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**Thermal insulating products for  
building equipment and industrial  
installations — Determination of  
dimensions, squareness and linearity  
of preformed pipe insulation**

*Produits isolants thermiques pour les équipements de bâtiments et  
les installations industrielles — Détermination des dimensions, de  
l'équerrage et de la linéarité des coquilles isolantes préformées*

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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 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 1, *Test and measurement methods*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 88, *Thermal insulating materials and products*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 12628:2011), which has been technically revised.

The main changes are as follows:

- EN 13467:2018 and ISO 12628:2011 have been merged into one document;
- [Clause 2](#), Normative references, has been added and the numbering of the following clauses has been changed accordingly;
- the terms [3.6](#), thickness uniformity, and [3.9](#), circular segment cord, have been added;
- new [Figure 2](#) has been added and the numbering of the following figures has been changed accordingly;
- [subclause 5.5](#) has been added and the numbering of the following clauses has been changed accordingly;
- technical revision, mainly of [Clause 6](#), Test specimens, [Clause 7](#), Procedure, and [Clause 8](#), Calculation and expression of results;
- editorial revisions.

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).

# Thermal insulating products for building equipment and industrial installations — Determination of dimensions, squareness and linearity of preformed pipe insulation

## 1 Scope

This document specifies the equipment and procedures for determining the dimensions, squareness and linearity of preformed pipe insulation, supplied in one piece, half sections or segments. It is applicable to thermal insulating products.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/>

### 3.1 circumference

$C$

circular length of the outer surface of the pipe insulation

Note 1 to entry: See [Figure 1](#).

### 3.2 outside diameter

$D_o$

linear distance between two opposite points on the outside surface of the pipe insulation measured across the centre

Note 1 to entry: See [Figure 1](#).

### 3.3 inside diameter

$D_i$

linear distance between two opposite points on the inside surface of the pipe insulation measured across the centre

Note 1 to entry: See [Figure 1](#).

### 3.4 length

$l$

linear dimension measured perpendicularly to the *circumference* ([3.1](#)) of the pipe insulation

Note 1 to entry: See [Figure 1](#).

**3.5  
thickness**

*d*

thickness of the insulation product measured perpendicularly between the outside and the inside surface of the pipe insulation

Note 1 to entry: See [Figure 1](#).

**3.6  
thickness uniformity**

$\Delta d$

variation measured on thickness, *d* ([3.5](#)), expressed as the difference between the two extremes of the measurements of thickness *d*

**3.7  
deviation from squareness**

*v*

maximum distance between a product, at its end, from a line which just touches the product and which is perpendicular to its major axis

Note 1 to entry: See [Figure 5](#).

**3.8  
deviation from linearity**

*L*

maximum distance between a plane reference surface on which the test specimen rests and the outside surface of the pipe insulation

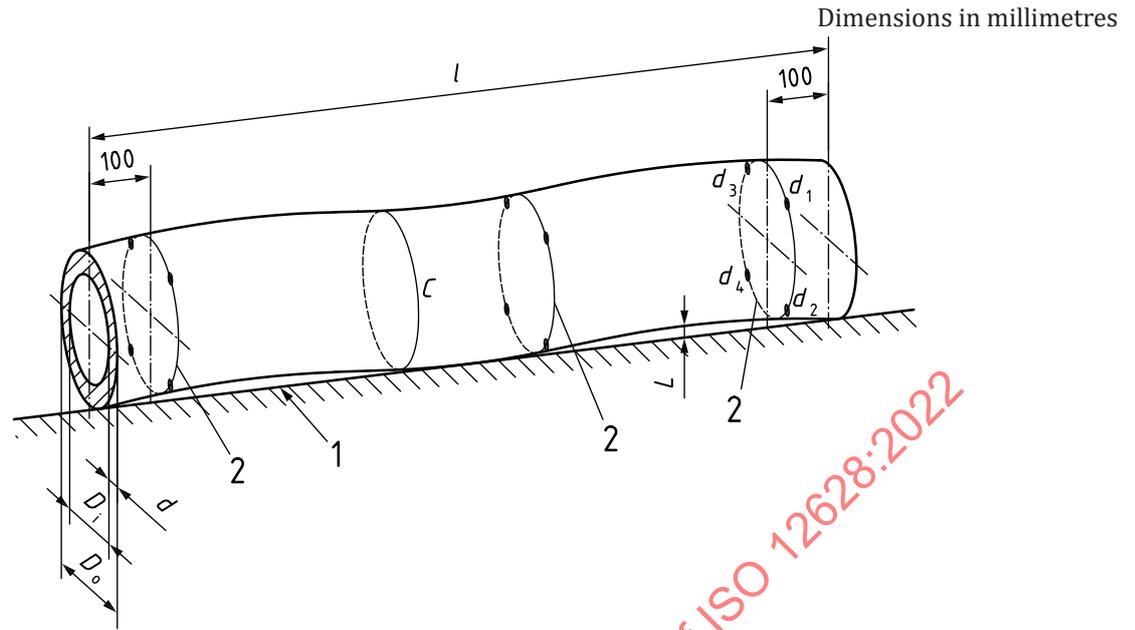
Note 1 to entry: See [Figure 1](#).

