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**Thermoplastics fittings — Determination  
of ring stiffness**

*Raccords en matières thermoplastiques — Détermination de la rigidité  
annulaire*

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ISO 13967:2009

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Published in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 13967 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 5, *General properties of pipes, fittings and valves of plastic materials and their accessories — Test methods and basic specifications*.

This second edition cancels and replaces the first edition (ISO 13967:1998), which has been technically revised.

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# Thermoplastics fittings — Determination of ring stiffness

## 1 Scope

This International Standard specifies a method of determining the ring stiffness of bends and branches made from thermoplastic material and for use with plastics pipes having a circular cross-section.

The method can be used to determine the stiffness of bends, equal branches and unequal branches, provided the fitting allows a diametric deflection of at least 4 %.

NOTE 1 If a fitting has the same wall thickness, wall construction, material and diameter as a pipe tested according to ISO 9969, then, because of its geometry, its stiffness can be equal to or greater than that of the pipe. In this case, the fitting can be classified as having the same stiffness class as the pipe, without testing.

NOTE 2 Any unequal branch can be expected to have at least the same stiffness as an equal branch, provided that it has the same main diameter, wall construction and material as the equal branch.

NOTE 3 A reducer having the same wall thickness, wall construction and material in the transition zone as a tested bend or branch can be expected to have at least the same stiffness as the tested bend or branch with the largest diameter of that reducer.

NOTE 4 The result of the test reflects the resistance the fitting has against deflection when installed. Advice on the significance of the test result is given in Annex A. [ISO 13967:2009](https://standards.iteh.ai/catalog/standards/sist/b0f7bf39-e500-4fb0-a58f-3ae0fd19c33c/iso-13967-2009)

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## 2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

### 2.1

#### ring stiffness

$S$

mechanical characteristic of a fitting, which is a measure of the resistance to diametric deflection under an external force applied between two parallel planes, as determined in accordance with this International Standard

NOTE 1 This method uses a deflection of 3 % as the reference at which to determine this characteristic.

NOTE 2 Throughout this International Standard, the term “ring stiffness” is used. In ISO 9969 that describes a method of determining the stiffness of a plastics pipe; the word “ring” is appropriate and is used to differentiate the circumferential stiffness or ring stiffness from the axial stiffness or longitudinal stiffness. The pipe test pieces have the shape of rings. Although fittings do not have the shape of rings, to emphasize the relationship between this International Standard and ISO 9969 and to stress that in both cases the stiffness is related to the resistance of the product to diametric deflection, the word “ring” has been retained in this International Standard for the determination of the stiffness of fittings.

### 2.2

#### compressive force

compressive load

$F$

force applied to cause the diametric deflection during testing in accordance with this International Standard

**2.3  
diametric deflection**

$y$   
change in diameter caused by a compressive force

**2.4  
percent deflection**

diametric deflection,  $y$ , expressed as a percentage of the inside diameter,  $D_i$ , of the fitting

NOTE Percent deflection is expressed as Equation (1):

$$\frac{y}{D_i} \times 100 \tag{1}$$

**2.5  
fitting wall height**

$e_c$   
overall thickness of the wall of a fitting, measured across the entire cross-section of the wall

NOTE For examples of fitting wall heights, see Figure 1.

