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# International Standard



# 4671

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

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

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## Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 4671 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*.

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

## 1 Scope and field of application

This International Standard specifies methods of measuring the inside diameter, outside diameter, wall thickness, concentricity and lining and cover thicknesses of hoses and a method for verifying the through bore of hydraulic hose assemblies.

## 2 General

The method selected should be appropriate to the particular hose being measured.

## 3 References

ISO/R 463, *Dial gauges reading in 0,01 mm, 0,001 in and 0,000 1 in.*

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

ISO 3611, *Micrometer callipers for external measurement.*

ISO 3670, *Blanks for plug gauges and handles (taper lock and trilock) and ring gauges — Design and general dimensions.*

## 4 Inside diameter

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

### 4.1 Method 1

For nominal 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 and ISO 3670) may be used. The gauge shall be inserted into the hose sample gently without pressure. Special care shall be taken if the hose bore is not precisely circular.

### 4.2 Method 2

For nominal inside diameters less than 63 mm, where greater accuracy is required, for example for wire reinforced hydraulic hoses, a suitable expanding ball or telescoping gauge shall be used.

### 4.3 Method 3

For all nominal 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. Two measurements shall be taken at right angles to each other and the average regarded as the inside diameter. Care shall be taken not to distort the hose when making the measurements. Callipers of suitable size may be used for inside diameters above 100 mm when greater accuracy than is obtainable by method 5 is required.

### 4.4 Method 4

For all inside diameters an internal calliper dial gauge (see ISO/R 463) with rounded feet designed for use in bores made of elastomeric material may be used, the calliper size to be suitable for the bore diameter to be measured. Two measurements shall be made at right angles to each other and their average taken as the inside diameter.

### 4.5 Method 5

For nominal inside diameters above 100 mm, a sufficient degree of accuracy for normal purposes is obtainable by the use of a graduated steel rule. Two measurements shall be made at right angles and their average obtained.

### 4.6 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. Two measurements shall be made at right angles to each other and their average obtained.

## 5 Outside diameter

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

### 5.1 Method 1

For nominal outside diameters up to and including 100 mm, sliding vernier callipers, or a micrometer complying with the requirements of ISO 3611, may be used. Two measurements

shall be taken at right angles to each other and the average obtained. Care shall be taken to avoid distorting the hose when making the measurements. When greater accuracy is required the sample shall be placed on a mandrel of outside diameter equal to the hose internal diameter to prevent distortion.

### 5.2 Method 2

For nominal outside diameters over 20 mm, a vernier stepped  $\pi$  tape may be used.

### 5.3 Method 3

For nominal 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.

### 5.4 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. Two measurements shall be made at right angles to each other and their average obtained.

## 6 Diameter over reinforcement

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

Measurements shall be made in accordance with 5.1 or 5.2, after completely removing the cover material.

## 7 Hose wall thickness

Where knowledge of the wall thickness is required, it should normally be 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 procedures.

### 7.1 Method 1

Sliding vernier callipers, care being taken to avoid errors due to curvature.

### 7.2 Method 2

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.

### 7.3 Method 3

A thickness calliper dial gauge with rounded feet designed for use with elastomeric material.

### 7.4 Method 4

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

## 8 Concentricity

The concentricity between the inside diameter and the diameter over the reinforcement and/or between the inside diameter and the hose outside diameter shall be measured using one of the following methods.

### 8.1 Method 1

The hose sample shall be mounted on a mandrel, of outside diameter equal to the hose internal diameter, the ends of which rest in vee blocks. A dial indicator gauge shall be used and the maximum variation between high and low readings shall be obtained. For hoses less than 63 mm nominal bore, the concentricity shall be the difference in total indicator reading for 360°. For hoses 63 mm nominal bore and above, eight readings at 45° intervals around the circumference of the hose shall be taken. All readings shall be taken at a minimum distance of 15 mm from the ends of the hose samples.

### 8.2 Method 2

A micrometer with rounded anvil contacting the inside of the hose, or a dial gauge using an arrangement similar to that shown in figure 2, shall be used. The procedure specified in 7.1 shall be followed.

## 9 Lining and cover thickness

### 9.1 Method 1

9.1.1 A hose sample approximately 50 mm in length shall be taken and a diameter marked on each end, the two diameters being at right angles to one another [figure 3a)].

9.1.2 The sample shall be cut into equal portions and each portion then bisected by cutting longitudinally along the marked diameters [figures 3b) and c)].

