
Thermoplastics piping systems for non-pressure underground drainage and sewerage — Thermoplastics shafts or risers for inspection chambers and manholes — Determination of ring stiffness

Systèmes de canalisations thermoplastiques pour branchements et collecteurs d'assainissement enterrés sans pression — Éléments de réhausse thermoplastiques pour chambres d'inspection et de branchement ou regards — Détermination de la rigidité annulaire



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Thermoplastics piping systems for non-pressure underground drainage and sewerage — Thermoplastics shafts or risers for inspection chambers and manholes — Determination of ring stiffness

1 Scope

This International Standard specifies a test method for assessing the initial (short-term) tangential ring stiffness of riser shafts for thermoplastics inspection chambers or manholes.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 9969, *Thermoplastics pipes — Determination of ring stiffness*

3 Terms and definitions

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

3.1

inspection chamber

drainage and sewerage fitting used for the connection of drainage or sewerage installations and for changing the direction of drainage or sewerage runs

NOTE An inspection chamber terminates at ground level, permitting the introduction of cleaning, inspection and test equipment and the removal of debris, but it does not provide access for personnel. The riser shaft connected to these fittings has a minimum outside diameter of 200 mm and a maximum inside diameter of less than 800 mm.

3.2

manhole

drainage and sewerage fitting used for the connection of drainage or sewerage installations and for changing the direction of drainage or sewerage runs

NOTE A manhole terminates at ground level, permitting the introduction of cleaning, inspection and test equipment and the removal of debris, and also providing access for personnel. The minimum inside diameter of a manhole riser shaft is 800 mm.

3.3

structured-wall ancillary fitting

fitting with an optimized structural design with regard to material usage, but which still achieves the relevant performance requirements

NOTE These fittings can be circular or rectangular in design.

3.4 regular cross section shaft

riser shaft either fabricated from plain pipe or from structured wall pipe or fittings with a regular symmetrical design on their external surface

NOTE These products can be manufactured by extrusion, injection moulding, blow moulding or rotational moulding.

3.5 irregular cross section shaft

riser shaft with an irregular asymmetrical design on its external surface, such as those with additional reinforcing rings or structures intended to strengthen the riser in specific areas

NOTE These products can be manufactured by extrusion, injection moulding, blow moulding or rotational moulding.

4 Principle

4.1 General

The ring stiffness of a shaft shall be determined using the ISO 9969 test method when the shaft has a circular and regular cross-section.

Where a shaft has a square or rectangular cross-section, or if the shape is irregular, the ISO 9969 test shall be modified as described in this International Standard to determine the ring stiffness (see Table 1).

Table 1 — Relevant International Standards for determination of ring stiffness

External shaft design	Type of cross-section	Relevant International Standard for determination of ring stiffness
Plain surface	Regular cross-section and circular	ISO 9969
	Irregular cross-section, circular, square or rectangular	This International Standard
Structured wall surface	Regular cross-section and circular	ISO 9969
	Irregular cross-section, circular, square or rectangular	This International Standard

4.2 Principle for shafts with circular and regular cross-section

The ring stiffness shall be determined by measuring the force and the deflection while deflecting the shaft at a constant rate.

A length of shaft supported horizontally shall be compressed vertically between two parallel flat plates moved at a constant speed, which is dependent upon the diameter of the shaft.

A plot of force versus deflection shall be generated. The ring stiffness shall be calculated as a function of the force necessary to produce a deflection of $0,03d_i$ diametrically across the shaft.

4.3 Principle for shafts with circular and irregular cross-section or square or rectangular

The ring stiffness shall be determined by measuring the force and deflection whilst deflecting the shaft at a constant rate or constant load, until sufficient force is applied to obtain a resulting deflection in the range of 2 % to 6 %.

A riser shaft or segment of shaft shall be placed symmetrically between two rigid parallel plates or beams or, alternatively, between one rigid beam and a V-shaped support. A compressive force shall be applied to the shaft or segment using a bearer shaped to the external surface of the test piece.

The ring stiffness shall be calculated as a function of the force required to produce the deflection.

5 Apparatus

5.1 Shaft with circular and regular cross-section

The apparatus shall conform to that described in ISO 9969.

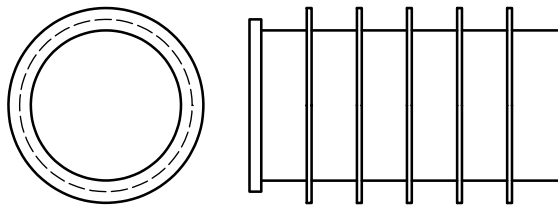


Figure 1 — Shaft with circular and regular cross-section

5.2 Shaft with circular and irregular cross-section or square or rectangular

NOTE Examples for representative test pieces are shown in Figures 2 and 3.