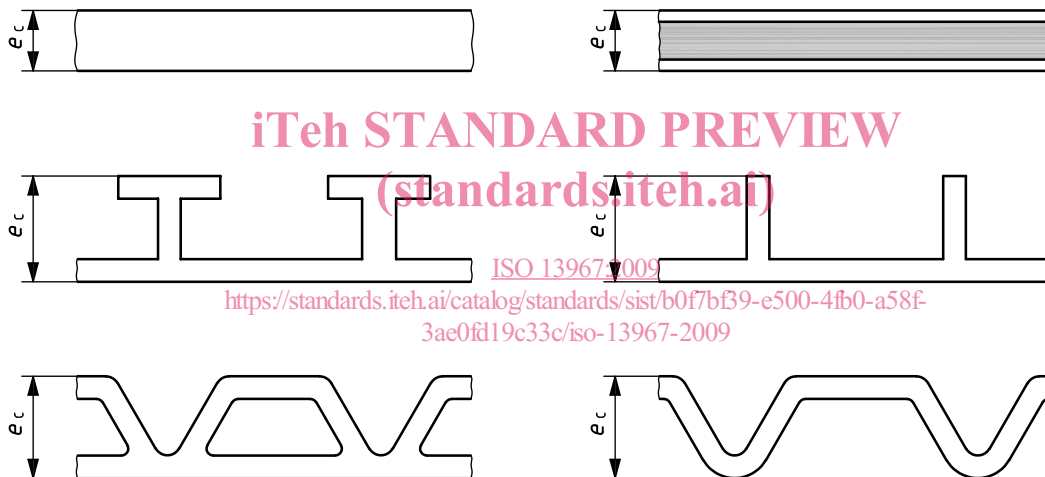


Figure 1 — Typical fitting wall heights,  $e_c$

**2.6  
calculation length**

$L$   
external free length of a fitting, excluding sockets, spigots, inlet zones and half of the transition zones between body and sockets, measured along a line parallel to the fitting axis

NOTE 1 The calculation length,  $L$ , depends on the geometry of the fitting, as specified in Clause 6. See Figures 3, 4 and 5.

NOTE 2 The length of loading is normally slightly shorter than the calculation length. This difference has no significant influence on the result of the test.

### 3 Symbols

Symbol	Description	Unit
$D_i$	Inside diameter of fitting	mm
$D_n$	Nominal diameter of fitting	mm
$e_c$	Height of fitting wall	mm
$F$	Force	N
$L$	Calculation length	mm
$S$	Calculated ring stiffness	kN/m <sup>2</sup>
$S_a$	Ring stiffness of test piece "a"	N/m <sup>2</sup>
$S_b$	Ring stiffness of test piece "b"	N/m <sup>2</sup>
$S_c$	Ring stiffness of test piece "c"	N/m <sup>2</sup>
$y$	diametric deflection	mm

### 4 Principle

Test pieces shall be compressed across their diameter at a constant rate of deflection between two parallel plates. Force versus deflection data shall be generated.

The force shall be applied as a load distributed along the body of the fitting without loading the spigot(s) and/or socket(s).

The ring stiffness shall be calculated as a function of the force necessary to produce a 3 % diametric deflection of the fitting.

NOTE As fittings are normally installed with socket and spigot connections, creating zones of high stiffness, the load is only applied to the body of the fitting and the equation used to calculate the stiffness uses the length of the body and not the overall length of the fitting.

### 5 Apparatus

**5.1 Compression testing machine**, capable of a constant rate of crosshead movement appropriate to the nominal diameter of the fitting in accordance with Table 1, with sufficient force and travel to produce the specified diametric deflection via a pair of bearing plates.

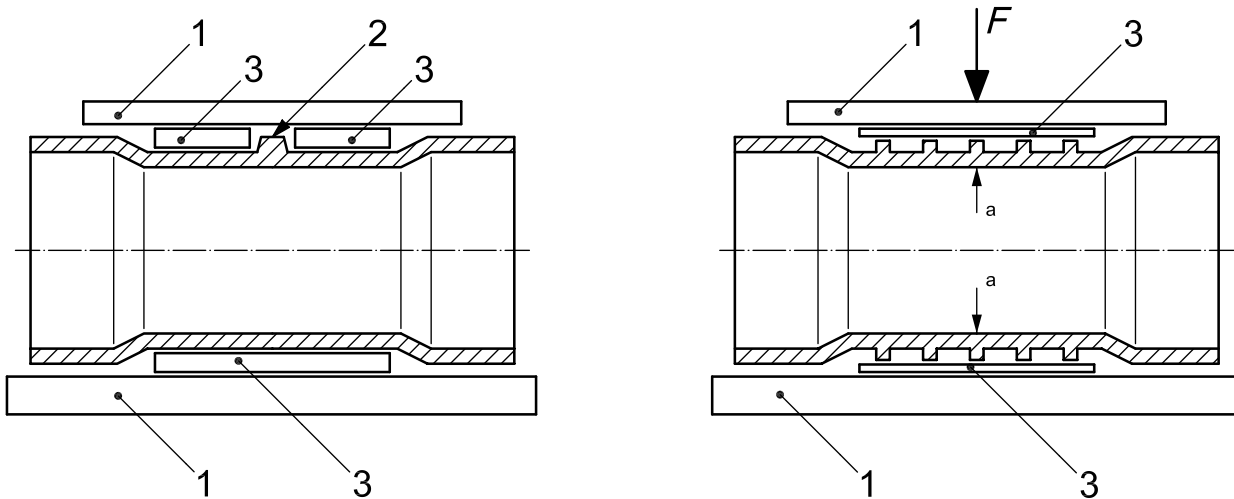
**5.2 Bearing plates**, capable of transferring the force and movement of the test machine (5.1) to the test piece and comprising a pair of bearing plates alone or in combination with insert plates as described in 5.2 b). If the fitting has a ribbed or structured wall construction, the plates shall make initial contact only with the top(s) of the ribs or structures (see Figure 2).

