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

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

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

Partie 6: Résistance mécanique — Résistance des composants



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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

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

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 methods*
- *Part 8: Measurement of RPD air flow rates of assisted filtering RPD*
- *Part 9: Determination of carbon dioxide content of the inhaled air*
- *Part 10: Resistance to heat, 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*
- *Part 14: Measurement of sound level*

Introduction

This test method, as part of ISO 16900, is specified for respiratory protective devices (RPD) or parts of RPD that are intended to comply with RPD 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.

ISO/IEC Directives, Part 2 (sixth edition, 2011), 3.3.1 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.”

ISO/IEC Directives, Part 2 (sixth edition, 2011), 3.3.2 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 6: Mechanical resistance/strength of components and connections

1 Scope

This part of ISO 16900 specifies the method of test for the mechanical resistance and strength of components of respiratory protective devices.

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*

3 Terms and definitions

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

3.1

ready for assembly state

components with seals, plugs or other environmental protective means, if applicable, still in place

3.2

ready for use state

state of the complete, but not necessarily fully assembled RPD, which allows the immediate start of the donning procedure as described by the manufacturer

4 Prerequisites

In order to implement this part of ISO 16900, the following parameters should at least be specified in the relevant performance standard.

- Test method(s) to be used (reference taken from [Table 1](#)).
- Number of specimens.
- Status of samples or specimen for testing, e.g. preconditioned, as received, ready for use state.
- Any deviations from the test methods.

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 ± 30) % relative humidity. 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 Test methods

6.1 General

Nine test methods are described hereafter, some including levels. These are referenced in [Table 1](#) and the reference is a part of the prerequisite. Any deviations from the methods shall be cited in the test report.

Table 1 — Test methods

Reference	Test method title
6.2	Resistance of hoses to deformation, via compressive load
6.3	Flexibility of medium pressure hoses, via bending
6.4^a	Flexibility of high pressure hoses, via bending
6.5	Coil kinking of hoses greater than 10 m in length
6.6^a	Corner kinking for hoses greater than two metres and up to and including 10 m in length
6.7	Shock resistance for filters
6.8	Mechanical stress resistance
6.9	Strength of visor
6.10	Strength of connections
^a Handling components under high pressure requires safety precautions	

6.2 Resistance of hoses to deformation, via compressive load

6.2.1 Principle

A compressive force or stress on a hose can reduce the gas flow to the wearer of the respiratory protective device. The objective of this test is to quantify any reduction of the gas flow rate through a hose utilized in a RPD caused by the application of a load or force.

6.2.2 Sample and apparatus

6.2.2.1 Hose sample, at least 200 mm long.

6.2.2.2 Two metal disks, at least 20 mm thick and (100 ± 5) mm in diameter each, with periphery edge radiused to R0,5. One of the disks shall be fixed and the other capable of moving only perpendicular to the plane of the disks. Additional means being capable of imposing a compressive load, as specified in [Table 2](#), may be required.

6.2.2.3 Environmental chamber or oven, capable of maintaining an air temperature of (35₋₂⁰) °C.

6.2.2.4 Source of breathable gas, at a pressure necessary to perform the test and capable of flowing gas through the hose sample at a rate of (110 ± 5) l/min.

6.2.2.5 Flow meter, capable of measuring the gas flow rate to the nearest 2 l/min.

6.2.2.6 Flow restrictor/restriction, capable of controlling the gas flow rate.

6.2.2.7 Pressure controlling and measuring device(s), of appropriate range and precision.

6.2.3 Procedure

6.2.3.1 Place the hose sample and metal disks into the environmental chamber and equilibrate for at least 1 h, at $(35 \pm 2) ^\circ\text{C}$.

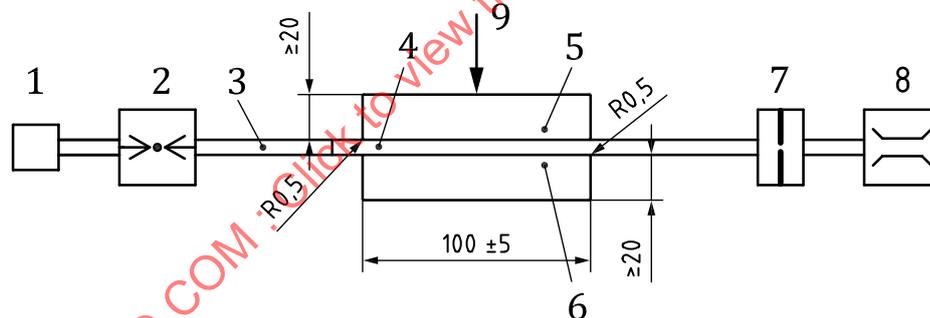
6.2.3.2 Within 60 s of removing the hose sample and disks from the environmental chamber or oven:

- install disks in test apparatus;
- attach one end of the hose sample to the source of compressed gas;
- attach the flow restrictor and flow meter to the “Open end” or effluent side of the hose sample;
- adjust the source of gas and flow restrictor to attain a gas flow rate of (110 ± 5) l/min, and specified gas pressure, if required in [Table 2](#).

This flow rate shall be recorded as Q_{t1} .

6.2.3.3 Within 30 additional seconds, centre the hose sample between the metal disks, and apply, through the moving disk, the specified compressive load, as given in [Table 2](#), to the hose sample. See [Figure 1](#).

Dimensions in millimetres



Key

- | | | | |
|---|--|---|---|
| 1 | source of breathable gas | 6 | fixed lower metal disk (corners radiused to R0,5) |
| 2 | pressure controlling and measuring device | 7 | flow restrictor |
| 3 | straight | 8 | flow meter |
| 4 | hose sample | 9 | applied compressive load (see Table 2) |
| 5 | moveable upper metal disk (corners radiused to R0,5) | | |

Figure 1 — Typical arrangement for determining the resistance of hoses to deformation, via compression

6.2.3.4 (60 ± 5) s after the application of the specified compressive load, measure the gas flow rate through the hose. Record the flow rate as Q_{t2} . The supply pressure shall be the same before and during the application of the compressive load.