**3.9  
circular segment chord**

*ch*

length ([3.4](#)) of the straight line joining the two end points of the curved surface of an insulation segment

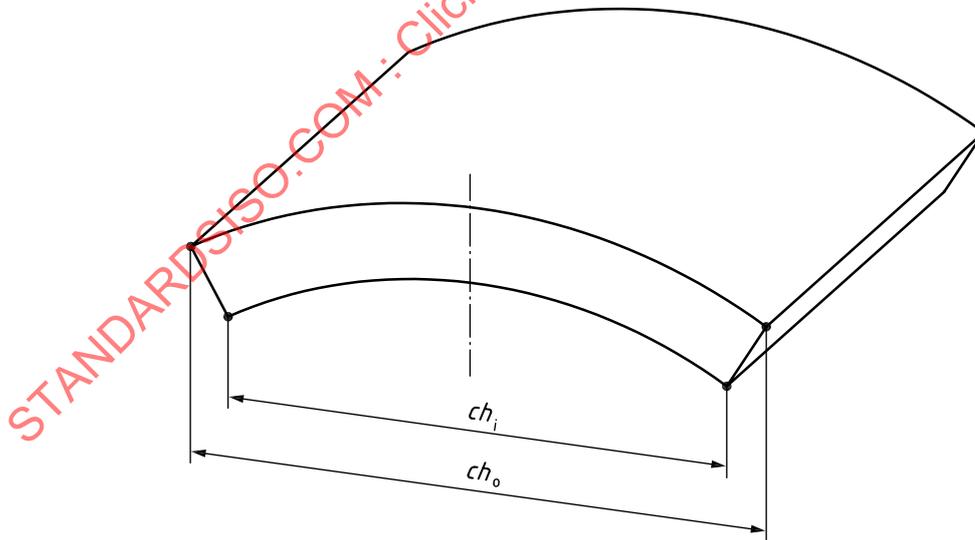
Note 1 to entry: For an insulation product, two chords are defined; inner chord,  $ch_i$ , for the inner surface and outer chord,  $ch_o$ , for the outer surface (see [Figure 2](#)).



**Key**

- |                      |  |       |                          |
|----------------------|--|-------|--------------------------|
| 1                    | flat surface                                     | $L$   | deviation from linearity |
| 2                    | locations for measurements (see 7.2.2.4)         | $D_i$ | inside diameter          |
| $C$                  | circumference                                    | $l$   | length                   |
| $D_o$                | outside diameter                                 | $d$   | thickness                |
| $d_1, d_2, d_3, d_4$ | thickness readings at right angles to each other |       |                          |

**Figure 1 — Illustration of the definitions**



**Key**

- |        |             |
|--------|-------------|
| $ch_i$ | inner chord |
| $ch_o$ | outer chord |

**Figure 2 — Illustration of the chords of a circular segment**

## 4 Principle

Determination of the dimensions, squareness and linearity of a pipe insulation along or at a right angle to its major axis.

## 5 Apparatus

### 5.1 For circumference, outside and inside diameter and thickness

**5.1.1 Metal tape**, graduated in millimetres for measuring the circumference and diameter.

Accuracy of reading:

diameter at least 1 mm;

circumference at least 3 mm.

**5.1.2 Metal pipe**, for supporting the insulation with an outside diameter, which ensures no deformation of the product.

**5.1.3 Rack**, for supporting the metal pipe (see [Figure 3](#)).

**5.1.4 Thickness gauge**, capable of applying a load of minimum  $(0,5 \pm 0,05)$  N to a load distributing plate, diameter 50 mm. The load shall be such that no deformation of the product occurs during measurement.

