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Thermoplastics fittings — Determination of ring stiffness

Raccords en matières thermoplastiques — Détermination de la rigidité annulaire

ISO 13967:1998(E)

Contents

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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.

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 13967 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids.*

Annex A of this International Standard is for information only.

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 that the fitting allows a ring deflection of at least 4 %.

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

Any unequal branch may 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 — 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.

2 Definitions

For the purposes of this International Standard, the following definitions apply.

2.1
ring stiffness
S
a mechanical characteristic of a fitting which is a measure of the resistance to ring deflection under an external force, 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 Although technically incorrect, throughout this standard the term "ring stiffness" has been used. In the ISO standard 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 the two standards and to stress that in both cases the stiffness is related to the resistance of the product to diametrical deflection, the word "ring" has been retained in this standard for the determination of the stiffness of fittings.

2.2
compressive force
F
the force which causes the vertical deflection during testing in accordance with this International Standard

NOTE — Although technically incorrect, in some clauses the word "load" has been used instead of "force" as it was felt that this reduced the possibility of misunderstanding.

2.3
vertical deflection
y
the change in vertical diameter caused by a compressive force

2.4
percent deflection
the vertical deflection *y* expressed as a percentage of the inside diameter d_i of the fitting, i.e.

$$\frac{y}{d_i} \times 100$$

2.5
fitting wall height
e_c
the 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.

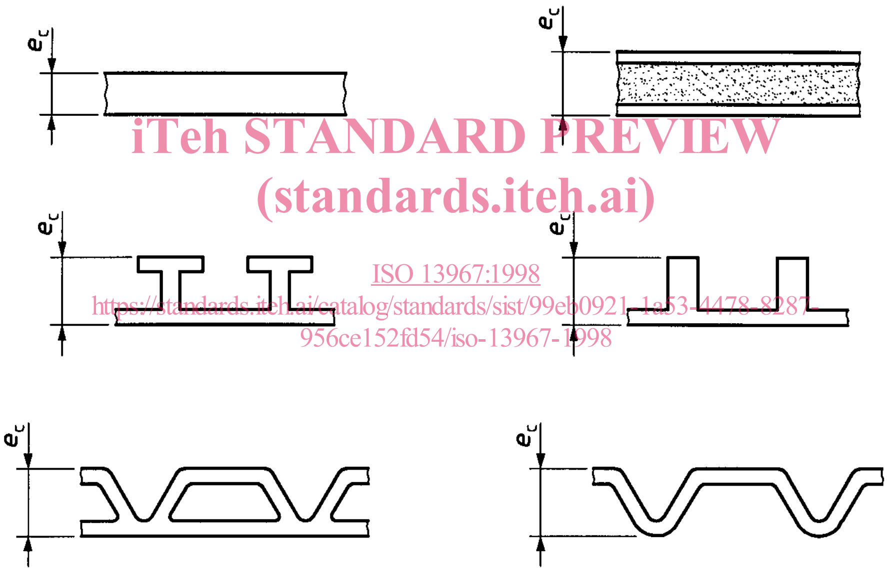


Figure 1 — Typical fitting wall heights e_c

2.6
calculation length
L
the 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 See clause 6 and 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^2
S_a	Ring stiffness of test piece "a"	N/m^2
S_b	Ring stiffness of test piece "b"	N/m^2
S_c	Ring stiffness of test piece "c"	N/m^2
y	Vertical deflection	mm

NOTE — The calculation length depends on the geometry of the fitting, as specified in clause 6.

4 Principle

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

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

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

NOTE — As fittings will normally be 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.

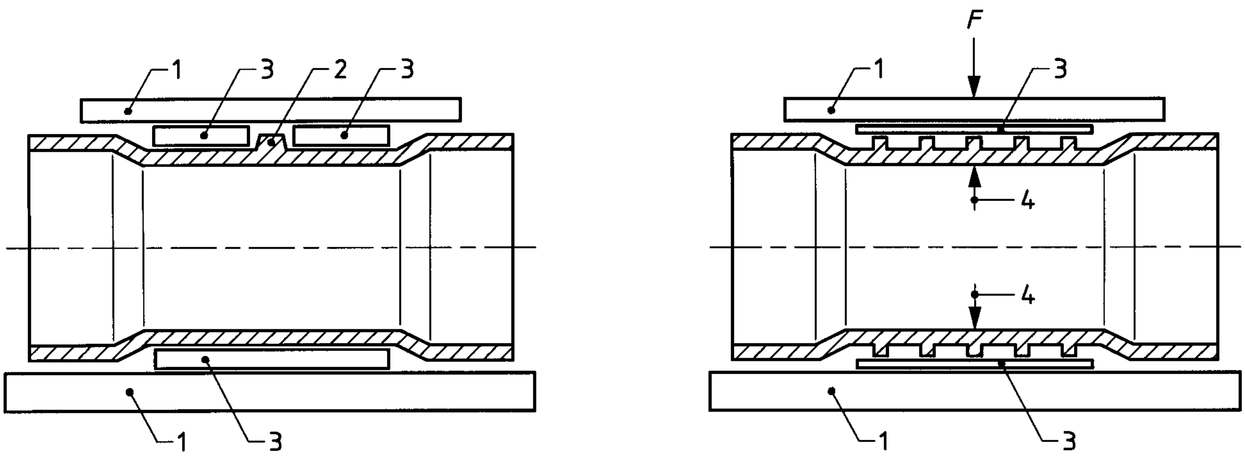
5.2 Bearing plates, capable of transferring the force and movement of the test machine (5.1) to the test piece and comprising a pair of bearing plates alone or in combination with insert plates as described below. If the fitting has a ribbed or structured wall construction, the plates shall make initial 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 ± 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 ± 1) mm.



Key

1 Bearing plate
2 Injection-moulding point
3 Insert plate
4 Deflection measurement point

Figure 2 — Typical bearing plates and insert plates

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 over a range from 1 % 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

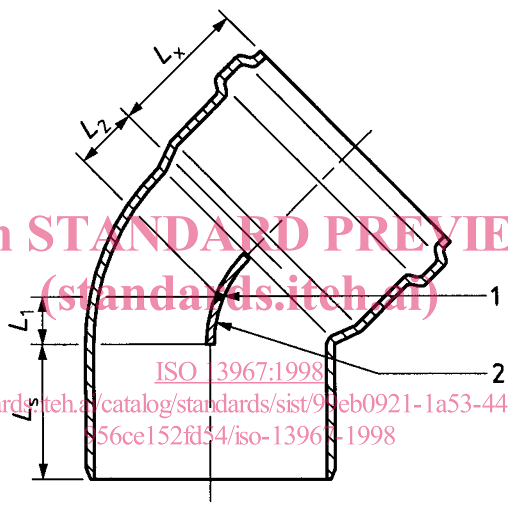
6.3.1 Inside diameter

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 0,5 % or 0,1 mm, whichever is the greater.

6.3.2 Calculation length of normal bends

The calculation length L of a normal bend 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.



Key

1 Deflection measurement point
2 Length of loading

$L = L_1 + L_2$

Figure 3 — Calculation length *L* of a normal bend

The calculation length L of a long-radius bend shall be determined in the same way as for normal bends, except that the following shall be observed:

— if the radius R of the bend is greater than 1,5 times the nominal diameter of the fitting, the length of the arch shall be calculated using the dimensions shown in figure 4 and the following equation:

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

— if in a long-radius bend it is impractical 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).