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**Rubber and plastics hoses and  
hose assemblies — Methods of  
measurement of the dimensions  
of hoses and the lengths of hose  
assemblies**

*Tuyaux et flexibles en caoutchouc et en plastique — Méthodes de  
mesurage des dimensions des tuyaux et de la longueur des flexibles*

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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](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 (see [www.iso.org/patents](http://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](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 218, *Rubber and plastics hoses and hose assemblies*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 4671:2007), which has been technically revised. It also incorporates the Amendment ISO 4671:2007/Amd 1:2011. The main changes are as follows:

- permissions (using the term “may”) have been changed to requirements (using the term “shall”) throughout the document along with resultant modified text;
- the position at which the outside diameter is measured has been clarified;
- [Clause 3](#) has been added.

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](http://www.iso.org/members.html).

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# Rubber and plastics hoses and hose assemblies — Methods of measurement of the dimensions of hoses and the lengths of hose assemblies

## 1 Scope

This document specifies methods of measuring the inside diameter, outside diameter (including diameter over reinforcement of hydraulic hoses), wall thickness, concentricity and lining and cover thickness of hoses, methods of measurement and identification of the lengths of hoses and hose assemblies, and a method of verifying the through-bore of hydraulic hose assemblies.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment: Micrometers for external measurements — Design and metrological characteristics*

ISO 8330, *Rubber and plastics hoses and hose assemblies — Vocabulary*

ISO 13385-1, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 1: Design and metrological characteristics of callipers*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8330 apply.

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 Test piece conditioning and temperature of measurement

### 4.1 Conditioning of test pieces

Unless otherwise specified, test pieces shall be taken at least 16 h after manufacture of the hose and conditioned at  $23_{-3}^{+7}$  °C for at least 3 h before measurement. This 3 h shall be included in the 16 h.

### 4.2 Measurement temperature

Unless otherwise specified, the measurement temperature shall be  $23_{-3}^{+7}$  °C.

## 5 Measurement of inside diameter

### 5.1 General

Measurements by methods 1 to 7 shall be made either on the ends of a full length of hose or on a test piece (minimum length 150 mm) cut from a full length. For wire-reinforced hydraulic hoses, measurements shall be made at a minimum distance of 25 mm from the end of the hose.

Measurements shall be made using one of the following methods, as appropriate.

### 5.2 Method 1

This method is applicable for inside diameters less than 150 mm and for all sizes of collapsible hose. Use plug gauges with 0,25 mm increments in diameter (see Figure 1) and tapered gauges with 0,1 mm increments in diameter (see Figure 2). Insert the gauge into the hose test piece gently without pressure. Take special care if the hose bore is not precisely circular.

