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**Respiratory protective devices —  
Methods of test and test equipment —**

**Part 11:  
Determination of field of vision**

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

*Partie 11: Détermination du champ de vision*





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ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

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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. [www.iso.org/directives](http://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. [www.iso.org/patents](http://www.iso.org/patents)

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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 11: Determination of field of vision*

The following parts are under preparation:

- *Part 5: Breathing machine/metabolic simulator/RPD headforms/torso, tools and transfer standards*
- *Part 6: Mechanical resistance – Strength of components*
- *Part 7: Practical performance test method*
- *Part 8: Measurement of RPD air flow rates*
- *Part 9: Determination of the carbon dioxide content of inhaled air*
- *Part 10: Resistance to ignition, flame, radiant heat and heat*
- *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 and duration*

## Introduction

This part of ISO 16900 is intended as a supplement to the respiratory protective devices (RPD) performance standard ISO 17420 (all parts). Test methods are specified for complete devices or parts of devices that are intended to comply with ISO 17420. If deviations from the test method given in this part of ISO 16900 are necessary, these deviations will be specified in ISO 17420.

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# Respiratory protective devices — Methods of test and test equipment —

## Part 11: Determination of field of vision

### 1 Scope

This part of ISO 16900 specifies the laboratory test method for determining the field of vision for a respiratory protective device (RPD).

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

### 3 Terms and definitions

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

#### 3.1

##### **apertometer**

extended hemispherical dome for measuring the angular area of the field of vision (peripheral isopter) of an RPD when mounted on a headform

#### 3.2

##### **peripheral isopter**

field of vision while wearing an RPD, indicated by the lighted area, which is measured by a solid line connecting the points

#### 3.3

##### **visual field score**

##### **VFS**

summation of grid points contained within the peripheral isopter shadow cast onto the apertometer by the RPD

### 4 Prerequisites

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

- a) number of specimens;
- b) any preconditioning;
- c) use of filter simulator, if applicable;
- d) any accessories;

- e) appropriate size(s) of headforms to be used.

### 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  $\pm 5\%$ . Unless otherwise specified, the ambient conditions for testing shall be between 16 °C and 32 °C and  $(50 \pm 30)\%$  relative humidity. Any temperature limits specified shall be subject to an accuracy of  $\pm 1$  °C.

### 6 Principle

This test quantifies the field of vision of a respiratory protective device (RPD) by measuring the functional visual field score. The RPD is mounted on a headform containing small light sources instead of eyes. The light from the light sources is projected onto the apertometer, creating a light area outlined by a shadow that follows the periphery of the visual obstruction of the RPD system. The light area represents the visual field, or peripheral isopter. A quantitative value for the visual field score is obtained by comparing the peripheral isopter with a visual field score defined for different segments of the unrestricted field of vision.

### 7 Apparatus

The following apparatus are used for determining the visual field score.

- a) Headforms: see [Annex B](#).
- b) Apertometer: see [Figure 1](#).
- c) Visual field score plotting chart: See [Figure 2](#).

### 8 Device preparation

Prepare the RPD to the ready for use condition in accordance with the manufacturer's instructions for use. This involves attaching any accessories that may obscure vision, such as demand valve or filter(s), or filter simulator (ISO 16900-5) for devices containing the thread connection in accordance with ISO 17420-3. The headform size(s) appropriate to the size of RPD being tested shall be selected for the test.

