BS ISO 16976-2:2022

BSI Standards Publication

Respiratory protective devices — Human factors

Part 2: Anthropometrics

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National foreword

This British Standard is the UK implementation of ISO 16976-2:2022. It supersedes PD ISO/TS 16976-2:2015, which is withdrawn.

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.

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Respiratory protective devices — Human factors

Part 2: Anthropometrics

Appareils de protection respiratoire — Facteurs humains — Partie 2: Anthropométrie

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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).

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*.

This first edition of ISO 16976-2 cancels and replaces ISO/TS 16976-2:2015, which has been technically revised.

The main changes are as follows:

— Figure 6 changed to show head forms front and side view (see ISO 16900-5:2016/Amd 1:2018);

— the document has been editorially revised.

A list of all parts in the ISO 16976 series can be found on the ISO website.

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.

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Introduction

For an appropriate design, selection, and use of respiratory protective devices, basic physiological demands of the user should be considered. Type and intensity of work affect the metabolic rate (energy expenditure) of the wearer. Mass and mass distribution of the device on the human body can also 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 appropriate design of various components of a respiratory protective device, as well as for the design of relevant test methods.

This document forms one part of a series of documents providing basic anthropometric measurement methods and data on humans. It contains information about the description, definition, and diagram of landmarks and dimensions, up-to-date head and face data for various race/ethnic groups, and human test panels.

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Respiratory protective devices — Human factors —

Part 2: Anthropometrics

1 Scope

This document is one part of the ISO 16976 series that provide information on factors related to human anthropometry, physiology, ergonomics, and performance for the preparation of standards for design, testing, and use of respiratory protective devices.

This document contains information related to anthropometry. In particular, information is given for:

— anthropometric measurement methods;

— anthropometric data for head, face, and neck dimensions;

— anthropometric data for torso dimensions;

— human test panels;

— models of headforms.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology 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/

4 Anthropometric measurements

4.1 Anthropometric instrument and software

The standard measurement tools which are recommended are the anthropometer, a spreading calliper, a sliding calliper, a pupillometer, and a steel measuring tape. A suitable data entry, editing, and analysis software is described in References [3] and [4].

4.1.1 Anthropometer, a specialized tool for measuring linear distance between points on the body and standard reference surfaces, such as the floor or a seat platform.

4.1.2 Spreading and sliding callipers, used for measuring the breadth and depth of body segments, as well as the distance between reference marks.

4.1.3 Measuring tape, used for measuring the arc and circumference of body segments.

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4.1.4 Pupillometer, a standard ophthalmic device used for measuring the interpupillary distance.

4.1.5 Frankfort plane, standard reference plane passing through the upper openings of the left and right external openings of the auditory canals and the left infraorbital.

4.2 Measurement procedures

4.2.1 Landmarking

Landmarks are generally, although not always, skeletal points that are usually marked on the skin overlying the point. Selected landmarks are listed in Table 1 and described in Annex A. Subjects are landmarked with a surgical marker or an eyeliner pencil prior to measurement.

Table 1 — List of landmarks

Landmarks	Landmark positioning
Alare	Right and left
Cheilion	Right and left
Chin	—
Ectocanthus	Right and left
Frontotemporale	Right and left
Glabella	—
Gonion	Right and left
Infraorbitale	Right and left
Menton	—
Nasal root point	Right and left
Pronasale	—
Pupil	Right and left
Sellion	—
Subnasale	—
Top of head	—
Tragion	Right and left
Zygion	Right and left
Zygofrontale	Right and left

4.2.2 Measuring

After landmarking, subjects are measured for each of the dimensions. Data are recorded on data sheets and simultaneously entered into computer software. The data entry and editing software evaluate each measurement as it is entered and indicate when a measurement value is out of the previously measured range or is otherwise unexpected. In such cases, the measurement shall be repeated, or data input errors corrected.

4.3 Dimensions to be measured

The dimensions to be measured are listed in Table 2. The detailed dimension descriptions are provided in Annex B. All dimensions are measured in millimetres and body mass is measured in kilograms.

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Table 2 — List of face dimensions

Dimensions	Common terms
Bigonial breadth	Jaw width
Bitragion chin arc	
Bitragion coronal arc	
Bitragion frontal arc	
Bitragion subnasale arc	
Bizygomatic breadth	Face width
Head breadth	
Head circumference	
Head length	
Interpupillary distance	
Lip length	
Maximum frontal breadth	
Menton-sellion length	Face length
Minimum frontal breadth	
Nasal root breadth	
Neck circumference	
Nose breadth	
Nose protrusion	
Subnasale-sellion length	Nose length
Stature	Height
Mass	

5 Anthropometric data for head, face, and neck dimensions

Test panels for the development of an International Standard must be representative of the world population. An anthropometric study of the US work population was conducted by the National Institute for Occupational Safety and Health (NIOSH) in 2003 (see Reference [3]). The survey consisted of three age strata (18 y to 29 y, 30 y to 44 y, 45 y to 66 y), two gender strata (male and female), and four racial/ethnic group strata (white, African American, Hispanic, and other). The selected test panel could be seen as almost representative for the worldwide population, since the US population is multi-ethnic. Height, mass, 19 face dimensions, and neck circumferences were measured using traditional methods. A total of 3 997 subjects (2 543 male and 1 454 female) were measured. The sampling strategy called for equal representation in each of the sampling cells. This was done to ensure that we had adequately captured the anthropometric variability in all segments of the population. NIOSH research has resulted in the development of Table 3.

The NIOSH data were supplemented with additional measurements in China and other data for various countries. See References [5] and [6]. The data were compared to the NIOSH US Data and were found to be within the 5th and 95th percentiles for US population in Table 3.

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