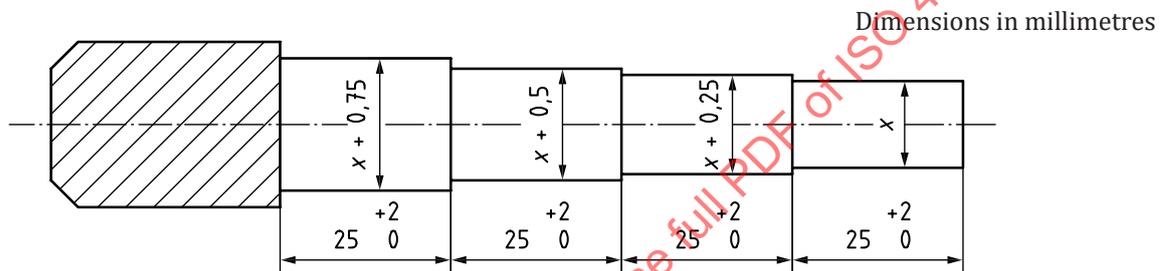


Figure 1 — Plug gauges

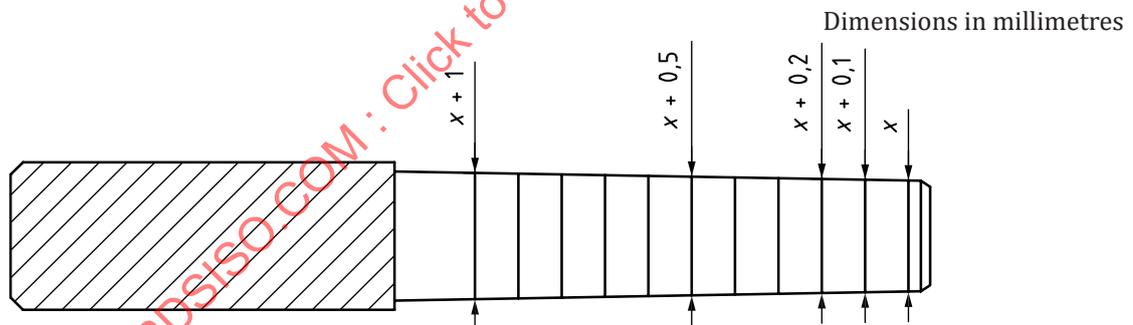


Figure 2 — Tapered gauges

### 5.3 Method 2

This method is applicable for inside diameters less than 63 mm, where greater accuracy is required, e.g. for wire-reinforced hydraulic hoses. Use an expanding ball or telescopic gauge.

### 5.4 Method 3

This method is applicable for all inside diameters up to and including 100 mm. Use the internal jaws of vernier slide callipers conforming to the requirements of ISO 13385-1. Make two measurements at right angles to each other and take their average as the inside diameter. Take care not to distort the hose when making the measurements. Use callipers of suitable size for inside diameter above 100 mm when greater accuracy than is obtainable by method 5 (see 5.6) is required.

### 5.5 Method 4

This method is applicable for all inside diameters. Use an internal calliper dial gauge (see ISO 463) with rounded feet designed for use in bores made of elastomeric material, a calliper size being chosen which is suitable for the inside diameter to be measured. Make two measurements at right angles to each other and take their average as the inside diameter.

### 5.6 Method 5

This method is applicable for inside diameters above 100 mm. Use a graduated steel rule to obtain a sufficient degree of accuracy for normal purposes. Alternatively, digital callipers or a digital micrometer can be used. Make two measurements at right angles to each other and take their average as the inside diameter.

### 5.7 Method 6

For suitable diameters, and where the hose cross-section has not been distorted by the cutting operation, use an optical magnifier with a scale graduated in 0,1 mm divisions. Make two measurements at right angles to each other and take their average as the inside diameter.

### 5.8 Method 7

For inside diameters above 300 mm, a sufficient degree of accuracy for normal purposes is obtained by measuring the inside circumference of the hose with a measuring tape. A pi-tape, graduated to give the diameter directly, should be used. Alternatively, use a measuring tape graduated in centimetres. The inside diameter is obtained by dividing the measured value by pi ( $\pi$ ).

## 6 Measurement of outside diameter

### 6.1 General

Measurements made by methods 1 to 5 shall be made either on a full length of hose or on a test piece (minimum length 150 mm) cut from a full length. Measurements shall be made at a minimum distance of 25 mm from the ends of the hose in methods 1, 2, 3 and 5 and at the end of the hose in method 4. If the cover is fluted or corrugated, measurements shall be made at the top of an outward-projecting part of the cover.

Measurements shall be made using one of the following methods, as appropriate.

### 6.2 Method 1

This method is applicable for outside diameters up to and including 100 mm. Use a vernier slide callipers, or a micrometer conforming to the requirements of ISO 3611. Make two measurements at right angles to each other and take their average as the outside diameter. Take care to avoid distorting the hose when making the measurements. When greater accuracy is required, place the test piece on a mandrel of outside diameter equal to the hose inside diameter to prevent distortion.

### 6.3 Method 2

This method is applicable for outside diameters over 20 mm. Use a vernier stepped pi-tape.

### 6.4 Method 3

For outside diameters over 100 mm, a sufficient degree of accuracy for normal purposes is obtained by measuring the outside circumference of the hose with a measuring tape. A pi-tape, graduated to give the diameter directly, should be used. Alternatively, use a measuring tape graduated in centimetres. The outside diameter is obtained by dividing the measured value by pi ( $\pi$ ).

## 6.5 Method 4

For suitable diameters, and where the hose cross-section has not been distorted by the cutting operation, use an optical magnifier with a scale graduated in 0,1 mm divisions. Alternatively, use a laser measuring device. Make two measurements at right angles to each other and take their average as the outside diameter.