#### 8.1 Mounting the device

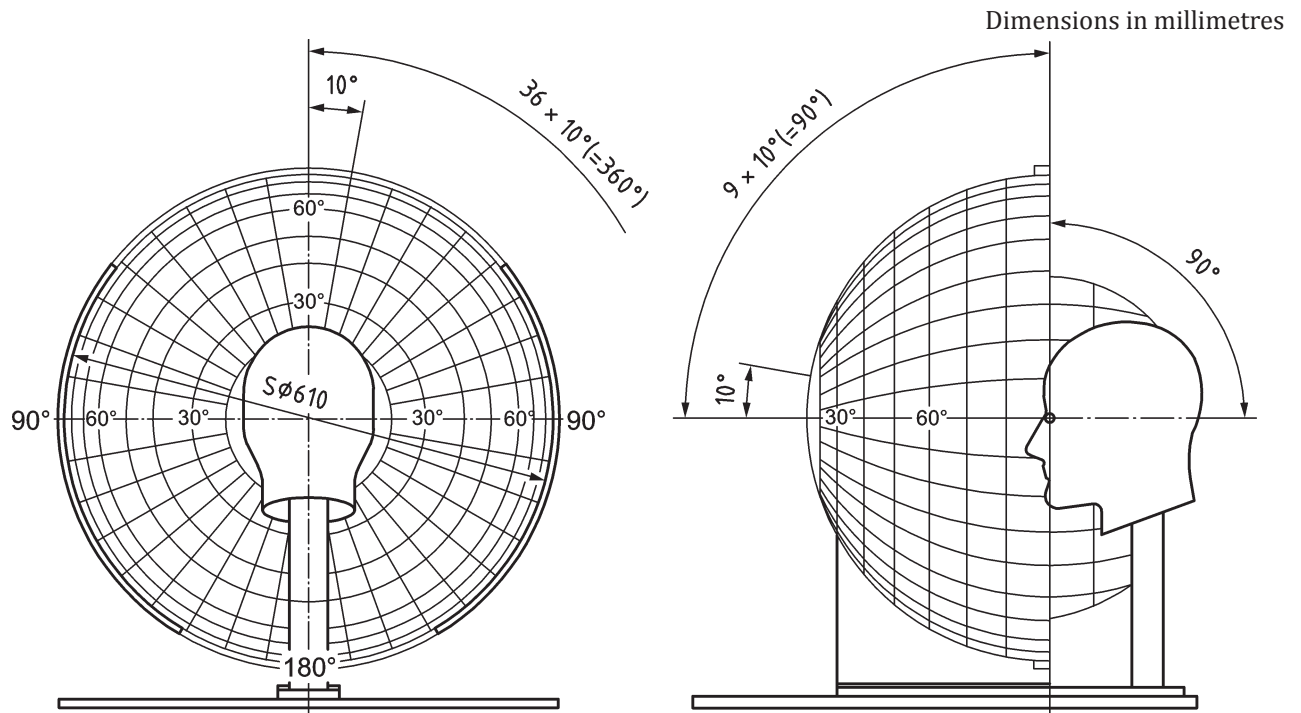
Mount the RPD on the selected headform in accordance with the manufacturer's donning instructions. Position the RPD symmetrically on the headform. If the RPD has wearer-adjustable head harness straps, tighten the straps to the extent that would be expected when wearing the device as specified by the manufacturer.

**NOTE** If necessary, apply a friction reducing material talcum powder to the headform to allow the RPD to slide more easily over the headform surface during adjustment.

Position the headform correctly within the apertometer (see [Figure 1](#)).

The headform is positioned correctly when the centre of the light source of the illuminated eyes are aligned with the 90 degree meridians on the dome, symmetrically about the centre line of the dome and the horizontal axis of the headform is coincident with the axis of the apertometer.





**Figure 1 — Position of headform in apertometer**

Switch on both illuminated eyes and re-adjust the RPD position on the headform so that the shadow on the apertometer is symmetrical about the vertical centre line such that the point at which the shadow crosses the horizontal centre line on the left and right sides is within 5 degrees of each other.

The RPD shall not be donned on the headform in an inappropriate position in an attempt to maximize the visual field score.

**NOTE** In the case of RPD with an asymmetric Respiratory Interface design or assembly, this is not possible and the Respiratory Interface shall just be centralised about the vertical centre line.

## 8.2 Mapping the field of vision

Using the visual field score plotting chart ([Figure 2](#)), transfer the outline of the light projected onto the apertometer's surface onto the chart by marking the point at which the light changes to a shadow along each of the 36 meridians within the apertometer. Once the points have been plotted along each meridian, connect the points from one meridian to the next, following the curve of the shadow on the apertometer. The solid line connecting the points represents the peripheral isopter for the RPD.

Remove the RPD and re-fit to the headform for a total of three fittings.

## 8.3 Calculating the Visual Field Score (VFS)

The VFS plotting chart ([Figure 2](#)) assigns 118 dots in total. Fifty dots are assigned to the central area, up to 10° of fixation. The remaining 68 points are assigned to the area beyond 10°. The grid dots are located along 10 meridians (two in each of the upper quadrants, three in each of the lower quadrants) at 25°, 65°, 115°, 155°, 195°, 225°, 255°, 285°, 315°, and 345°.

