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

*Tuyaux et flexibles en caoutchouc ou en plastique — Méthodes
de mesurage des dimensions*



Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 4671 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Hoses (rubber and plastics)*.

This second edition cancels and replaces the first edition (ISO 4671:1984), which has been technically revised.

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Rubber and plastics hoses and hose assemblies — Methods of measurement of dimensions

1 Scope

This International Standard 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 length of hoses and hose assemblies, and a method of verifying the through-bore of hydraulic hose assemblies.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 463:—¹⁾, *Geometrical product specifications (GPS) — Dimensional measuring instruments: Dial gauges — Design and metrological requirements.*

ISO 3599:1976, *Vernier callipers reading to 0,1 and 0,05 mm.*

ISO 3611:1978, *Micrometer callipers for external measurement.*

3 Measurement of inside diameter

3.1 General

Measurements for methods 1 to 5 may be made either on the ends of a full length of hose or on a specimen (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:

3.2 Method 1

For inside diameters less than 150 mm and for all sizes of collapsible hose, plug gauges with 0,25 mm increments in diameter (see figure 1) may be used. Insert the gauge into the hose specimen gently without pressure. Take special care if the hose bore is not precisely circular.

1) To be published. (Revision of ISO/R 463:1965)

3.3 Method 2

For inside diameters less than 63 mm, where greater accuracy is required, for example for wire-reinforced hydraulic hoses, an expanding ball or telescopic gauge may be used.

3.4 Method 3

For all inside diameters up to and including 100 mm, the internal jaws of sliding vernier callipers complying with the requirements of ISO 3599 may be used. 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. Callipers of suitable size may be used for nominal bores above 100 when greater accuracy than is obtainable by method 5 (see 3.6) is required.

3.5 Method 4

For all inside diameters, an internal calliper dial gauge (see ISO 463) with rounded feet designed for use in bores made of elastomeric material may be used, 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.

3.6 Method 5

For inside diameters above 100 mm, a sufficient degree of accuracy for normal purposes is obtainable by the use of a graduated steel rule. Make two measurements at right angles to each other and take their average as the inside diameter.

3.7 Method 6

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

4 Measurement of outside diameter

4.1 General

Measurements for methods 1 to 3 may be made either on a full length of hose or on a specimen (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.

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

4.2 Method 1

For outside diameters up to and including 100 mm, sliding vernier callipers, or a micrometer complying with the requirements of ISO 3611, may be used. Take 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 specimen on a mandrel of outside diameter equal to the hose inside diameter to prevent distortion.

4.3 Method 2

For outside diameters over 20 mm, a vernier stepped π -tape may be used.

4.4 Method 3

For outside diameters over 100 mm, a flexible tape graduated to read diameter directly may be used, or the circumference may be measured using a flexible tape and the diameter derived therefrom.

4.5 Method 4

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

5 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 specimen cut from the hose.

Make measurements in accordance with 4.2 or 4.3, after completely removing the cover material.

6 Measurement of wall thickness

6.1 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 may be measured directly using one of the following methods:

6.2 Method 1

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

6.3 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 2.

6.4 Method 3

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

6.5 Method 4

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

7 Measurement of concentricity

7.1 General

The concentricity is the measurement of the difference between the highest and lowest readings of the inside diameter and the outside diameter of the hose construction. These shall be measured using one of the following methods. All readings shall be taken at a minimum distance of 15 mm from the ends of the hose specimens.

7.2 Method 1

Mount the hose specimen 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 maximum variation between high and low readings around the circumference.

7.3 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 2.

For hoses of inside diameter up to and including 63 mm, take eight readings at 45° intervals round the circumference.

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

8 Measurement of lining and cover thickness

8.1 Method 1

8.1.1 Take a hose specimen approximately 50 mm in length and mark a diameter on each end, the two diameters being at right angles to one another [see figure 3a)].

8.1.2 Cut the specimen into equal portions and then bisect each portion by cutting longitudinally along the marked diameters [see figures 3b) and 3c)].