## 6.6 Method 5

For all outside diameters, use laser micrometers. Make two measurements at right angles to each other and take their average as the outside diameter.

## 7 Measurement of diameter over reinforcement

Measurement of the diameter over reinforcement is normally confined to hydraulic hoses in connection with the fitting of couplings and shall be carried out on a test piece cut from the hose.

Make measurements in accordance with [6.2](#) or [6.3](#), after completely removing the cover material.

## 8 Measurement of wall thickness

### 8.1 General

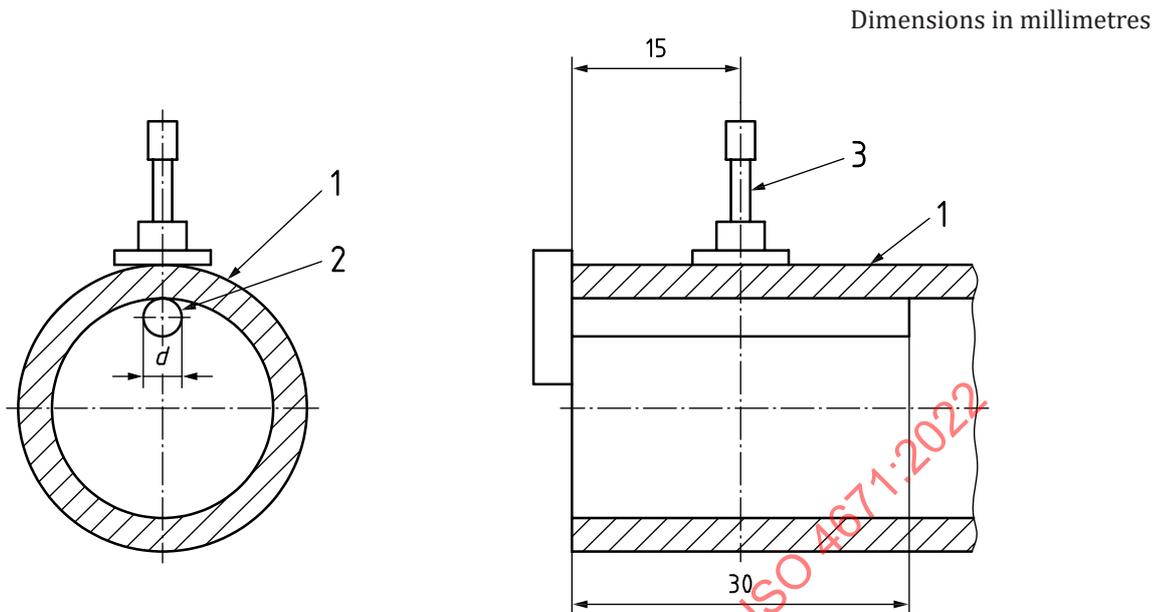
Where knowledge of the wall thickness is required, it is normally sufficient to calculate this by taking half the difference between the outside and inside diameters. Alternatively, the wall thickness can be measured directly using one of the following methods. The readings shall be taken at the end of the hose test piece for methods 1 and 4 and at a minimum distance of 15 mm from the end of the hose test piece for methods 2 and 3.

### 8.2 Method 1

Use vernier slide callipers, taking care to avoid errors due to curvature.

### 8.3 Method 2

Use a micrometer with a rounded anvil contacting the inside of the hose, or a dial gauge using an arrangement similar to that shown in [Figure 3](#).

**Key**

- 1 hose (minimum length 30 mm)
- 2 hose support or anvil
- 3 dial-indicator spindle

$d = 3$  mm for hoses up to and including inside diameter 6 mm

$d = 6$  mm for hoses above 6 mm inside diameter

**Figure 3 — Suitable arrangement for the measurement of the wall thickness of a hose using a dial gauge**

**8.4 Method 3**

Use a thickness calliper dial gauge with rounded feet designed for use with elastomeric materials.

**8.5 Method 4**

Use an optical magnifier with a scale graduated in 0,1 mm divisions.

**9 Measurement of concentricity****9.1 General**

The concentricity is the difference between the highest and lowest readings of the wall thickness (difference between the inside diameter and the outside diameter) of the hose construction or the difference between the highest and lowest readings of the thickness (difference between the inside diameter and the diameter over the reinforcement). The readings shall be taken at the end of the hose test piece for methods 3 and 5 and at a minimum distance of 15 mm from the end of the test piece for methods 1, 2 and 4.