6.2.3.5 Calculate the percentage change in gas flow rate ($Q\%$) as shown in Formula (1):

$$Q_{\%} = \frac{Q_{t1} - Q_{t2}}{Q_{t1}} \times 100 \quad (1)$$

where

Q_{t1} is the gas flow rate before the application of a compressive load;

Q_{t2} is the gas flow rate 1 min after the application of a compressive load.

Table 2 — Initial test conditions for resistance of hoses to deformation, via compressive load

Hose type	Gas flow rate l/min	Gas pressure within hose	Applied compressive load N
Low pressure hose	(110 ± 5)	n/a	(50 ± 2,5)
Medium and high pressure hose up to 10 m long	(110 ± 5)	Minimum pressure specified by manufacturer	(250 ± 12,5)
Medium and high pressure hose greater than 10 m long	(110 ± 5)	Minimum pressure specified by manufacturer	(1 000 ± 50)

6.2.4 Test report

The test report shall include information regarding those parameters specified in [Clause 4](#), the pressure at which the test was conducted and the percentage change in the gas flow rate after the specified compressive load has been applied to the hose sample.

6.3 Flexibility of medium pressure hoses, via bending

6.3.1 Principle

A bending force placed on a hose can cause it to crack. The objective of this test is to determine if any cracking of a medium pressure hose, utilized in a supplied breathable gas respiratory protection device, occurs when it is bent through an angle of 180° after equilibration at -5 °C and tested immediately afterwards. Class SY RPD are tested at the extremes of the operating pressures.

6.3.2 Sample and apparatus

6.3.2.1 Hose sample, at least 300 mm long.

6.3.2.2 Rigid metallic cylinder, at least 100 mm long with (80 ± 4) mm diameter.

6.3.2.3 Environmental chamber, capable of maintaining an air temperature of (-5⁺²₀) °C, and equipped with an inlet through for compressed gas.

6.3.2.4 Source of compressed gas, capable of pressurizing the hose sample.

6.3.2.5 Pressure controlling and measuring device(s), of appropriate range and precision.

6.3.2.6 Fixture, to support and align hose with respect to cylinder.

6.3.3 Procedure

6.3.3.1 Attach the inlet end of the hose sample to the source of compressed gas, and seal the “open end” or effluent side of the hose sample with an end cap.

6.3.3.2 Adjust the source of compressed gas to attain the manufacturer’s maximum specified gas pressure.

6.3.3.3 Place at least 300 mm of the pressurized hose sample into the environmental conditioning chamber, making certain that a length of at least 300 mm is straight. The hose sample may be disconnected from the pressure source for this, provided the pressure is maintained inside the hose.

6.3.3.4 Equilibrate the hose sample, along with the metal cylinder for a minimum of 1 h at (-5^{+2}_0) °C.

6.3.3.5 Within 60 additional seconds of removing the hose sample from the environmental conditioning chamber, bend the section of the hose sample that was kept straight 180° around the metallic cylinder. The hose shall be in contact with the cylinder, as shown in [Figure 2](#)

6.3.3.6 Maintain the hose in this bent condition for (60^{+15}_0) s.

6.3.3.7 After completion of the test, release the pressure, remove the hose sample from the cylinder and examine the hose sample for cracks that are superficial, or that occur through the thickness of the hose. In addition, examine the hose sample for any exposure of braiding that forms part of the hose structure

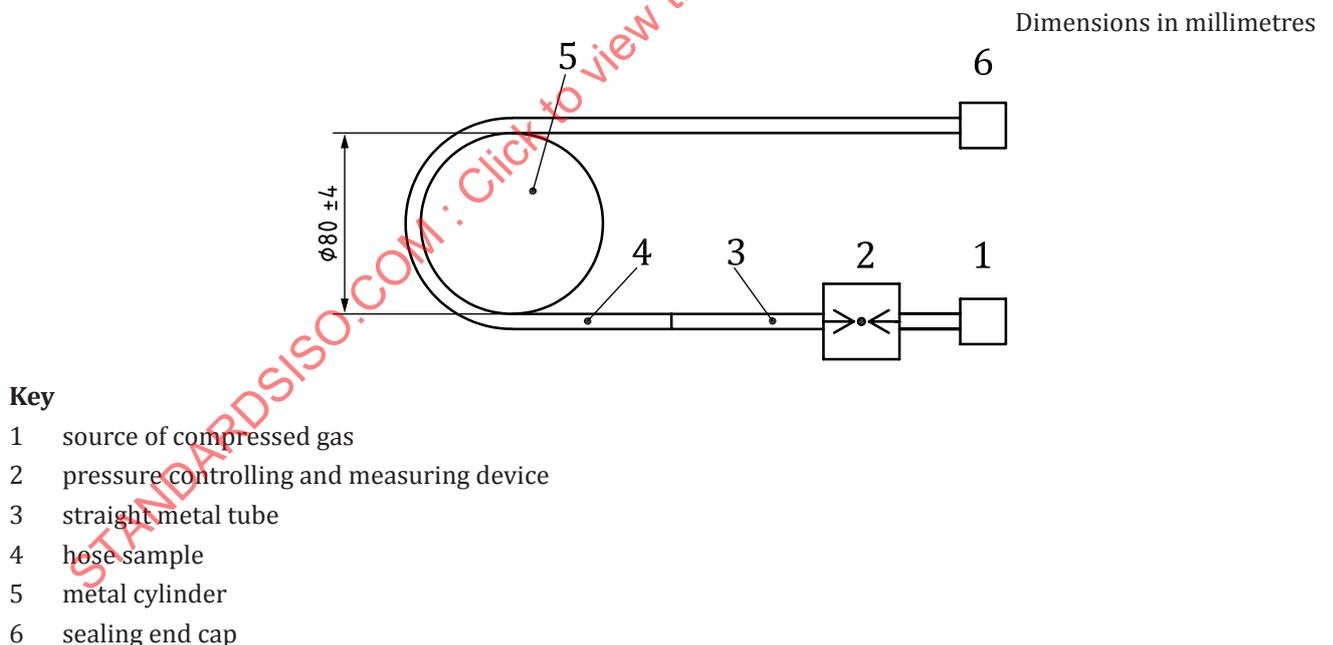


Figure 2 — Typical arrangement for determining the resistance of a hose to cracking when bent through 180°

6.3.4 Test report

The test report shall include the test temperature and supply pressure and information regarding those parameters specified in [Clause 4](#) along with any information or observations regarding the hose sample.