Outside the central area the dots are distributed along the meridians according to a weighting system that is based on an assessment of the importance of different meridians being within the visual field when wearing RPD. The four peripheral dots which lie on the 25, 155, 195 and 345 meridians are considered of critical importance and therefore called critical dots. (see [Figure 2](#) and [Table 1](#)).

Count the VFS grid dots that fall on or inside of the peripheral isopter for the RPD. This number is the VFS. Record the number of mandatory dots within the VFS.

The centre of a dot shall be within the light area to be counted.

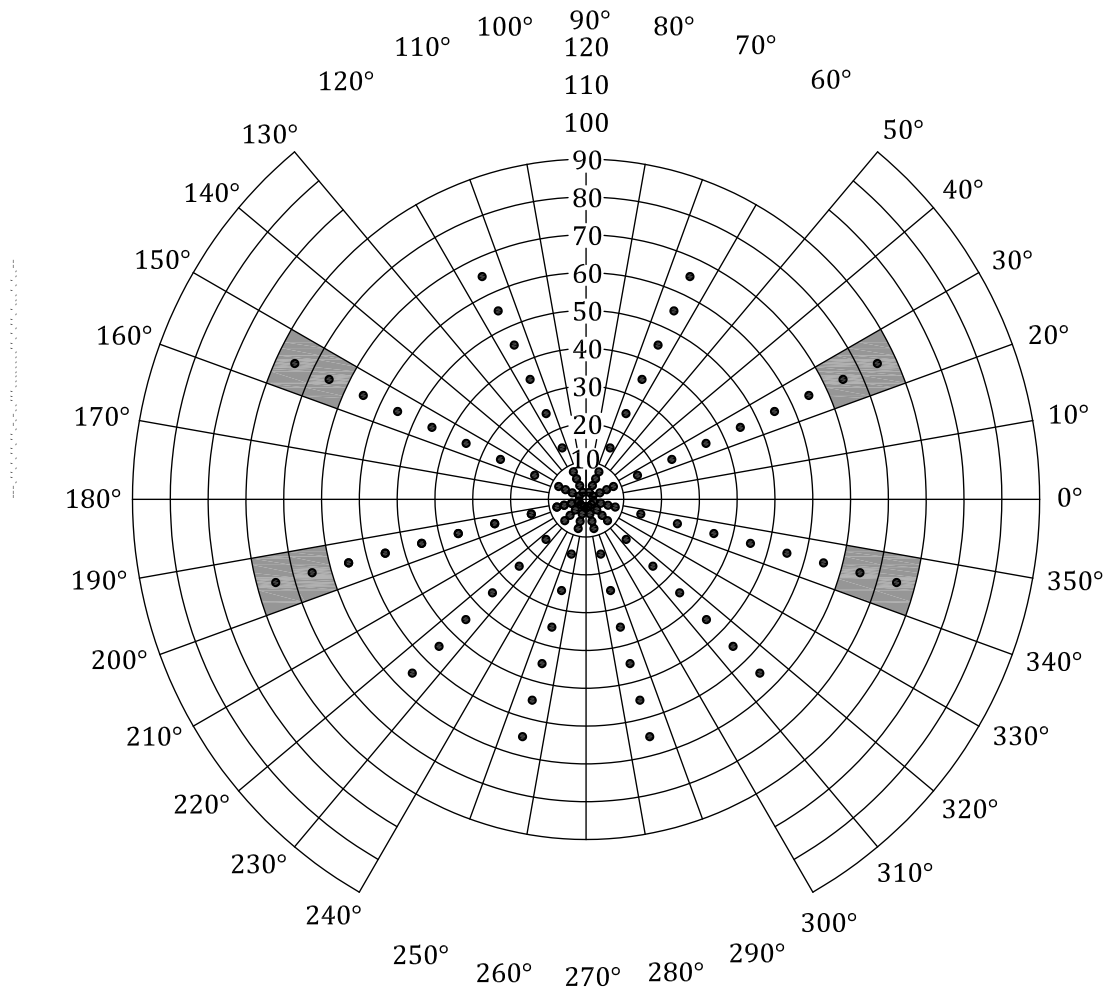


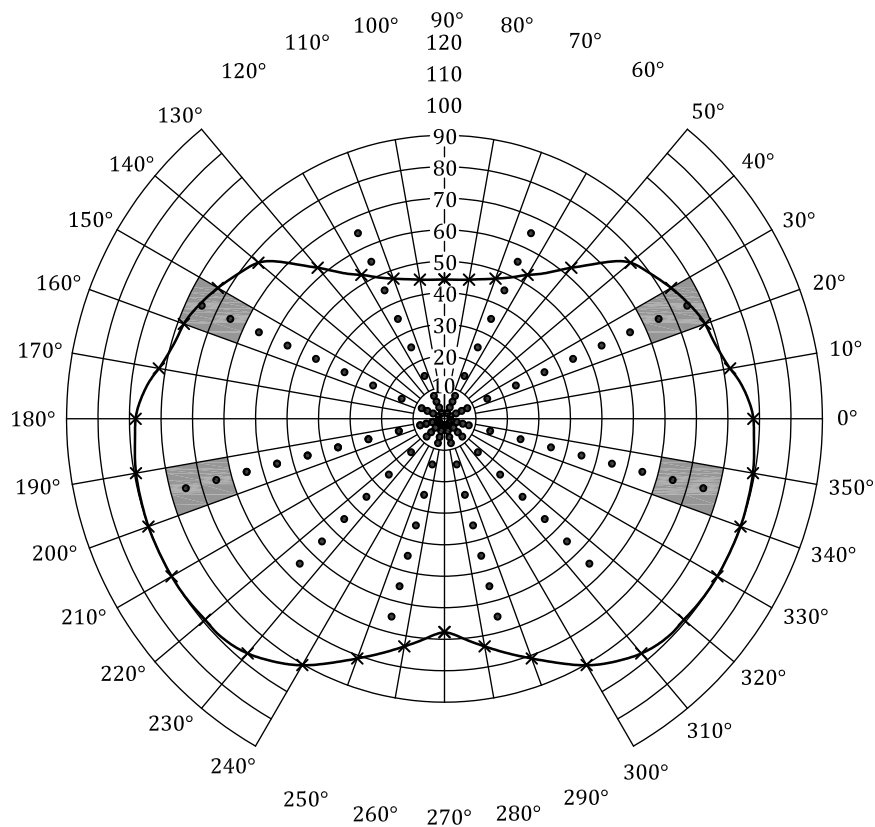
Figure 2 — Visual Field Score (VFS) plotting chart

The dots within each segment represent the individual points counted to determine the VFS.

**Table 1 — Results table for Visual Field Score (VFS): Example shows data from one fitting**

Meridian (°)	Number of dots within peripheral Isopter outside the 10° of fixation central area			Average total VFS
	Fitting 1	Fitting 2	Fitting 3	
25	8	-	-	
65	4	-	-	
115	4	-	-	
155	8	-	-	
195	8	-	-	
225	6	-	-	
255	6	-	-	
285	6	-	-	
315	6	-	-	
345	8	-	-	
Add 50 dots for area inside 10° of fixation	<b>50</b>	<b>50</b>	<b>50</b>	
<b>Total VFS</b>				
<b>Number of critical dots included</b>				Average number of critical dots ≥ 2? Yes/no
				Yes

An example of a visual field score plot is shown in [Figure 3](#) with the results for one fitting tabulated in [Table 1](#).



**Figure 3 — Example of VFS plot**

## 9 Test report

The test report shall include at least the following information:

- a) the number of test specimens;
- b) any preconditioning;
- c) use of filter simulator, if applicable;
- d) any accessories;
- e) headform used;
- f) the VFS at each meridian, the number of critical points within the score and average total VFS of the three fittings (table).