**9.2 Method 1**

Mount the hose test piece on a mandrel of outside diameter equal to the hose inside diameter, the ends of which rest in vee-blocks. Use a dial indicator gauge to obtain the difference between the highest and lowest readings around the circumference.

### 9.3 Method 2

Use a micrometer with a rounded anvil contacting the inside of the hose or a dial gauge using an arrangement similar to that shown in [Figure 3](#) to obtain the difference between the highest and lowest readings.

For hoses of inside diameter 63 mm and over, take eight readings at 45° intervals around the circumference.

For hoses of inside diameter less than 63 mm, take four readings at 90° intervals around the circumference.

### 9.4 Method 3

Use vernier slide callipers, taking care to minimize errors due to curvature. For hoses of inside diameter less than 63 mm, the difference between the highest and lowest readings is obtained by taking four readings at 90° intervals around the circumference. For hoses of inside diameter 63 mm and over, the difference between the highest and lowest readings is obtained by taking eight readings at 45° intervals around the circumference.

### 9.5 Method 4

Use a thickness calliper dial gauge with rounded feet designed for use with elastomeric materials. For hoses of inside diameter less than 63 mm, the difference between the highest and lowest readings is obtained by taking four readings at 90° intervals around the circumference. For hoses of inside diameter 63 mm and over, the difference between the highest and lowest readings is obtained by taking eight readings at 45° intervals around the circumference.

### 9.6 Method 5

Use an optical magnifying glass with a scale graduated in 0,1 mm divisions. For hoses of inside diameter less than 63 mm, the difference between the highest and lowest readings is obtained by taking four readings at 90° intervals around the circumference. For hoses of inside diameter 63 mm and over, the difference between the highest and lowest readings is obtained by taking eight readings at 45° intervals around the circumference.

## 10 Measurement of lining and cover thickness

### 10.1 General

Three methods are specified. In method 1, the thickness of the lining and cover is measured at a cut edge of the test piece. This method is suitable not only for hoses with smooth covers but also for those with fluted and corrugated covers. Method 2 is intended for use with hoses incorporating a reinforcement. Method 3 measures the cover thickness only.

### 10.2 Method 1

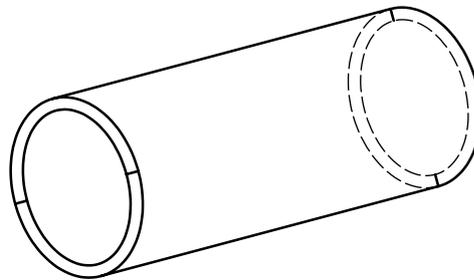
**10.2.1** With fluted and smooth covers, cut four test pieces 25 mm or more in length from the hose. Measure the thickness of the lining and cover at each end of each test piece, at the thinnest point (i.e. between the projections) in the case of fluted covers, using an optical magnifying glass with a scale graduated in 0,1 mm divisions. Record the average of the eight measurements as the thickness of the lining and cover.

**10.2.2** With corrugated covers, take a test piece approximately 50 mm in length from the hose and mark a diameter on each end, the two diameters being at right angles to one another [see [Figure 4 a](#)].

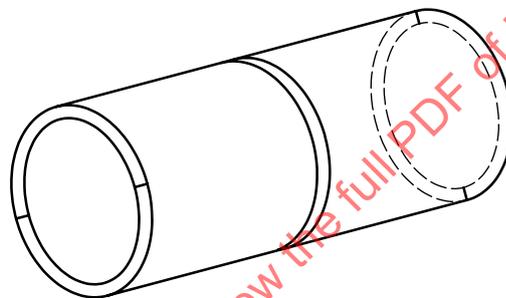
Cut the test piece into equal portions and then bisect each portion by cutting longitudinally along the marked diameters [see [Figure 4 b\)](#) and [Figure 4 c\)](#)].

Measure the thickness of the lining and cover on each segment at the thinnest point on each of the eight longitudinal cut edges, using an optical magnifying glass with a scale graduated in 0,1 mm divisions.