6.4 Flexibility of high pressure hoses, via bending

6.4.1 Principle

A bending force placed on a hose can deform it, causing it to crack. The objective of this test is to determine if any cracking of a high pressure hose, utilized in a supplied breathable gas respiratory protection device, occurs when it is bent through an angle of 90° after equilibration at -5°C .

6.4.2 Sample and apparatus

6.4.2.1 **Hose sample**, at least 300 mm long.

6.4.2.2 **Rigid metallic cylinder**, at least 100 mm long with (80 ± 4) mm diameter.

6.4.2.3 **Environmental chamber**, capable of maintaining an air temperature of (-5^{+2}_0) °C.

6.4.2.4 **Source of compressed gas**.

6.4.2.5 **Pressure controlling and measuring device(s)**, of appropriate range and precision.

6.4.2.6 **Fixture**, to support and align hose with respect to cylinder.

6.4.3 Procedure

6.4.3.1 Attach the inlet end of the hose sample to the source of compressed gas, and seal the “Open end” or effluent side of the hose sample with an end cap.

6.4.3.2 Adjust the source of compressed gas to attain the manufacturer’s maximum specified gas pressure.

6.4.3.3 Place at least 300 mm of the pressurized hose sample into the environmental conditioning chamber, making certain that a length of at least 300 mm is straight. The hose sample may be disconnected from the pressure source for this, provided the pressure is maintained inside the hose.

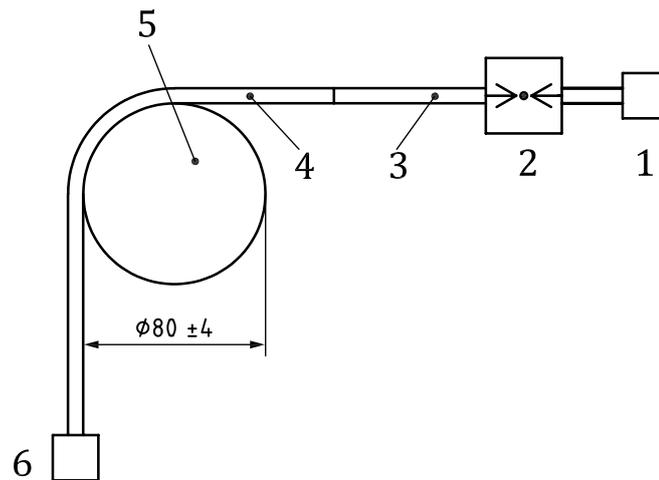
6.4.3.4 Equilibrate the hose sample, along with the metal cylinder for a minimum of 1 h, at (-5^{+2}_0) °C.

6.4.3.5 Within 60 additional seconds of removing the sample from the environmental conditioning chamber, bend the hose sample 90° around the metallic cylinder. See [Figure 3](#).

6.4.3.6 Maintain the hose in this bent condition for (60^{+15}_0) s.

6.4.3.7 After completion of the test, release the pressure, remove the hose sample from the cylinder and examine the hose sample for fractures (superficial and through the thickness of the hose).

Dimensions in millimetres

**Key**

- 1 source of compressed gas
- 2 pressure controlling and measuring device
- 3 straight metal tube
- 4 hose sample
- 5 metallic cylinder
- 6 sealing end cap

Figure 3 — Typical arrangement for determining the resistance of a hose to cracking when bent 90°

6.4.4 Test report

The test report shall include the test temperature and supply pressure and information regarding those parameters specified in [Clause 4](#), along with any information or observations regarding the sample after the specified conditioning and bending of 90° has been applied.

6.5 Coil kinking of hoses greater than 10 m in length

6.5.1 Principle

Kinking of a hose can deform it causing it to collapse, thus reducing the gas flow to the wearer of the RPD. The objective of this test is to quantify the reduction in the gas flow rate to the RPD when the hose, operating at the minimum supply pressure as specified by the manufacturer is looped and pulled straight

6.5.2 Sample and apparatus

6.5.2.1 Two hose samples, at least 1,5 m long.

6.5.2.2 Oven and/or environmental chamber, capable of maintaining an air temperature of (-5^{+2}_0) °C and (35^0_{-2}) °C, respectively.

6.5.2.3 Source of compressed gas, capable of flowing gas through the hose sample at the minimum pressure specified by the manufacturer of the respiratory protective device.

6.5.2.4 Flow meter, of the appropriate range and precision.

6.5.2.5 **Pressure controlling and measuring device(s)**, of appropriate range and precision.

6.5.2.6 **Flow restrictor**.

6.5.3 **Procedure**

6.5.3.1 Equilibrate the sample hose for a minimum of one hour at (-5^{+2}_0) °C.

6.5.3.2 Within 60 s of removing the hose sample from the environmental conditioning chamber

- place the sample on a horizontal surface,
- attach one end of the sample to the source of compressed gas,
- attach the flow meter to the other end (“open end”) of the sample, and
- adjust the source of gas and flow restrictor to attain a gas flow of (110 ± 5) l/min at the manufacturer’s minimum supply pressure.

This flow rate shall be recorded as Q_{t1} .

6.5.3.3 Within 30 additional seconds, bend the hose sample to create a loop having an inside diameter of approximately (300 ± 10) mm. See [Figure 4](#).

6.5.3.4 Immediately after creating a loop, pull the ends of loop tangentially to the loop until the sample takes a form of a straight line. Continuously monitor the flow rate through the sample.