9.1.3 The thickness of the lining and the cover shall be measured on each segment at one point on each of the longitudinal cut edges using an optical magnifier with a scale graduated in 0,1 mm divisions.

9.1.4 The average of the eight measurements shall be recorded as the thickness of the lining or cover.

9.1.5 Where the cover is fluted or corrugated, the measurements shall be made at the thinnest point.

### 9.2 Method 2

9.2.1 Determine the thickness of the tube and cover from any type of hose by means of a standard micrometer graduated to 0,02 mm and having a presser foot 3 to 10 mm diameter, exerting a pressure of  $22 \pm 5$  kPa.

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**9.2.2** Take the thickness of the tube 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. The average reading of two samples taken at 90° intervals should be recorded.

**9.2.3** Take the thickness of the tube or cover adjoining a woven reinforcement on a specimen that is buffed just sufficiently to remove the corrugations caused by the woven reinforcement.

### 9.3 Method 3

Where the maximum cover thickness is specified for wire reinforced hoses, cover thickness shall be measured 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 to 25 mm width of cover from the hose. A mandrel shall be placed in the hose bore to ensure that misalignment is minimized. The maximum and minimum readings around the circumference shall be recorded.

## 10 Through bore of hose assemblies

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

The test shall be carried out by determining whether a test ball of specified size passes completely through the assembly.

NOTE — It is recommended that hose specifications should specify the size of ball to be used, choosing a standard ball-bearing size, rather

than quote a percentage of the nominal bore, since the latter usually results in non-standard ball sizes which are not readily obtainable.

## 11 Test report

The test report shall include the following information as appropriate :

- a) a full description of the hose tested;
- b) the date of test;
- c) a reference to this International Standard;
- 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 ball size used for the through bore test and whether the ball passed freely and completely through the assembly.