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

8.1.4 Record the average of the eight measurements as the thickness of the lining or cover.

8.1.5 Where the cover is fluted or corrugated, make the measurements at the thinnest point.

8.2 Method 2

8.2.1 Determine the thickness of the lining and cover from any type of hose by means of a standard micrometer graduated to 0,02 mm and having a presser foot 3 mm to 10 mm in diameter exerting a pressure of 22 kPa ± 5 kPa.

8.2.2 Take the thickness of the lining or cover adjoining a braid or helical-wound reinforcing member as the average between two measurements of thickness, one of which shall be obtained using a specimen that is buffed just sufficiently to remove the braid or helical corrugations. Record the average reading of two specimens taken at 90° intervals.

8.2.3 Determine the thickness of the lining or cover adjoining a woven reinforcement as the thickness of a specimen that is buffed just sufficiently to remove the corrugations caused by the woven reinforcement. Record the average reading of the specimens taken at 90° intervals.

8.3 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 maximum and minimum readings round the circumference.

9 Measurement of length and identification of measurement points

9.1 Measurement of length

For lengths of up to and including 20 m, measure the length with a graduated steel tape. For lengths of over 20 m, measure the length with a graduated steel tape or with a wheel-type measuring gauge.

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

9.2 Measurement points

9.2.1 Hoses without end fittings

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

9.2.2 Hoses with end fittings

Ensure that the measurement points for the length of the assembly are identified. Figures 4 to 9 show typical end fittings and how to identify the different measurement points.

For hose assemblies with end fittings not illustrated in figures 4 to 9, ensure that the measurement point on the fitting is identified from the fitting manufacturer's published data.

10 Verification of through-bore of hose assemblies

This test is applied to hose assemblies fitted with end couplings to confirm that the bore through the assembly, including any bulge or constriction resulting from attachment of couplings, is not less than a specified value.

Carry out the test by determining whether a test ball of specified size passes completely through the assembly.

NOTE It is recommended that hose specifications specify the size of ball to be used, choosing a standard ball-bearing size, rather than quote a percentage of the inside diameter, since the latter usually results in non-standard ball sizes that are not readily obtainable.

11 Test report

The test report shall include the following information as appropriate:

- a) a reference to this International Standard;
- b) a full description of the hose or hose assembly tested;
- c) the date of the test;
- d) the inside diameter, including the method used and the individual readings obtained;
- e) the outside diameter, including the method used and the individual readings obtained;
- f) the diameter over reinforcement, including the method used and the individual readings obtained;
- g) the wall thickness, including the method used and the individual readings obtained;
- h) the concentricity, including the method used and the individual readings obtained;

- i) the lining thickness, including the method used and the individual readings obtained;
- j) the cover thickness, including the method used and the individual readings obtained;
- k) the length of the hose or hose assembly, including the method and measurement points used;
- l) the size of the ball used for the through-bore test and whether the ball passed freely and completely through the assembly.