6.5.3.5 Record the minimum gas flow rate as Q_{t2} .

6.5.3.6 Calculate the percentage change in gas flow rate ($Q_{\%}$) as shown in Formula (2):

$$Q_{\%} = \frac{Q_{t1} - Q_{t2}}{Q_{t1}} \times 100 \tag{2}$$

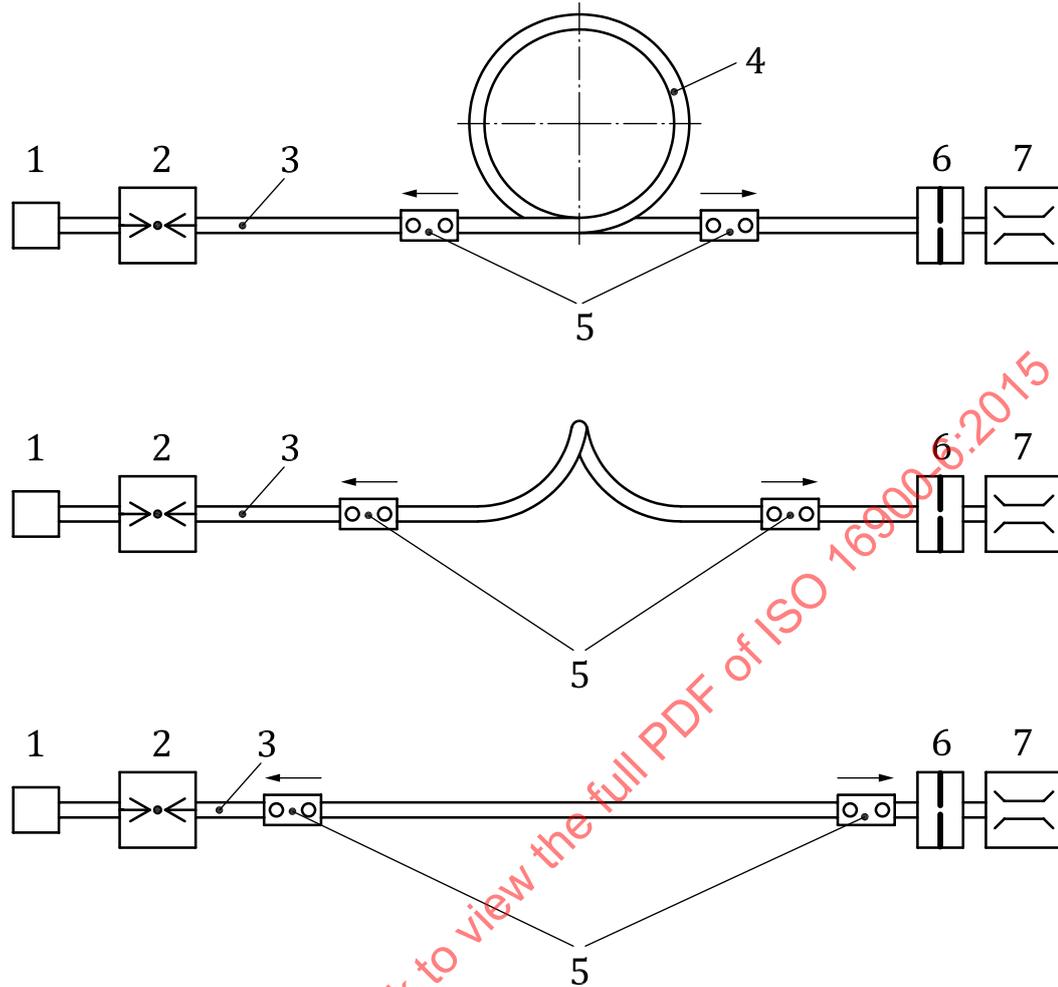
where

Q_{t1} is the gas flow rate before the bending of the hose;

Q_{t2} is the minimum rate of gas flow through the sample as it is looped, spiralled and pulled.

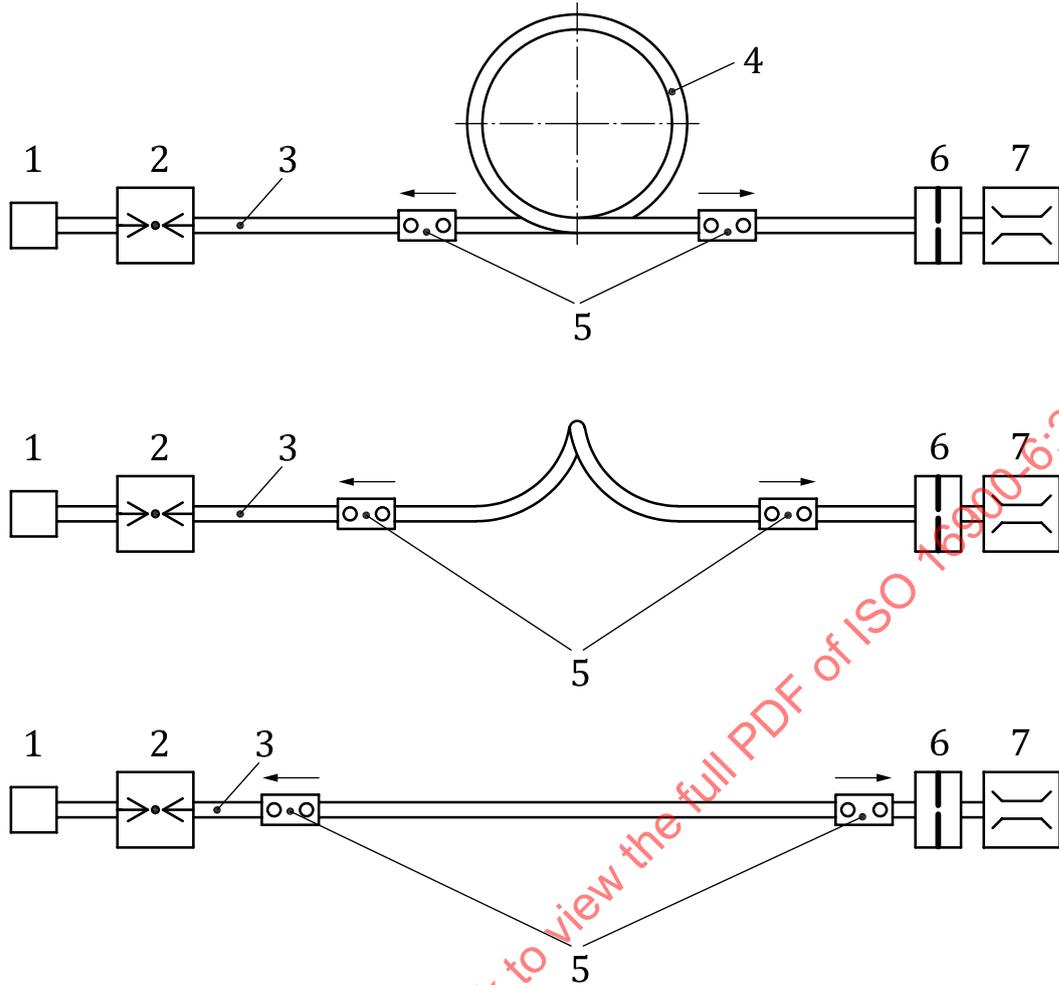
6.5.3.7 Repeat [6.5.3.1](#) to [6.5.3.6](#) on the same test sample with the hose looped in the opposite (clockwise or anti-clockwise) direction. See [Figures 4](#) and [5](#). The whole test sequence [6.5.3.2](#) to [6.5.3.5](#) shall be completed within 5 min.