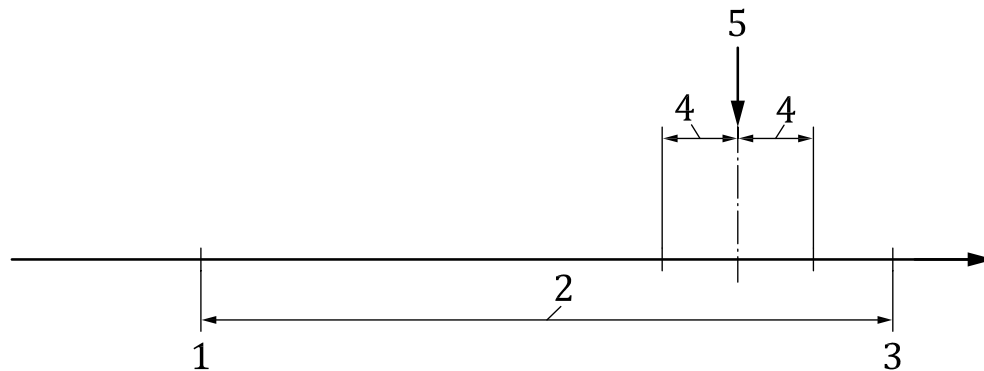
## Annex A (normative)

### Application of uncertainty of measurement

#### A.1 Determination of compliance

In order to determine compliance or otherwise of the measurement made in accordance with this test method, when compared to the specification limits given in the protective device standard, the following protocol shall be applied.

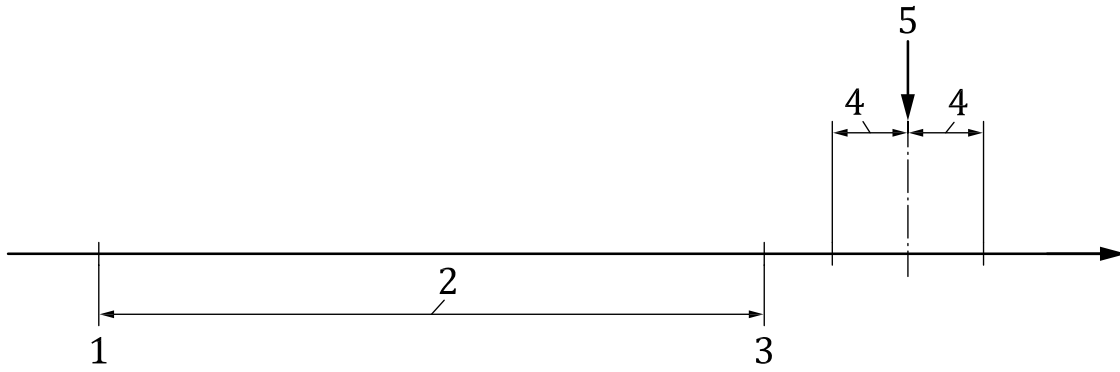
If the test result  $\pm$  the uncertainty of measurement,  $U$ , falls completely inside or outside of the specification zone for the particular test given in the protective device standard, then the result shall be deemed to be a straightforward pass or fail (see [Figures A.1](#) and [A.2](#)).



#### Key

- 1 lower specification limit
- 2 specification zone
- 3 upper specification limit
- 4 uncertainty of measurement,  $U$
- 5 measured value

Figure A.1 — Result pass

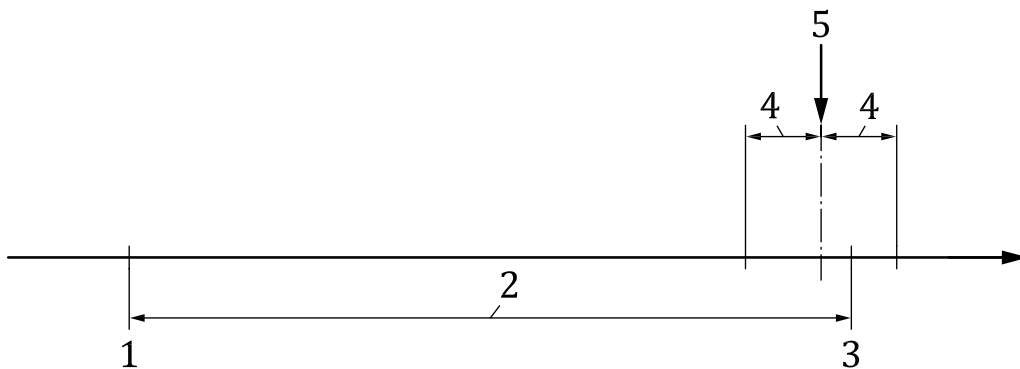


**Key**

- 1 lower specification limit
- 2 specification zone
- 3 upper specification limit
- 4 uncertainty of measurement,  $U$
- 5 measured value

**Figure A.2 — Result fail**

If the test result  $\pm$  the uncertainty of measurement,  $U$ , overlaps a specification limit value (upper or lower) for the particular test given in the protective device standard, then the assessment of pass or fail shall be determined on the basis of safety for the wearer of the device; that is, the result shall be deemed to be a fail (see [Figure A.3](#)).