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Dimensions in millimetres

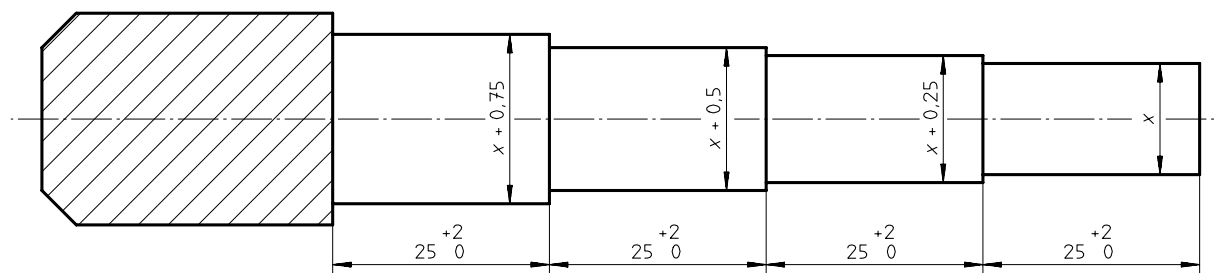
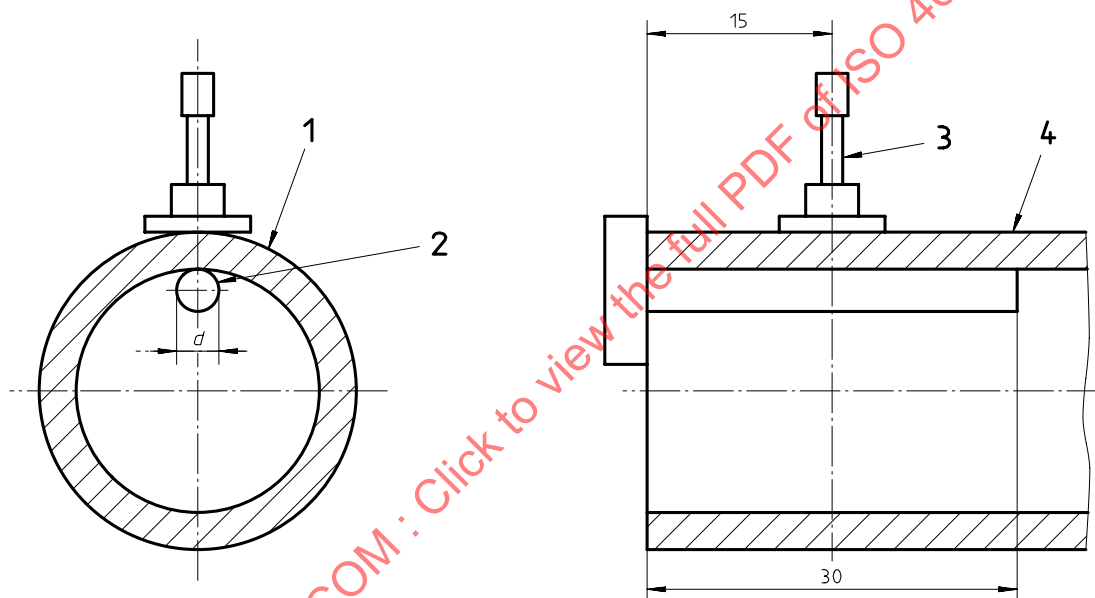


Figure 1 — Plug gauges

Dimensions in millimetres

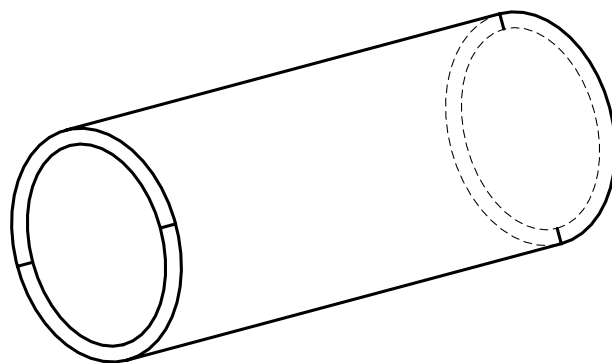
**Key**

- 1 Hose
- 2 Hose support or anvil
- 3 Dial-indicator spindle
- 4 Hose (minimum length 30 mm)

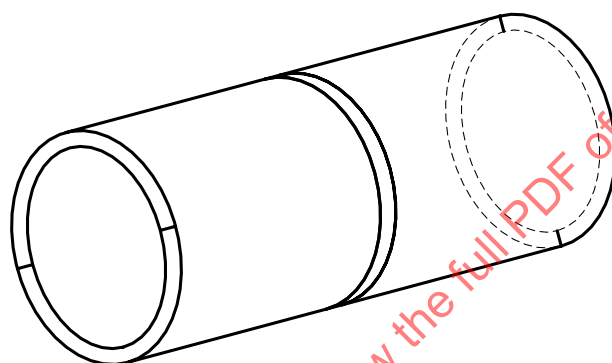
$d = 3$ mm for hoses up to and including inside diameter 6 mm