#### a) Bearing plates

The plates shall be flat and clean. The stiffness of the plates shall be sufficient to prevent them from deforming during the test. The geometry of the plates shall be such that the force is equally distributed over the loaded area of the test piece when the test piece is compressed over the length of loading (see Figures 3, 4 and 5), e.g. by means of insert plates. The width of the bearing plates shall be at least 50 mm. When equal branches are tested without the use of insert plates, the width of the bearing plates shall be  $(50 \pm 1)$  mm.

**b) Insert plates**

When insert plates are needed in order to distribute the force equally over the loaded area of the test piece (see Figures 3, 4 and 5), they shall be flat and clean. The stiffness of the plates shall be sufficient to prevent them from deforming during the test. The geometry of the plates shall be appropriate to the type of fitting and shall be such that the force is applied evenly to the fitting without loading the socket(s) and/or spigot(s). The width of the plates shall be at least 50 mm. When equal branches are tested, the width shall be  $(50 \pm 1)$  mm.



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**Key**

- 1 bearing plate
- 2 injection-moulding point
- 3 insert plate
- a Deflection measurement point.

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**Figure 2 — Typical positioning of bearing plates and insert plates for various constructions**

**5.3 Dimension-measuring instruments**, capable of determining the following dimensions:

- the individual values of the lengths defined in 6.3, to within 1 mm;
- the inside diameter of the test piece, to within 0,5 %;
- the change in inside diameter in the direction of loading, to an accuracy of within 0,1 mm or 1 % of the deflection, whichever is the greater.

**5.4 Force-measuring instrument**, capable of determining, to within 2 %, the force necessary to cause diametric deflection of the test piece up to 4 %.

**6 Test pieces**

**6.1 Preparation**

Each test piece shall comprise a complete fitting with its attachments, such as retaining caps or rings. To improve the linearity of the test curve, small protrusions on the fitting which would come into contact with the deflection plates may be removed. Alternatively, insert plates adapted to the geometry of the fitting may be used (see Figure 2).



## 6.2 Number

The test shall be carried out on three test pieces. They shall be marked “a”, “b” and “c”.

## 6.3 Determination of dimensions

### 6.3.1 Inside diameter

The vertical inside diameter of each test piece shall be determined at the deflection measurement point (which is at the mid-point of the overall length of the body) (see Figures 3, 4 and 5) to an accuracy of within 0,2 % or 0,1 mm, whichever is the greater.

### 6.3.2 Calculation length of bends

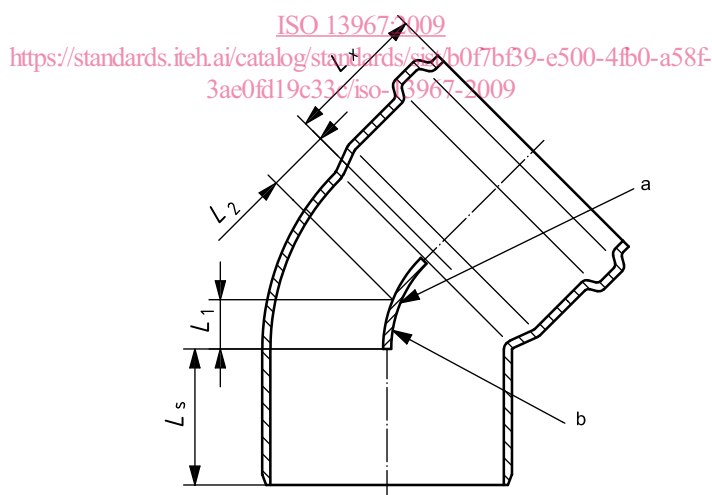
#### 6.3.2.1 General

The method of determining the calculation length,  $L$ , of a bend depends on its bending radius at the centre line.