6.5.3.8 Repeat [6.5.3.1](#) to [6.5.3.7](#) on a new test sample(s), after equilibration at (35^{+2}_0) °C.

**Key**

- 1 source of compressed gas
- 2 pressure controlling and measuring device
- 3 hose sample
- 4 loop having an inside diameter of approximately (300 ± 10) mm
- 5 suitable clamping arrangements for securing hose sample. These shall prevent sample from rotating
- 6 flow restrictor
- 7 flow meter

Figure 4 — Typical arrangement of coil kinking test showing different stages of straightening of hose when looped in clockwise direction



Key

- 1 source of compressed gas
- 2 pressure controlling and measuring device
- 3 hose sample
- 4 loop having an inside diameter of approximately (300 ± 10) mm
- 5 suitable clamping arrangements for securing hose sample. These shall prevent sample from rotating
- 6 flow restrictor
- 7 flow meter

Figure 5 — Typical arrangement of coil kinking test showing different stages of straightening of hose when looped in anti-clockwise direction n

6.5.4 Test report

The test report shall include information regarding those parameters specified in [Clause 4](#), the pressure at which the test was conducted along with the initial flow rate, minimum flow rate and the percentage change in the gas flow rate, in both clockwise and anticlockwise directions, at both low and high temperature. Any deviations from the test method shall be reported.

6.6 Corner kinking for hoses greater than two metres and up to and including 10 m in length

6.6.1 Principle

When a hose is bent it can reduce the gas flow to the wearer of the RPD. The objective of this test is to quantify the reduction in the gas flow rate to the RPD when the hose is bent over a 90° corner.

6.6.2 Sample and apparatus

6.6.2.1 Two hose samples, at least 1,0 m long.

6.6.2.2 Metal block, at least (250 ± 12) mm long and (250 ± 12) mm wide, with at least one corner radiused to 10 mm.

6.6.2.3 Hanger, with mass arrangement capable of imposing a force of (250 ± 13) N on the sample.

6.6.2.4 Oven and/or **environmental chamber**, capable of maintaining an air temperature of (-5^{+2}_0) °C and (35^{+0}_{-2}) °C, respectively.

6.6.2.5 Source of compressed gas, capable of flowing gas through the hose sample at a rate of (110 ± 5) l/min at the minimum pressure specified by the manufacturer.

6.6.2.6 Pressure controlling and measuring device(s).

6.6.2.7 Flow restrictor/restriction, capable of controlling the gas flow rate.

6.6.2.8 Flow meter, capable of measuring the gas flow rate to the nearest 3 l/min.

6.6.3 Procedure

6.6.3.1 Equilibrate the sample hose and metal block for 1 h minimum, at (-5^{+2}_0) °C.

6.6.3.2 Within 60 s of removing the hose sample from the environmental conditioning chamber or oven

- attach one end of the hose sample to the source of compressed gas,
- attach the flow restrictor and flow meter to the “Open end” or effluent side of hose sample, and
- adjust the source of compressed gas and flow restrictor to attain an gas flow rate of (110 ± 5) l/min.

This flow rate shall be recorded as Q_{t1} .

6.6.3.3 Within 30 additional seconds, bend the centre of the sample around a corner of the metal block having a radius of 10 mm, and attach the hanger with weight assembly progressively applying a force of (250 ± 13) N within 5 s to 8 s. See [Figure 6](#).

6.6.3.4 Record the flow rate as Q_{t2} .

6.6.3.5 Calculate the percentage change in gas flow rate ($Q_{\%}$) as shown in Formula (3):

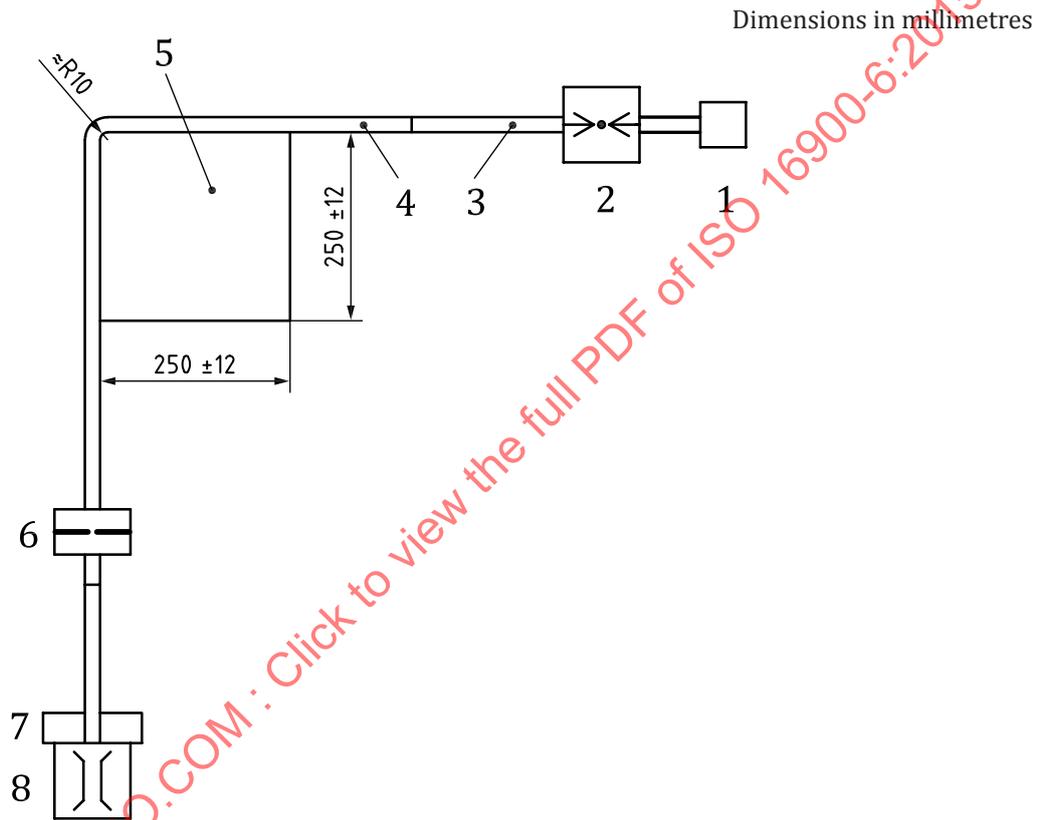
$$Q_{\%} = \frac{Q_{t1} - Q_{t2}}{Q_{t1}} \times 100 \tag{3}$$

where

Q_{t1} is the gas flow rate before the bending of the hose;