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

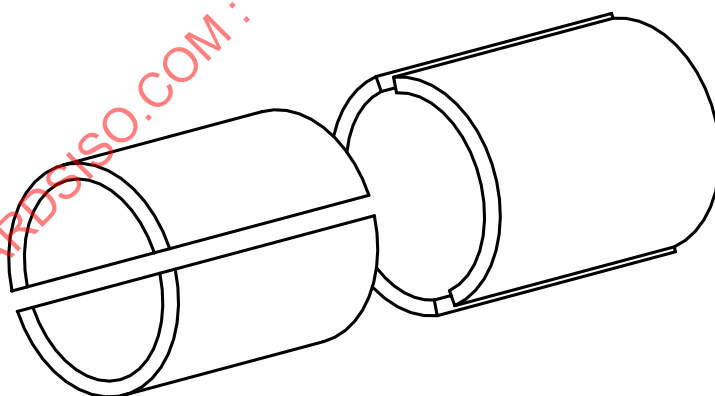
Figure 2 — Suitable arrangement for the measurement of the wall thickness of a hose using a dial gauge



a) Diameter marked



b) Specimen cut in half



c) Each half bisected

Figure 3 — Measurement of lining and cover thickness

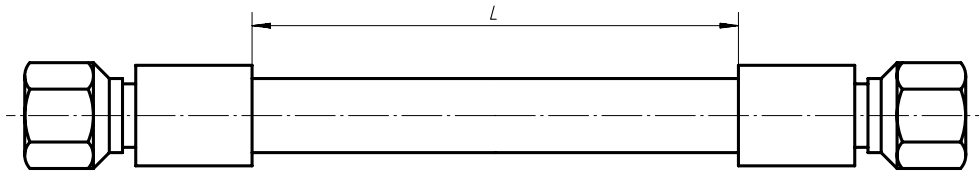


Figure 4 — Length of exposed hose between couplings

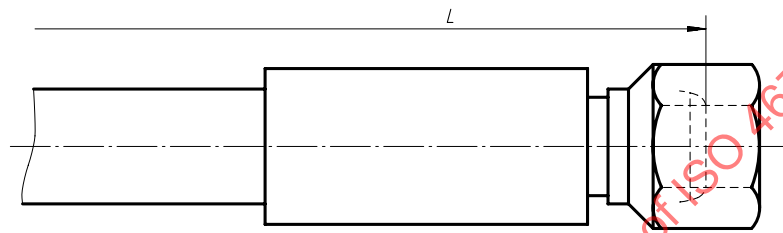


Figure 5 — Length to nipple of the coupling (female)

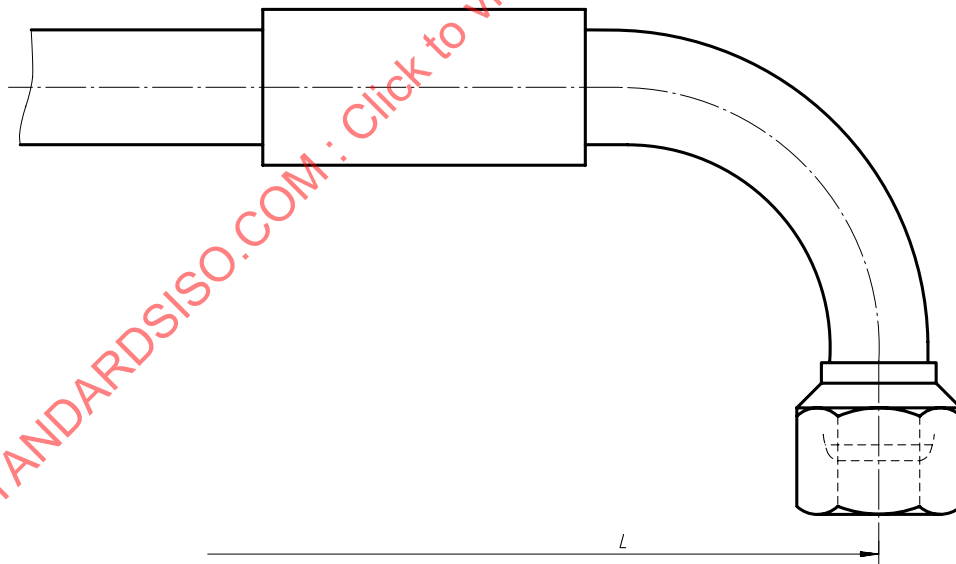


Figure 6 — Length from centreline of nipple (90° angle) of a coupling (female)