Dimensions in millimetres

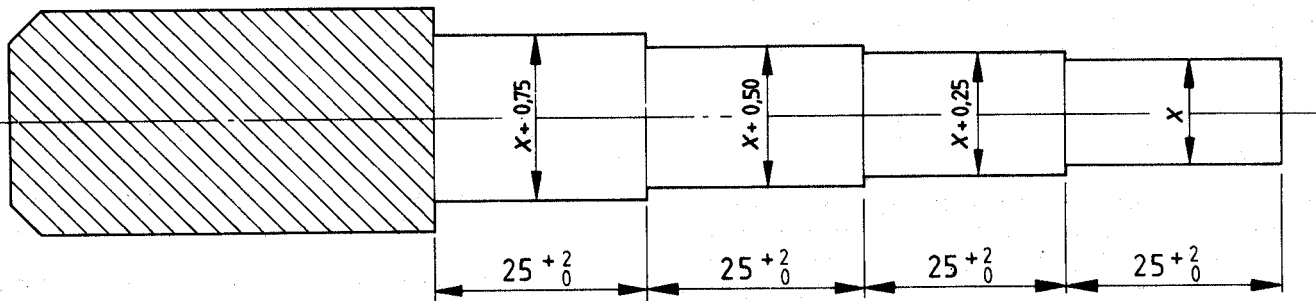


Figure 1 — Plug gauges

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Dimensions in millimetres

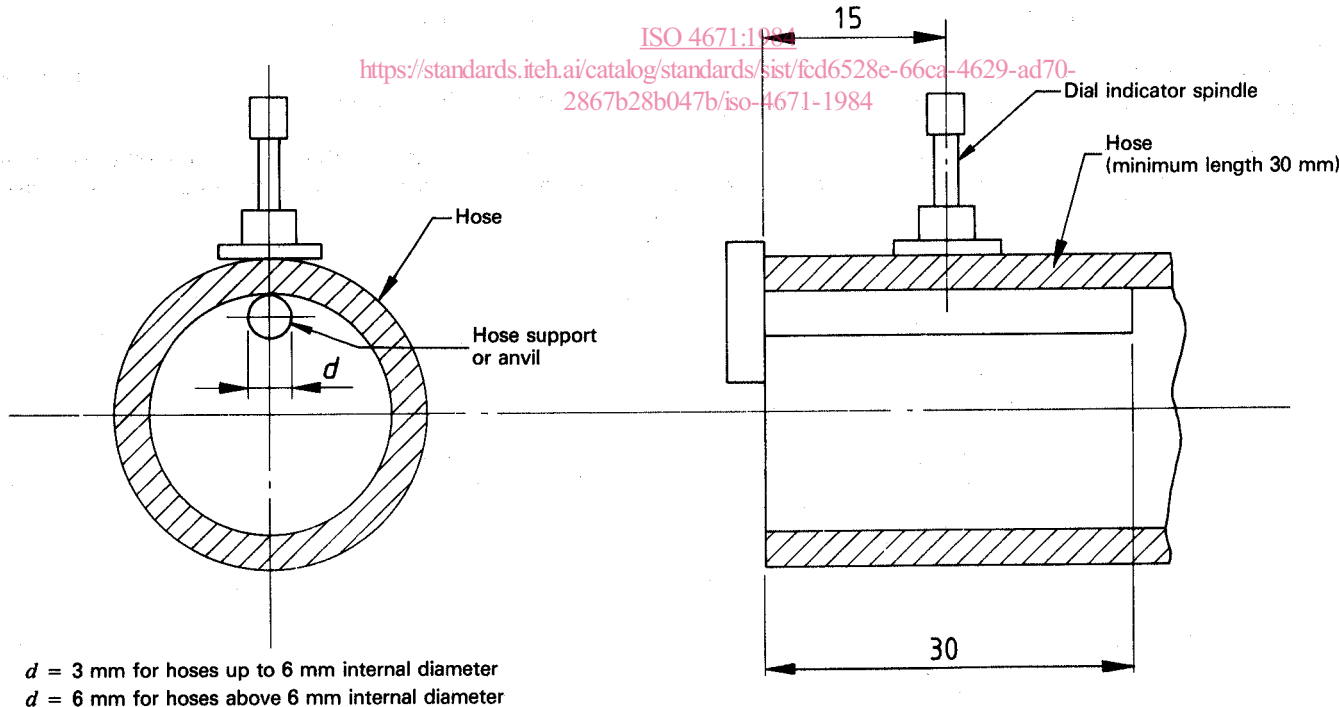
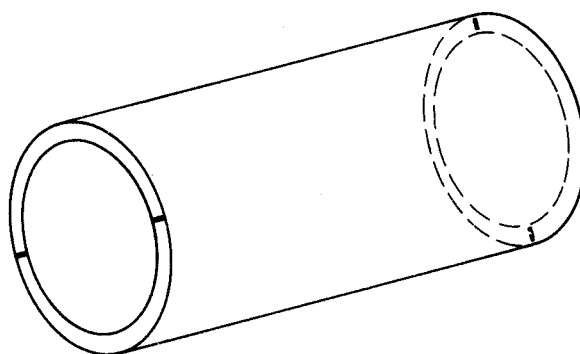
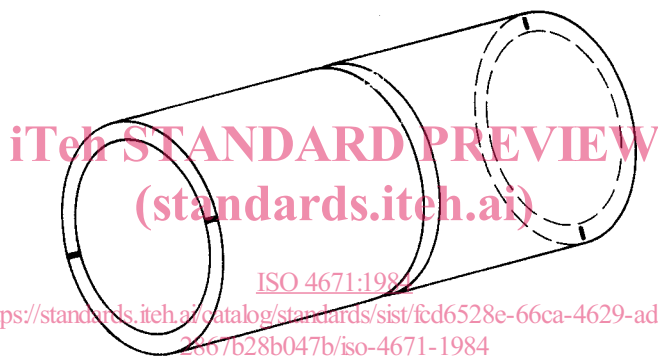


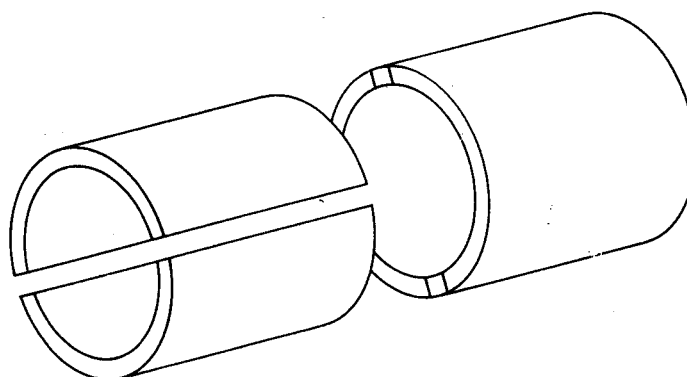
Figure 2 — Suitable arrangement for the measurement of hose wall thickness using a dial gauge



a) Diameter marked



b) Sample cut in half



c) Each half bisected

Figure 3 — Measurement of lining and cover thicknesses

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