**Key**

- 1 lower specification limit
- 2 specification zone
- 3 upper specification limit
- 4 uncertainty of measurement,  $U$
- 5 measured value

**Figure A.3 — Result fail**

## Annex B (normative)

### Headforms for determining the field of vision

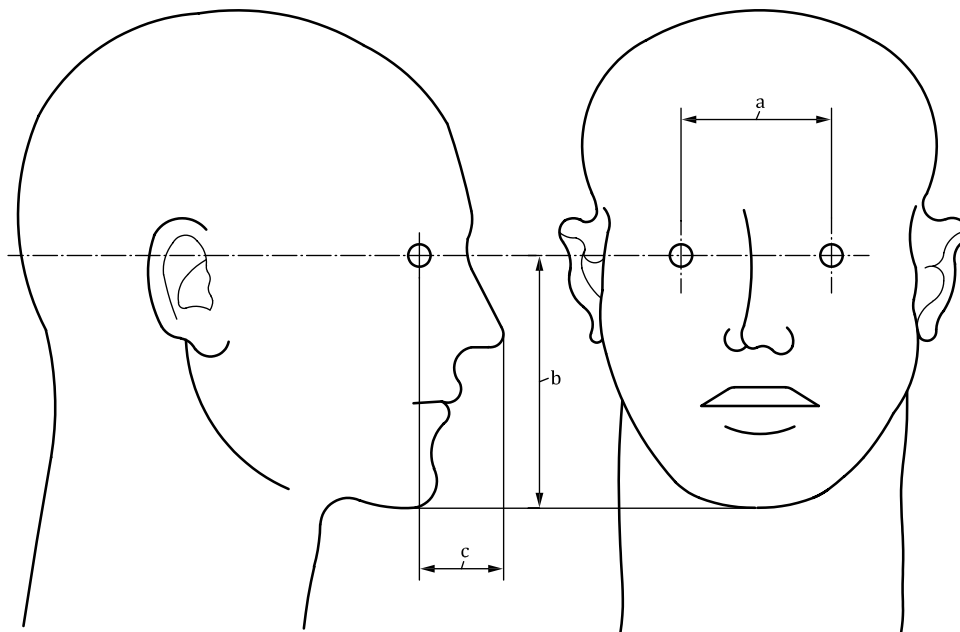
#### B.1 General

The headforms for determining the field of vision are based on the anthropometric measurements of the laboratory tests heads described in ISO 16900-5.

Any mechanism for adjusting of the light source shall not interfere with the fit of the RPD being evaluated.

#### B.2 Distances and symbols for headforms for determining the field of vision

Distances and symbols for headforms for determining the field of vision are shown in [Figure B.1](#). The tolerance shall be  $\pm 1$  mm on each dimension.



#### Key

- a Interpupillary distance.
- b Geometric centre of the light sources to tip of chin.
- c Geometric centre of the light sources to tip of nose.

**Figure B.1 — Headform for determining the field of vision**

#### B.3 Special dimensions for headforms for determining the field of vision

The following special dimensions for field of vision headforms are also specified in ISO 16900-5 but are listed in Table B.1 for reference only.

**Table B.1 — Special dimensions for field of vision headforms**

<b>Headform category</b>	<b>Inter-pupillary distance mm</b>	<b>Geometric centre of the light sources to tip of chin mm</b>	<b>Geometric centre of the light sources to tip of nose mm</b>
Symbol in Figure B.1	a	b	c
Large	68	106	32
Medium	64	105	31
Small	59	101	30
Short wide	65	95	28
Long narrow	63	115	38

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## Bibliography

- [1] ISO 16900-5, *Respiratory protective devices — Methods of test — Part 5: Test equipment — Breathing machine, metabolic simulator, RPD headforms/torso, tools and transfer standards*
- [2] ISO 21748, *Guidance for the use of repeatability, reproducibility and trueness estimates in measurement uncertainty estimation*

