SLOVENSKI STANDARD
SIST EN 13274-6:2002

01-junij-2002

Oprema za varovanje dihal ï Metode preskuġanja ï 6. del: Doloļ evanje ogljikovega dioksida v vdihanem zraku

Respiratory protective devices - Methods of test - Part 6: Determination of carbon dioxide content of the inhalation air

Atemschutzgeräte - Prüfverfahren - Teil 6: Bestimmung des Kohlenstoffdioxid-Gehaltes der Einatemluft

Appareils de protection respiratoire - Méthodes d'essai - Partie 6: Détermination de la teneur en dioxyde de carbone de l'air inhalé

Ta slovenski standard je istoveten z: **EN 13274-6:2001**

ICS:

13.340.30	Varovalne dihalne naprave	Respiratory protective devices

SIST EN 13274-6:2002 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13274-6

December 2001

ICS 13.340.30

English version

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Ref. No. EN 13274-6:2001 E

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 79 "Respiratory protective devices", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2002, and conflicting national standards shall be withdrawn at the latest by June 2002.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this standard.

This is one of several parts, which are as follows:

Part 1: Determination of inward leakage and total inward leakage

Part 2: Practical performance tests

Part 3: Determination of breathing resistance

Part 4: Flame tests

Part 5: Climatic conditions

Part 6: Determination of carbon dioxide content of the inhalation air

Part 7: Determination of particle filter penetration

Part 8: Determination of dolomite dust clogging

Annex A is normative. Annex B is informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This standard is intended as a supplement to the specific device standards for respiratory protective devices. Test methods are specified for complete or parts of devices. If deviations from the test method given in this standard are necessary, these deviations will be specified in the relevant device standard.

1 Scope

This European Standard specifies the test procedure for measuring the carbon dioxide content in the inhaled air (dead space) of respiratory protective devices.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 132, *Respiratory protective devices - Definitions of terms and pictograms.*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 132 apply, together with the following:

3.1
ambient conditions
atmosphere where the temperature is 16 °C to 32 °C and the relative humidity is 20 % to 80 %

3.2
dry atmosphere
atmosphere where the relative humidity is less than 20 %

3.3
wet atmosphere
atmosphere where the relative humidity is greater than or equal to 95 %

4 Prerequisites

In order to implement this part of EN 13274, at least the following parameters need to be specified in the appropriate device standard:

— number of samples;

— number of repeat tests per sample;

— sample preconditioning;

— size(s) of facepiece;

— use of dummy head or head/torso;

— method of sealing facepiece to dummy head/torso (if appropriate);

— complete equipment or facepiece only;

— device air supply on or off;

— direction of any supplementary air flow;

— pass/fail criteria;

— any deviations from test method.

5 Test method

5.1 Principle

The device is fitted, as described by the device standard, to a Sheffield dummy head/torso and, in the case of complete equipment tests, any air supply is operated in the manufacturer's minimum condition unless prescribed otherwise by that standard. Breathing air containing a defined concentration of carbon dioxide is supplied at a specified rate from a breathing machine to a dummy head/torso. The inhaled air is analysed for carbon dioxide content.

The carbon dioxide level measured gives an assessment of the "dead space" of the facepiece rather than a "real life" measurement of the level of carbon dioxide in the inhaled air.

5.2 Test equipment

5.2.1 General

A typical test arrangement using a single cylinder breathing machine is shown in Figure 1.

The total dead space of the gas path of the test installation, excluding the volume of the breathing machine, shall not exceed 2000 ml.

The test shall be carried out at ambient conditions.

5.2.2 Breathing machine

A breathing machine and associated equipment with solenoid valves controlled by the breathing machine. In order to avoid errors in the measurement of carbon dioxide in the inhaled air, it is important that the solenoid valves make a good seal on closing and that the timing of their action allows no overlap to occur.

5.2.3 Carbon dioxide sampling arrangement

A sample of the inhaled air is taken by an auxiliary lung driven by the breathing machine and in phase with it. It is set to inhale a known sample volume (a chosen percentage of the inhalation volume of the breathing machine) during the inhalation stroke of the breathing machine. This apparent "loss" in inhalation volume of the breathing machine is compensated for by the volume of carbon dioxide fed via the flowmeter into the breathing machine on its inhalation stroke. It is therefore important that these two volumes are equal.

The exhaled air is continuously monitored for carbon dioxide content at a flow determined by the analyser. The sample point is immediately before the solenoid valve in the exhalation circuit. To maintain equilibrium the sample is returned to the circuit upstream of the sample point.