Accuracy of reading at least 0,5 mm.

**5.1.5 Conical mandrel**, graduated in 0,5 mm intervals (see [Figure 4](#)).

Accuracy of reading at least 0,5 mm.

**5.1.6 Caliper**

Accuracy of reading at least 0,1 mm.

### 5.2 For length

**5.2.1 Metal tape**, graduated in millimetres.

Accuracy of reading at least 1 mm.

### 5.3 For deviation from squareness

**5.3.1 Metal square** with limbs at least 500 mm long with a deviation from squareness of not more than  $\pm 0,1$  mm when measured at 500 mm from the corners (see [Figure 5](#)).

**5.3.2 Metal tape**, graduated in millimetres.

Accuracy of reading at least 1 mm.

### 5.4 For deviation from linearity

**5.4.1 Flat surface**, on which the test specimen rests.

### 5.4.2 Metal tape, graduated in millimetres.

Accuracy of reading at least 1 mm.

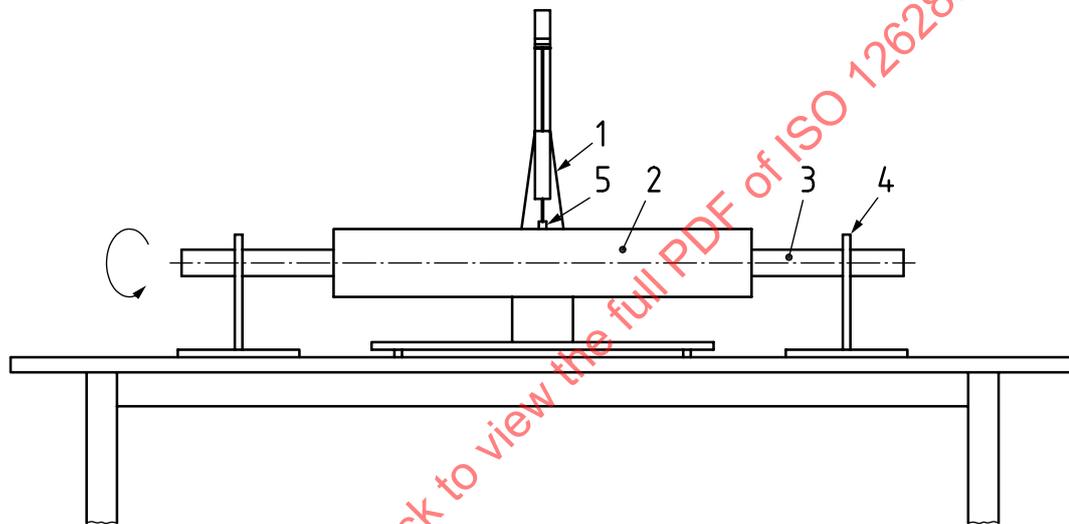
### 5.4.3 Thickness gauge, (wedge shape), graduated in 0,5 mm (see [Figure 6](#)).

Accuracy of reading at least 0,5 mm.

## 5.5 For circular segment chord

### 5.5.1 Metal tape, graduated in millimetres. The accuracy of reading shall be at least 1 mm.

NOTE For all measured dimensions, test equipment, which provides the same result with at least the same accuracy, can be used.



#### Key

- |                   |                           |
|-------------------|---------------------------|
| 1 thickness gauge | 4 rack                    |
| 2 test specimen   | 5 load distribution plate |
| 3 metal pipe      |                           |