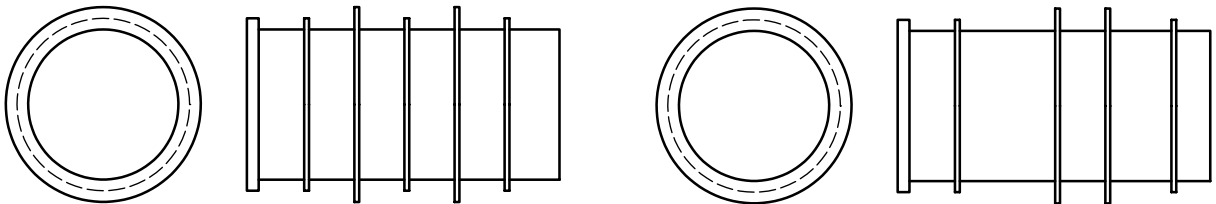


Figure 2 — Shafts with circular and irregular cross-section

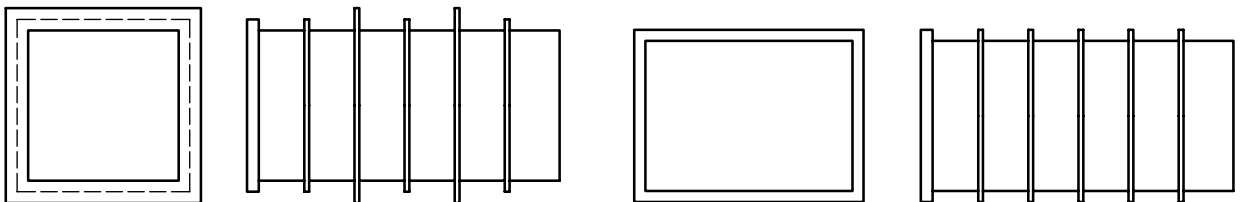


Figure 3 — Square and rectangular shaft

5.2.1 Loading frame, with two rigid parallel plates or beams, between which a compressive force, F , can be applied to the test piece such that the force and the resulting deflection of the test piece in the direction of the force can be measured to an accuracy of $\pm 1\%$.

Where a V-shaped support is used, the included angle shall be 170° or more.

For shafts with square or rectangular cross-sections, the bearers shall have a width, W , not greater than 25 mm.

For circular shafts with irregular cross-section, the maximum width of bearers shall be for:

- $DN/ID \leq 400$: 50 mm;
- $400 < DN/ID \leq 1\,200$: $0,12 \times [DN/ID]$, expressed in millimetres;
- $DN/ID > 1\,200$: 150 mm.

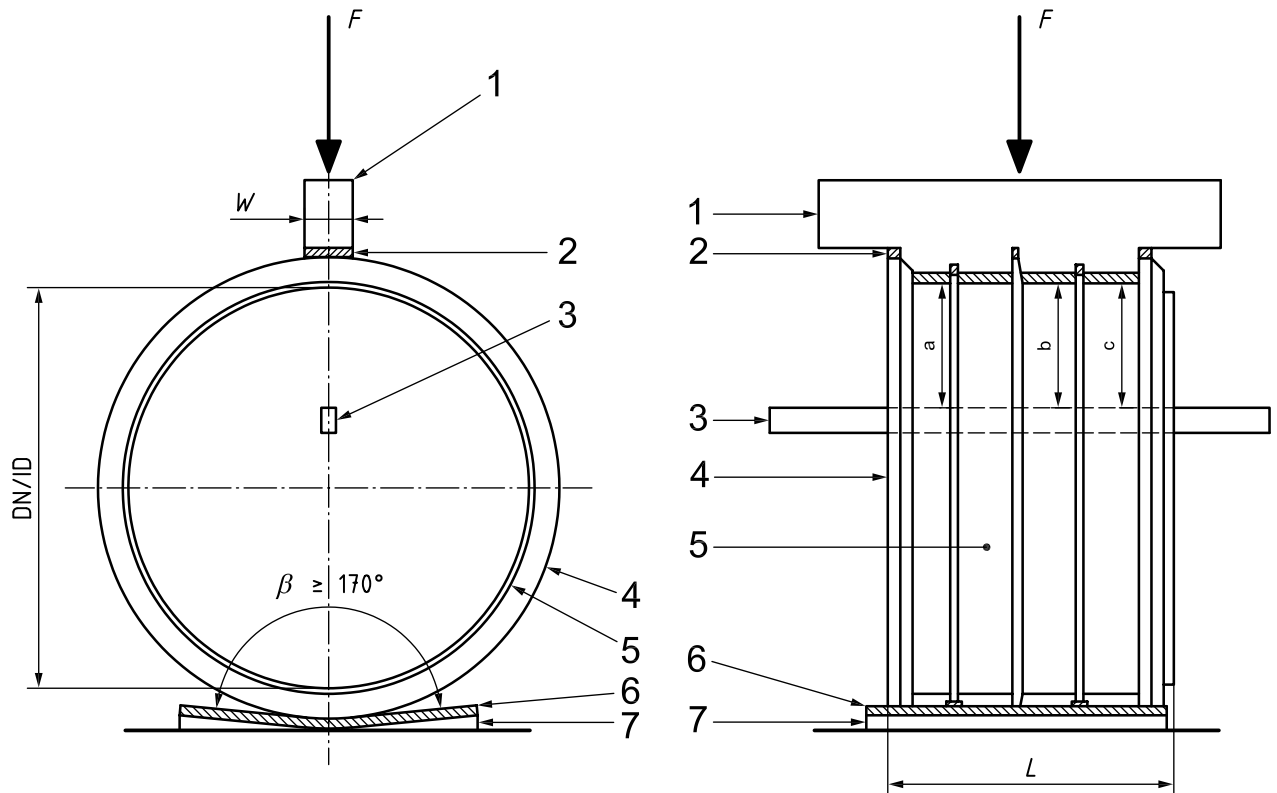
NOTE The above values have been taken from EN 476:1997, 9.2.1^[1].