The carbon dioxide absorber is necessary to prevent build-up of carbon dioxide in the test equipment circuit. The compensators allow constant conditions to be maintained for particular parts of the test circuit.

5.2.4 Sheffield head/torso

Sheffield head fitted with concentric tubes and central carbon dioxide sampling tube, shown in Figure 2. Where a torso is fitted, the tubes are directed down the neck section to exit from the torso at a convenient point as shown in Figure A.2. The extra volume of this arrangement should be borne in mind (see 5.2.1).

The end of the concentric tubes is level with the top "lip" of the dummy head and the end of the sample tube is level with the end of the concentric tubes.

The arrangement for setting up and testing hooded devices which seal around the neck is given in annex A.

5.2.5 Auxiliary fan

In order to ensure that the device inhales laboratory air containing a minimum level of carbon dioxide, an auxiliary fan is arranged so that it blows the exhaled air emerging from the device away from the device inlet. The fan is arranged to deliver air at 0,5 m/s when measured at a point 50 mm in front of the device inlet.

NOTE The auxiliary fan arrangement is not required when carrying out tests on devices which have their own independent air supply (e.g. compressed airline devices).

5.2.6 Carbon dioxide sampling of ambient air

It is necessary to assess the level of carbon dioxide in the laboratory air in the immediate vicinity of the device inlet. This is achieved by using a sample probe placed at a point 50 mm in front of the device inlet. The probe is connected to the auxiliary lung used for measuring dead space. It samples during the inhalation phase of the breathing machine at the same sample rate as used to measure the carbon dioxide in the inhalation air.

5.3 Procedure for measurement of carbon dioxide in inhalation air

5.3.1 Confirm whether the device standard requires breathing machine settings and exhaled carbon dioxide levels which lead to sample volumes different to those specified in the following procedure. An example of the calculation necessary for different requirements is given in 5.3.10.

5.3.2 Fit the facepiece or complete equipment as directed by the device standard to the Sheffield head/torso as appropriate, and operate the device in its minimum design condition defined in the device standard. Ensure as far as possible that exhaled air from the device (which during subsequent testing will contain 5 % carbon dioxide) is not rebreathed by the device.

5.3.3 Connect the breathing circuit to the Sheffield dummy head/torso.

5.3.4 Switch on the breathing machine (and with it the auxiliary lung and valves) and operate at 25 cycles per minute and 2,0 l/stroke.

5.3.5 Switch on the auxiliary fan (if appropriate) and adjust the air velocity to 0,5 m/s at a point 50 mm in front of the device inlet(s), ensuring that the air is directed away from the device inlet(s).

5.3.6 Adjust the carbon dioxide supply into the breathing machine to 2,5 l/min (i.e. a carbon dioxide concentration equivalent to 5 % of the volume of the exhalation stroke of the breathing machine) via a control valve (if fitted), the flow meter, compensating bag and non-return valves. Check the carbon dioxide concentration in the exhaled air on a dry basis and adjust as necessary to achieve a stabilised level of 5 %.

5.3.7 Draw off a sample of the inhaled air during the inhalation phase by the auxiliary lung set at a rate of 100 ml displacement/stroke (i.e. 5 % of the volume of the inhalation stroke of the breathing machine).

Measure the carbon dioxide concentration in the sample by means of the analyser. Continue the test until a steady value is obtained. Record this value as the uncorrected level of carbon dioxide in the inhaled air.

5.3.8 Continue the test and measure the ambient carbon dioxide level 50 mm in front of the inlet(s) to the device. Take the measure once a stabilised level for carbon dioxide in the inhalation air has been attained. The reference level shall be less than 0,1 %. For devices with an independent air supply, the carbon dioxide level in the supply air shall be less than 0,1 %.

5.3.9 Subtract either the laboratory ambient carbon dioxide level or that in the independent air supply, as appropriate, from the measured value in the inhaled air and record this as the corrected carbon dioxide content of the inhaled air.

5.3.10 Example of calculation for alternative requirements.

Breathing machine setting	20 cycles per minute and 1,75 l/stroke
Exhaled carbon dioxide	4,5 %
Volume of input CO_2 / stroke	= 4,5 % of 1,75 l = 0,07875 l
Flow rate of CO_2	= 0,07875 x 20 cycles/min. = 1,575 l/min
Inhalation sample volume	
(auxiliary lung displacement)	= 4,5 % of 1,75 l = 78,75 ml