Q_{t2} is the gas flow rate after bending of the sample and application of the force.

6.6.3.6 Repeat 6.6.3.1 to 6.6.3.5 on a new test sample(s), after equilibration of the sample(s) at $(35 \pm 2) ^\circ\text{C}$.



Key

- 1 source of compressed gas
- 2 pressure controlling and measuring device
- 3 straight connector
- 4 hose sample
- 5 metal block (radiused to 10 mm, on at least one edge)
- 6 flow restrictor
- 7 hanger-weight assembly
- 8 flow meter

Figure 6 — Typical arrangement for determining the resistance of a hose to corner kinking

6.6.4 Test report

The test report shall include information regarding those parameters specified in [Clause 4](#), the pressure at which the test was conducted along with the initial flow rate, minimum flow rate and the percentage

change in the gas flow rate, at both low and high temperature. Any deviations from the test method shall be reported.

6.7 Shock resistance for filters

6.7.1 Principle

Filters can be damaged after impact, particularly those which have a large mass. The objective of this test is to determine the ability of a replaceable filter to withstand impact in its “ready for use state” when dropped three times from a height of 1,0 m, once in each axis (x-, y- and z-axis)

6.7.2 Specimen and apparatus

6.7.2.1 Filters, in their “ready for use” state as specified by the manufacturer.

6.7.2.2 Steel plate, at least 600 mm long, 600 mm wide and 5 mm thick. The plate shall be sufficiently flat so that the level difference between any two points on the surface is no more than 2 mm. The plate shall rest, in full contact, on a flat level and smooth surface.

6.7.2.3 Quick-release mechanism, capable of holding the specimen in various orientations, and which permits an unobstructed drop of the specimen.

6.7.3 Procedure

6.7.3.1 Prepare the filter into its “ready for use state” and determine the flow axis of the filter element. In the case of irregularly shaped filters, the details of the drop orientation shall be agreed upon between the manufacturer of the RPD and the test authority.

NOTE The flow axis is determined by the direction of the flow at the effluent/exit side of the filter.

6.7.3.2 Centre the specimen above the steel plate, such that its air flow axis is in the vertical position, with the connector facing upwards, and the lowest point of the specimen is at the $(1 \begin{smallmatrix} +0,1 \\ 0 \end{smallmatrix})$ m elevation mark. See [Figure 7](#).

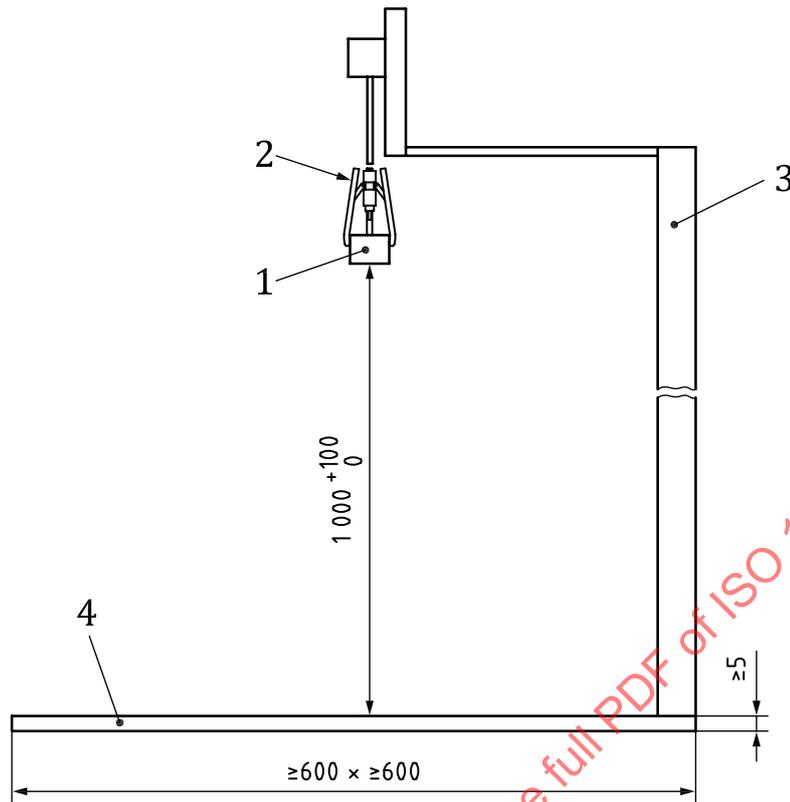
6.7.3.3 Release the specimen.

6.7.3.6 Repeat [6.7.3.2](#) and [6.7.3.3](#) in the other two axes

6.7.3.8 After impact, thoroughly examine the specimen, noting any damage or physical anomalies to the specimen which may alter its fit or function. The total period of time to complete [6.7.3.1](#) to [6.7.3.8](#) shall not exceed 10 min.

Immediately after the shock test, further testing with the filter shall be done or filters shall be resealed for storage for later testing.

Dimensions in millimetres



Key

- 1 test specimen
- 2 mechanical quick release mechanism
- 3 supporting stand
- 4 steel plate

Figure 7 — Typical arrangement for determining the resistance of replaceable filters to drop impact

6.7.4 Test report

The test report shall include information regarding those parameters specified in [Clause 4](#) along with any visible or physical anomalies to the specimen which may alter their fit or function. For irregularly shaped filters, include photographs of the drop arrangement/orientation.

