volume
V_T
size of a breath

Note 1 to entry: Expressed in litres.

1) To be published.

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3.4
volume-averaged pressure
WOB/V_T
work for a breath divided by its *tidal volume* (3.3)

Note 1 to entry: Expressed in kPa.

Note 2 to entry: The WOB/V_T can be determined separately for an inspiration, for an expiration, or for a whole breath.

4 Prerequisites

The performance standard shall indicate the conditions of the test. This includes the following:

a) number of specimens;

b) operating parameters specific to RPD;

c) selection and types of support such as RPD headform/torso;

d) any prior conditioning or testing;

e) minute ventilation;

f) temperature(s) at which tests are to be performed.

5 General test requirements

Unless otherwise specified, the values stated in this part of ISO 16900 are expressed as nominal values. Except for temperature limits, values which are not stated as maxima or minima shall be subject to a tolerance of ±5 %. Unless otherwise specified, the ambient temperature for testing shall be between 16 °C and 32 °C and (50 ± 30) % RH. Any temperature limits specified shall be subject to an accuracy of ±1 °C.

Where the assessment of the pass/fail criterion depends on a measurement, an uncertainty of measurement as specified in Annex A shall be reported.

6 Principle

The RPD is fitted to a headform/torso and is operated at the manufacturer's minimum condition, unless specified otherwise by the performance standards.

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

Validation of work of breathing measurements and calculations is performed using the verification orifices as specified in ISO 16900-5.

Validation of the correct functioning of the breathing machine/metabolic simulator is performed using the validation orifices specified in ISO 16900-5. Validation is satisfactory when the WOB calculations give results which are in accordance with the data shown in Table 1.

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