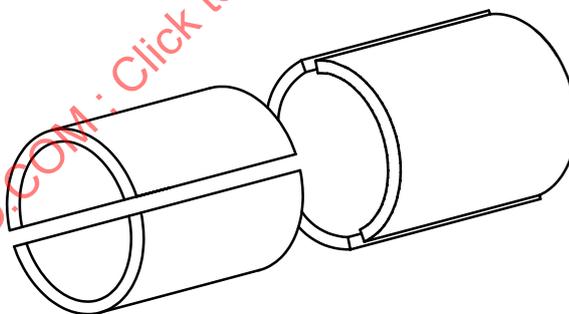
Record the average of the eight measurements as the thickness of the lining and cover.



a) Diameter marked



b) Test piece cut in half



c) Each half bisected

Figure 4 — Measurement of lining and cover thickness

### 10.3 Method 2

**10.3.1** In this method, the thickness of the lining and cover is measured, on a test piece of any suitable length, using a standard micrometer graduated at 0,02 mm intervals and having a presser foot 3 mm to 10 mm in diameter exerting a pressure of 22 kPa  $\pm$  5 kPa.

**10.3.2** With hoses incorporating a braid or helical-wound reinforcement, strip the lining and cover from the reinforcement and measure the thickness with the micrometer in two directions at 90° intervals round the circumference. Then buff the hose and cover just sufficiently to remove the corrugations caused by the reinforcement and repeat the thickness measurements. Record the average of the four readings as the lining and cover thickness.

**10.3.3** With hoses incorporating a woven reinforcement, strip the lining and cover from the reinforcement and buff just sufficiently to remove the corrugations caused by the reinforcement. Measure the thickness with the micrometer in two directions at 90° intervals round the circumference. Record the average of the two readings as the lining and cover thickness.

**10.4 Method 3**

Where the maximum cover thickness is specified for wire-reinforced hoses, measure the cover thickness by means of a dial indicator depth gauge having a rounded foot placed parallel to the hose, bridging a groove obtained by stripping a 12,5 mm to 25 mm width of cover from the hose. Place a mandrel in the hose bore to ensure that misalignment is minimized. Record the difference between the highest and lowest readings around the circumference as the maximum cover thickness.

**11 Measurement of length and identification of measurement points**

**11.1 Measurement of length**

For lengths of up to and including 20 m, measure the length with a graduated steel tape or, with short lengths, a metal rule or, with very short lengths, vernier slide callipers. For lengths over 20 m, measure the length with a graduated steel tape or a wheel-type measurement gauge.

Make all measurements with the hose in the straight and unstretched condition.

**11.2 Measurement points**

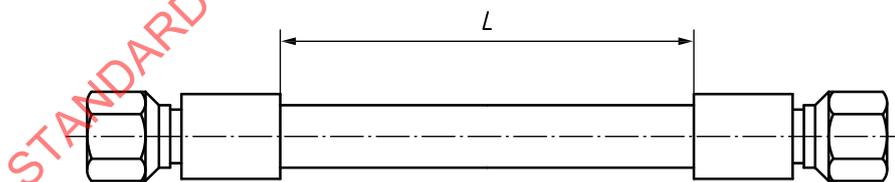
**11.2.1 Hoses**

Determine the length of the hose between the extreme ends of the cut length.

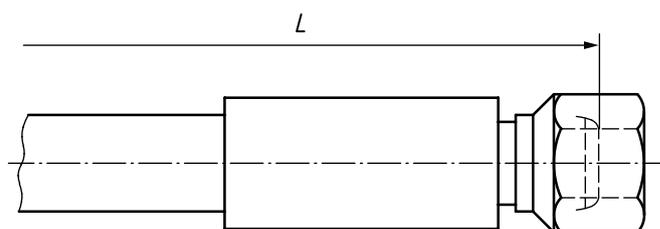
**11.2.2 Hose assemblies**

Ensure that the points between which the length ( $L$ ) of the assembly is to be measured are identified. The length of assembly is generally measured from sealing surfaces of the end fittings. [Figures 5 to 10](#) show typical end fittings and how to identify the different measurement points.

For hose assemblies with end fittings not illustrated in [Figures 5 to 10](#), ensure that the measurement point on the fitting is identified from the fitting manufacturer's published data.



**Figure 5 — Free length of exposed hose between couplings**



**Figure 6 — Length to nipple of the coupling (female)**