6.8 Mechanical stress resistance

6.8.1 Principle

Respiratory protective devices or components can be damaged after repeated mechanical stress, i.e. physical vibration. The objective of this test is to subject a RPD or component in its ready for assembly state to a repeated mechanical stress.

6.8.2 Specimen and apparatus

6.8.2.1 RPD and/or RPD components, in the “ready for assembly” state.

6.8.2.2 Vibration equipment, consisting of a steel case at least 10 kg in mass, affixed to a vertically moving piston that is attached to a rotating cam. See [Figure 8](#). The individual compartments within the case shall be sized to allow horizontal movement of (7 ± 3) mm, and free vertical movement. The weight of the steel plate onto which the steel case falls shall be at least 10 times the weight of the steel case. This

may be achieved by bolting the base plate to a hard solid floor. The piston and case shall be raised by a rotating cam to a vertical height of (20 ± 1) mm, and allowed to fall under its own weight onto a steel plate as the cam rotates at a rate of (100 ± 5) cycles/min.

6.8.3 Procedure

6.8.3.1 Only one specimen shall be placed into each compartment of the conditioning equipment as shown in [Figure 8](#).

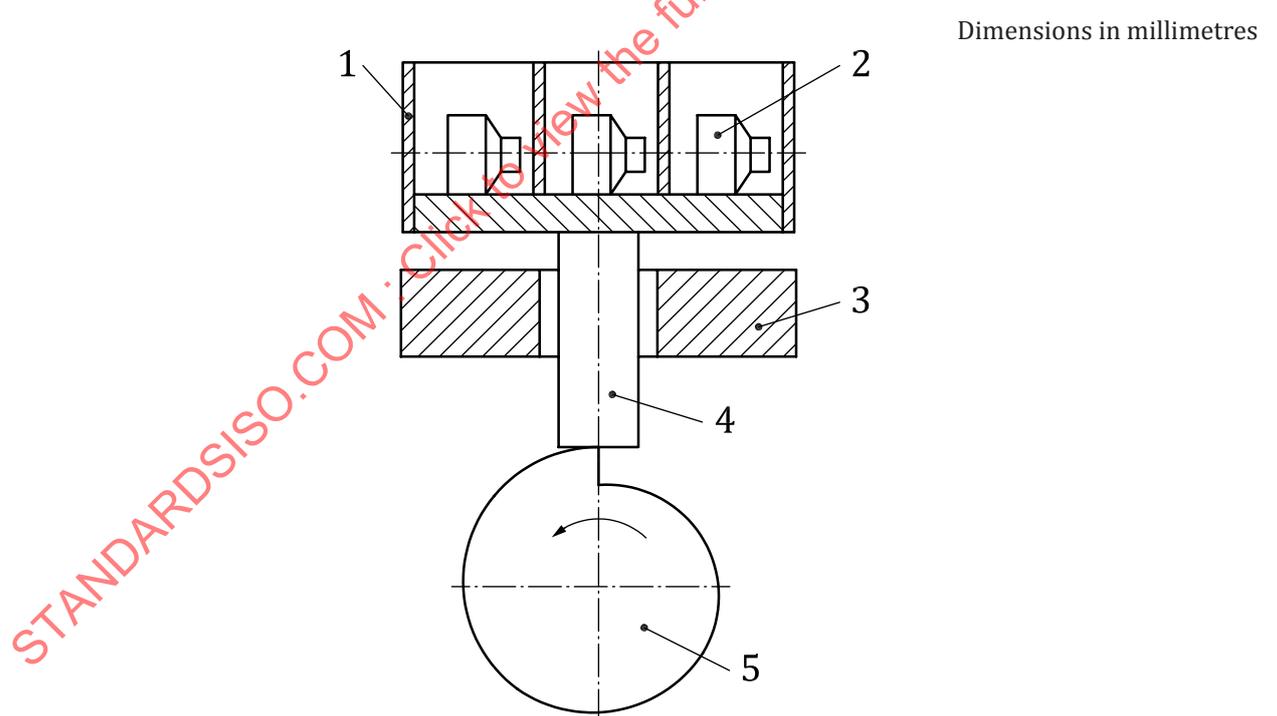
6.8.3.2 Specimens shall be positioned in the steel case in their ready for assembly state allowing (7 ± 3) mm horizontal movement and free vertical movement within their compartments. In case of filters, the axis of air flow through the specimens shall be horizontal.

6.8.3.3 Each of the specimens shall be mechanically conditioned for $(2\ 000^{+100}_0)$ cycles.

6.8.3.4 After the conditioning, any loose material that may have been released from the specimen shall be removed prior to any further testing.

6.8.4 Test report

The test report shall include information regarding those parameters specified in [Clause 4](#) along with any visible or physical anomalies to the RPD which may alter its fit or function.



Key

- | | |
|---------------|--|
| 1 steel case | 4 piston |
| 2 specimen | 5 rotating cam [capable of lifting the steel case (20 ± 1) mm] |
| 3 steel plate | |

Figure 8 — Typical arrangement for conditioning respiratory protective devices or components to mechanical stress

6.9 Strength of visor

6.9.1 Principle

Visors of respiratory protective devices can be damaged by an impact, thereby altering the function and fit of the RPD. The objective of this test is to evaluate the ability of a visor, when properly installed in a RPD, to withstand impact by a projectile (steel ball).

6.9.2 Specimen and apparatus

6.9.2.1 Respiratory interface, equipped with a visor.

6.9.2.2 Oven and/or **environmental chamber**, capable of maintaining an air temperature of (-5^{+2}_0) °C and (35^{+0}_-2) °C, respectively.

6.9.2.3 Respiratory protective device headform, the appropriate size for the respiratory interface.

6.9.2.4 Steel ball, (22 ± 1) mm in diameter and (44 ± 2) g in mass.

6.9.2.5 Quick release mechanism, capable of holding the steel ball, and permits its unobstructed drop on to the specimen.

6.9.3 Procedure

6.9.3.1 Equilibrate the specimen for 1 h minimum, at (-5^{+2}_0) °C.

NOTE Alternatively, the specimen may be securely mounted to the headform, and both subsequently equilibrated in an environmental chamber.