#### 6.3.2.2 Bends with a radius $\leq 1,5$ times nominal size of the bend

The calculation length,  $L$ , of a bend with a radius  $\leq 1,5$  times the nominal size shall be determined as the length  $L_1 + L_2$  as shown in Figure 3 in which  $L_s$  is the spigot length as defined by the manufacturer. If  $L_s$  is not provided by the manufacturer, it shall be taken as the length  $L_x$ .

The values of  $L_1$ ,  $L_2$  and  $L_s$  shall be taken from the product drawing provided by the manufacturer or shall be measured from the product. When measured from the product, the values of  $L_1$  and  $L_2$  shall be determined to an accuracy of within 1 % or 1 mm, whichever is the greater.



$$L = L_1 + L_2$$

a Deflection measurement point.

b Length of loading.

**Figure 3 — Calculation length,  $L$ , of a bend with a radius  $\leq 1,5$  times nominal size**

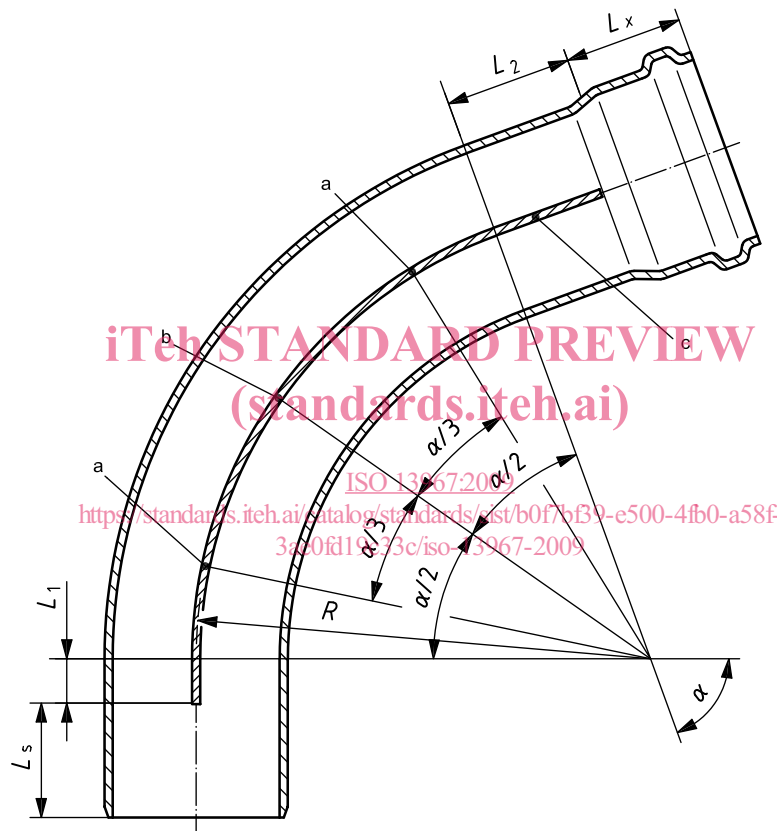
6.3.2.3 Bends with a radius > 1,5 times nominal size of the bend

The calculation length,  $L$ , of a bend with a radius > 1,5 times nominal size shall be determined in the same way as for bends with a radius  $\leq$  1,5 times nominal size, except that the following shall be observed:

- the length of the arc shall be calculated using the dimensions shown in Figure 4 and Equation (2):

$$L = \frac{2\pi R\alpha}{360} + L_1 + L_2 \tag{2}$$

- if, in a bend with a radius > 1,5 times nominal size, it is impracticable to measure the change in inside diameter at the mid-point of the body, the average value of the change in inside diameter at two other points each at  $\alpha/3$  from the mid-point may be taken (see Figure 4).