Figure 3 — Example of equipment for thickness measurement with thickness gauge

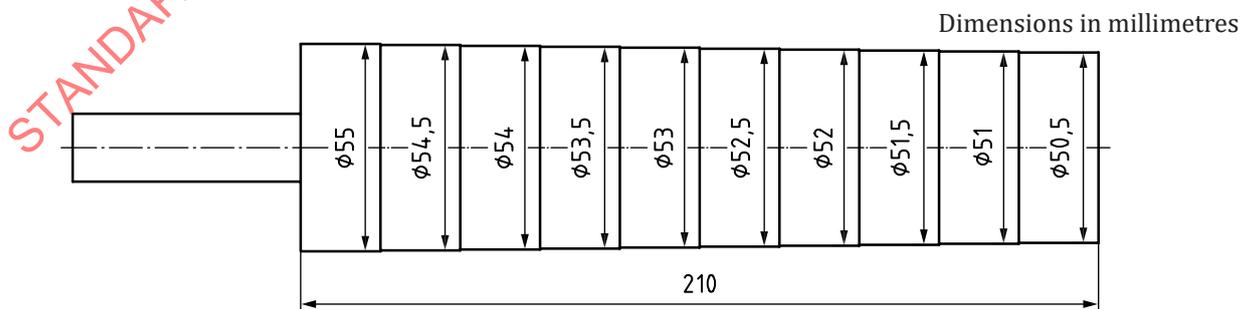
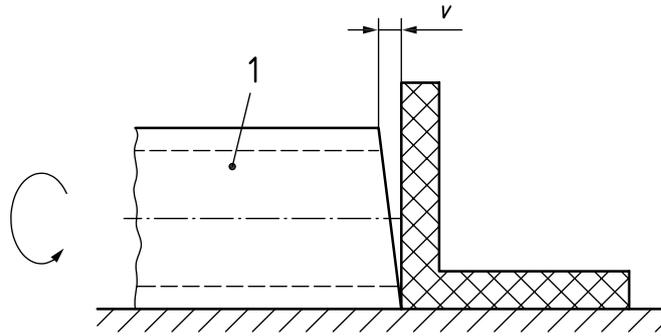


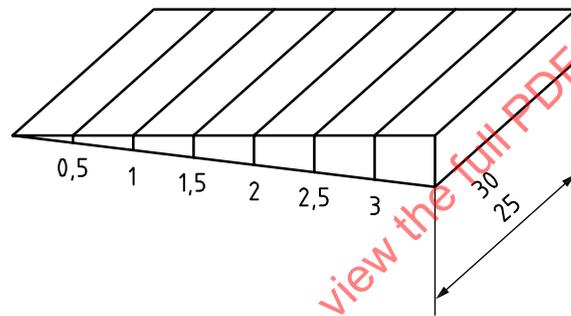
Figure 4 — Example of conical mandrel



**Key**

- 1 test specimen
- v deviation from squareness

**Figure 5 — Principle of measurement of deviation from squareness**



Dimensions in millimetres

**Figure 6 — Thickness gauge (wedge shape)**

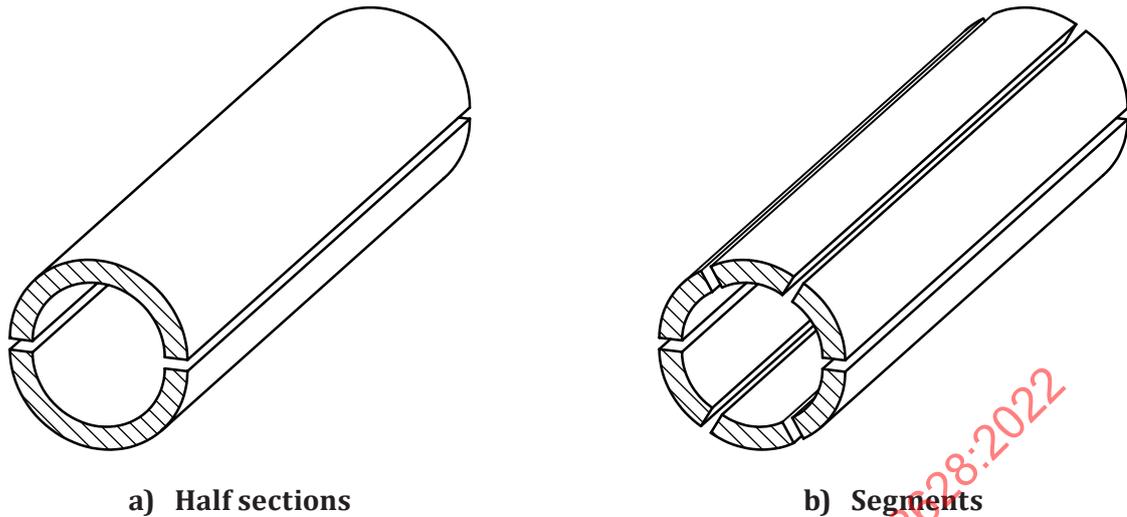
## 6 Test specimens

### 6.1 Dimensions of test specimens

The test specimens shall be, wherever possible, the full-size pipe insulation product. The dimensions of the test specimens shall be measured including any surface skins, facings, and/or coatings on both the inner and the outer surfaces.