6.9.3.2 Within 60 s of removing the specimen from the temperature conditioning chamber

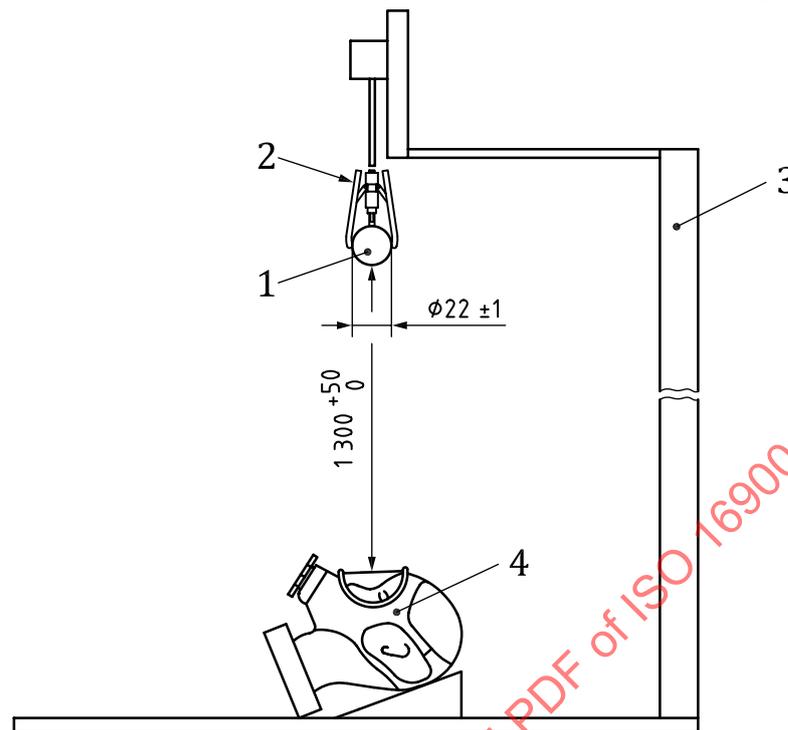
- securely mount it to the appropriate headform or headform-torso assembly, if appropriate,
- position the headform such that the impact of the steel ball to the visor is perpendicular, and
- impact the visor with the steel ball from a height of (130^{+5}_0) cm.

Typical arrangement is shown in [Figure 9](#).

6.9.3.3 Repeat [6.9.3.1](#) to [6.9.3.2](#) on the same specimen, mounted on a head form, but conditioned at (35^{+0}_-2) °C. After equilibration at (35^{+0}_-2) °C, the steel ball shall not impact the visor in the same location as in the previous test. If the respiratory interface is equipped with a binocular viewing system, use one lens for impacting after equilibration at (35^{+0}_-2) °C, and use the other lens for impacting after equilibrating at (-5^{+2}_0) °C.

6.9.3.4 After impact, thoroughly examine the respiratory interface with visor, noting any separation of material from the inner surface, as well as damage or physical anomalies which may alter its fit or function.

Dimensions in millimetres

**Key**

- 1 steel ball
- 2 quick release mechanism
- 3 supporting stand,
- 4 headform of appropriate size with mounted specimen rigidly supported on the base

Figure 9 — Typical Arrangement for determining the resistance to impact of a visor

6.9.4 Test report

The test report shall include information regarding those parameters specified in [Clause 4](#) along with any damage or anomalies to the respiratory interface with visor which may present a hazard to the wearer.

6.10 Strength of connections**6.10.1 Principle**

The objective of this test method is to determine if the following meet the minimum specified axial force requirements:

- the connections of filters or of supplied breathable gas devices to a respiratory interface;
- components attached to the respiratory interface having the potential of being hooked or snagged;
- breathable gas supply connections not directly attached to the respiratory interface;

NOTE This includes any connection within the breathable gas supply chain, e.g. T-pieces, elbow connections and connections between hoses.

- high-pressure hose connections.

6.10.2 Specimen and apparatus

6.10.2.1 Complete RPD, to be tested.

6.10.2.2 RPD headform, of the size appropriate to the respiratory interface, plus RPD torso, where necessary, on which the RPD with components can be properly mounted;

6.10.2.3 F_x force probe, with 5 mm index ball.

6.10.2.4 Suitable means of imposing the axial force(s), to the components to be tested.

6.10.3 Procedure for evaluating the strength of connections to a respiratory interface

6.10.3.1 Securely attach the headform (and torso, if necessary) to a solid surface.

6.10.3.2 Securely mount the respiratory interface with components to the headform (and torso, if necessary).

6.10.3.3 Use the F_x force probe to determine which of the respiratory interface components have the potential to be caught or snagged during use. The F_x force probe is used as follows:

- The surface of the respiratory interface (or other components of the RPD) shall be probed with the ball of the F_x force probe to identify any openings or gaps that are large enough to allow the ball to enter, therefore giving the potential for the component to be caught or snagged. If the ball can enter the opening or gap, then the component shall be tested with an axial force.

Examples of such connections and components are shown in [Figure 10](#).

6.10.3.4 Position the headform (and torso, if necessary) with the specimen such that an axial pull force can be imposed on the connections of filters or of supplied breathable gas devices to a respiratory interface, as well as those components identified as having the potential of being “caught or snagged.” Examples of the components and connections are shown (schematically) in [Figure 10](#). The direction of the applied forces is shown in [Figure 11](#).

NOTE 1 By positioning the respiratory interface onto the headform the strength of the fixation of the respiratory interface to the head form is included in this test.

NOTE 2 If it is not possible to apply the required force for the required time due to breakage or slippage of the fixation through, e.g. buckles, this is deemed to be a failure. Dislodging of the respiratory interface from the head form is not deemed to be a failure and shall not stop testing.

6.10.3.5 Progressively apply the specified pull force within 5 s to 7 s to the connection or component (in order to avoid an initial shock or jerking motion to the specimen under test).

6.10.3.6 Once the total pull force has been applied, the connection or component shall be subjected to this force for $(10 \pm 2)_0$ s.

6.10.3.7 Examine the specimen for any fracture, separation or permanent deformation while under test and after testing has been completed.

6.10.4 Procedures for testing the strength of breathable gas supply connections other than to the respiratory interface

6.10.4.1 Attach one side of the connection or component to a suitable fixation arrangement