Key

- $\alpha$  angle of fitting, in degrees
- a Alternative deflection measurement point.
- b Normal deflection measurement point.
- c Length of loading.

Figure 4 — Calculation length,  $L$ , of a bend with a radius > 1,5 times nominal size

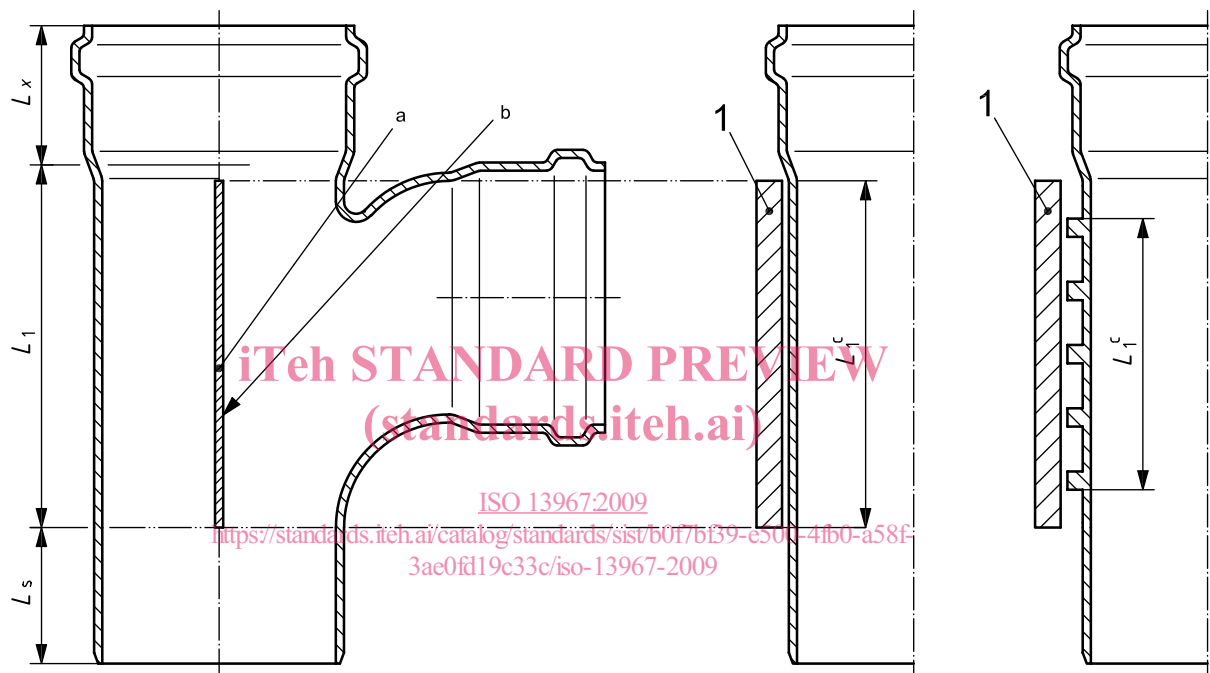
### 6.3.3 Calculation length of branches

The calculation length,  $L_1$ , of a branch ( $L = L_1$ ) shall be determined as shown in Figure 5, in which  $L_s$  is the spigot length as defined by the manufacturer.

The values of  $L_1$  and  $L_s$  shall be taken from the product drawing provided by the manufacturer or shall be measured from the product.

When measured from the product, the values of  $L_1$  and  $L_s$  shall be measured to an accuracy of within 1 % or 1 mm, whichever is the greater.

If  $L_s$  cannot be determined, it shall be taken as the length  $L_x$ .



$$L = L_1$$

#### Key

- 1 insert plate
- a Deflection measurement point.
- b Length of loading.
- c Examples of length of loading  $L_1$ .

Figure 5 — Calculation length,  $L$ , of a branch

### 6.4 Age

At the start of testing in accordance with Clause 9, the age of the test pieces shall be at least 24 h.

For type testing, and in cases of dispute, the age of the test pieces shall be  $(21 \pm 2)$  days.