**NOTE** For the measurement of circumference/outside diameter, inside diameter, and thickness, the test specimen can be divided transversely or longitudinally into several pieces with a minimum dimension of 100 mm.

Pipe insulation pieces (half sections or segments, see [Figure 7](#)), which together form a complete pipe insulation layer, without visual deformation, shall be held in place by adhesive tape to facilitate measurement. The determination of the diameter of a circular segment can be done by measurement of the inner chord without joining the segments.



**Figure 7 — Examples of pipe insulation pieces**

## 6.2 Number of test specimens

The number of test specimens shall be as specified in the relevant product standard. If the number is not specified, then at least three test specimens shall be used.

NOTE In the absence of a product standard or any other technical specification, the number of test specimens can be agreed between parties.

## 6.3 Conditioning of test specimens

The test specimens shall be stored for at least 6 h at  $(23 \pm 5)$  °C. In case of dispute, they shall be stored at  $(23 \pm 2)$  °C and  $(50 \pm 5)$  % relative humidity (RH) for the time stated in the relevant product standard.

In tropical climates, different conditioning and testing conditions can be relevant. In this case, the conditions shall be  $(27 \pm 5)$  °C and  $(65 \pm 5)$  % RH and shall be stated clearly in the test report.

## 7 Procedure

### 7.1 Test conditions

The test shall be carried out at  $(23 \pm 5)$  °C. In case of dispute, it shall be carried out at  $(23 \pm 2)$  °C and  $(50 \pm 5)$  % RH.

In tropical climates, different conditioning and testing conditions can be relevant. In this case, the conditions shall be  $(27 \pm 2)$  °C and  $(65 \pm 5)$  % RH.

### 7.2 Test procedure

#### 7.2.1 General

Determine the thickness,  $d$ , of the test specimen and its inside and outside diameter,  $D_i$  and  $D_o$ , from one of the following pairs of measurements:

- a) outside circumference and inside diameter;
- b) inside diameter and outside diameter;
- c) inside diameter and thickness;

- d) outside diameter and thickness;
- e) outside circumference and thickness;
- f) inner chord and thickness (for segments).

Each set of measurements shall be performed at the same place on the pipe insulation.

NOTE 1 The listed options are not equivalent. Only when thickness itself is measured can an estimate of concentricity be obtained.

For pipe insulation with large inside diameter and small thickness, attention should be paid to the required accuracy. Method c) or d) or e) should be used.

Determine the length,  $l$ , deviation from squareness,  $v$ , and deviation from linearity,  $L$ , in accordance with [7.2.3](#), [7.2.4](#) and [7.2.5](#).

NOTE 2 Determination of deviation from squareness and deviation from linearity are not relevant for all materials and/or applications.

## 7.2.2 Circumference — Outside diameter, inside diameter, wall thickness, inner chord

### 7.2.2.1 General

The appropriate apparatus, described in [Clause 5](#), shall be used for the measurements below.

During the measurement, any longitudinal joints shall be kept close together.

The pipe insulation shall not be visibly deformed due to the measuring process.

Measure pipe insulation, with a length smaller than or equal to 600 mm, at two locations, either at the ends or 100 mm from each end.

Measure pipe insulation, with a length larger than 600 mm, as above with one extra measurement for each additional 400 mm in length evenly distributed along the length, with a maximum of five measurements.

NOTE The pipe insulation can be cut into smaller pieces at appropriate locations to facilitate measurement.

The reading accuracy of the measurements shall correspond to the accuracy of the apparatus.

### 7.2.2.2 Circumference — Outside diameter

Measure the circumference,  $C$ , of the test specimen using a metal tape.

Measure the outside diameter,  $D_o$ , using either a metal tape or a caliper. Each measurement shall consist of two readings at right angles to the longitudinal axis of the test specimen at the selected locations. The readings of the outside diameter shall also be made at right angles to each other.

### 7.2.2.3 Inside diameter

Measure the inside diameter,  $D_i$ , using either a metal tape or a caliper. Each measurement shall consist of two readings at right angles to the longitudinal axis of the test specimen at the selected locations. The readings of the inside diameter shall also be made at right angles to each other.

Alternatively, the inside diameter may be measured with a conical mandrel moved into position along the major axis of the pipe insulation.

NOTE For inside diameter greater than 55 mm, the use of a conical mandrel can be impractical.

For circular segments, measure the inner chord,  $ch_i$ , and use this dimension for calculation of the inner diameter according to the formula in [Table 1](#).