TECHNICAL SPECIFICATION

ISO/TS 16976-1

Second edition
2015-12-01

Respiratory protective devices — Human factors —

Part 1: Metabolic rates and respiratory flow rates

Appareils de protection respiratoire — Facteurs humains —
Partie 1: Régimes métaboliques et régimes des débits respiratoires

This document is a preview generated by EVS



Reference number
ISO/TS 16976-1:2015(E)

© ISO 2015

This document is a preview generated by EVS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2015, Published in Switzerland

All rights reserved. Unless otherwise specified, 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
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

 © ISO 2015 – All rights reserved

Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Activity and metabolic rate **2**
5 Metabolic rate and oxygen consumption **4**
6 Oxygen consumption and minute volume **5**
7 Minute volume and peak inspiratory flow rates **7**
7.1 Normal breathing 7
7.2 Speech and breathing 8
7.3 Sneezing and coughing 10
8 Individual variation and gender aspects **12**
Annex A (informative) **Examples for the use of data** **15**
Bibliography **18**

This document is a preview generated by EVS

© ISO 2015 – All rights reserved

Foreword

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

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

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

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

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

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

This second edition cancels and replaces the first edition (ISO/TS 16976-1:2007), of which it constitutes a major revision with the following technical change:

— 7.3 has been added.

ISO/TS 16976 consists of the following parts, under the general title *Respiratory protective devices — Human factors*:

— *Part 1: Metabolic rates and respiratory flow rates* [Technical Specification]

— *Part 2: Anthropometrics* [Technical Specification]

— *Part 3: Physiological responses and limitations of oxygen and limitations of carbon dioxide in the breathing environment* [Technical Specification]

— *Part 4: Work of breathing and breathing resistance: Physiologically based limits* [Technical Specification]

— *Part 5: Thermal effects* [Technical Specification]

— *Part 6: Psycho-physiological effects* [Technical Specification]

— *Part 7: Hearing and speech* [Technical Specification]

— *Part 8: Ergonomic factors* [Technical Specification]

This document is a preview generated by EVS

 © ISO 2015 – All rights reserved

Introduction

For an appropriate design, selection, and use of respiratory protective devices, it is important to consider the basic physiological demands of the user. The type and intensity of work affect the metabolic rate (energy expenditure) of the wearer. The weight and weight distribution of the device on the human body also may influence metabolic rate. Metabolic rate is directly correlated with oxygen consumption, which determines the respiratory demands and flow rates. The work of breathing is influenced by the air flow resistances of the device and the lung airways. The work (or energy cost) of a breath is related to the pressure gradient created by the breathing muscles and the volume that is moved in and out of the lung during the breath. Anthropometric and biomechanical data are required for the appropriate design of various components of a respiratory protective device, as well as for the design of relevant test methods.

This part of ISO/TS 16976 is the first part of a series of documents providing basic physiological and anthropometric data on humans. It contains information about metabolic rates and respiratory flow rates for various types of physical activity.

This document is a preview generated by EVS

© ISO 2015 – All rights reserved

This document is a preview generated by EVS

Respiratory protective devices — Human factors —

Part 1: Metabolic rates and respiratory flow rates

This document is a preview generated by EVS

1 Scope

This part of ISO/TS 16976 provides information on factors related to human anthropometry, physiology, ergonomics, and performance for the preparation of standards for performance requirements, testing, and use of respiratory protective devices. This part of ISO/TS 16976 contains information related to respiratory and metabolic responses to rest and work at various intensities. Information is provided for the following:

— metabolic rates associated with various intensities of work;

— oxygen consumption as a function of metabolic rate and minute ventilation for persons representing three body sizes;

— peak inspiratory flow rates during conditions of speech and no speech for persons representing three body sizes as a function of metabolic rates.

The information contained within this part of ISO/TS 16976 represents data for healthy adult men and women of approximately 30 years of age, but is applicable for the age range of the general population.

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 8996:2004, *Ergonomics of the thermal environment — Determination of metabolic rate*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
aerobic energy production
biochemical process in the human cells that delivers energy by combustion of fat, carbohydrates and, to a lesser extent, protein in the presence of oxygen, with water and carbon dioxide as end products

3.2
anaerobic energy production
biochemical process in the human cells that delivers energy by combustion of carbohydrates without oxygen, with lactic acid as the end product

3.3
ambient temperature pressure saturated
ATPS
standard condition for the expression of ventilation parameters related to expired air

Note 1 to entry: Actual ambient temperature and atmospheric pressure; saturated water vapour pressure.

© ISO 2015 – All rights reserved