Where the outside of an irregular shaft has a change in cross-section incorporated within the test piece, the bearers shall be shaped to accommodate this (see Figure 4). Where square or rectangular shafts have a regular rib configuration, this shall not be considered not to be a change in cross-section, and the load, F , imposed shall be applied just to the crests of the ribs.

The centre of loading shall be so arranged that the vertical deflection of the two ends of the test piece differs by not more than 0,5 % of the nominal size of the shaft.

Where the surface of the outside of the shaft does not provide a smooth bearing contact, the bearers shall be surfaced with a strip, not less than 3 mm thick, of elastomeric material of (50 ± 5) IRHD hardness in accordance with ISO 48.

The length of each bearer shall be not less than the length of the test piece.



Key

- | | | | |
|---|--|-----|-------------------------------|
| 1 | bearer, accommodated to shape of test piece | F | load, applied to upper bearer |
| 2 | elastomeric strips | L | length of test piece |
| 3 | reference beam for measuring | W | width of bearer |
| 4 | joint element, assembled, comprising standard sealing system of the manufacturer | a | Measuring point 1. |
| 5 | test piece | b | Measuring point 2. |
| 6 | elastomeric material | c | Measuring point 3. |
| 7 | support | | |

Figure 4 — Loading arrangement

5.2.2 Measuring devices, capable of determining the length to an accuracy of $\pm 0,5$ mm and the force and deflection along the length of the test piece to an accuracy of ± 1 % in the direction of the applied force.

6 Test pieces

6.1 Number of test pieces

Three test pieces shall be taken, each consisting of a riser or an appropriate length of riser segment incorporating a joint element, if required.

6.2 Age of test pieces

Test pieces shall be (21 ± 2) days old and conditioned, in air, at ambient temperature for at least 24 h prior to testing.

6.3 Specification of test pieces

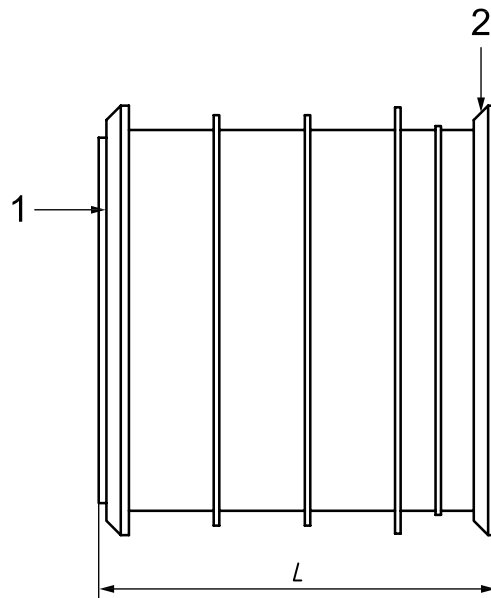
6.3.1 Shafts with circular and regular cross-section

When the shaft has a circular and regular cross-section, the test piece shall be in accordance with ISO 9969 and have a minimum length of 300 mm. In the case of a one-piece chamber or manhole, the shaft shall be cut off at a minimum of 300 mm from the top of the main channel. It shall be cut smoothly and perpendicular to the main axis.

6.3.2 Shafts with a square, rectangular or irregular cross-section

When the chamber or manhole consists of a chamber base and a separate shaft, the whole shaft with an additional joint element shall be used as the test piece. The additional joint element shall be connected with the shaft by using the standard sealing or welding system of the manufacturer (see Figure 5).

In the case of a one-piece chamber or manhole, the test piece shall be cut off at a minimum of 300 mm from the top of the main channel. It shall be cut smoothly and perpendicular to the main axis of the chamber or manhole. The length of the piece shall be chosen to obtain maximum symmetry, but shall be not less than 300 mm and not exceed 1 000 mm.



Key

- 1 joint element
- 2 joint element connected with the standard sealing system of the manufacturer

Figure 5 — Shaft with an irregular cross-section connected with a joint element

7 Procedure

7.1 Test temperature

The test shall be conducted at a temperature of $(23 \pm 2) ^\circ\text{C}$.

7.2 Shafts with circular and regular cross-section

The test shall be carried out in accordance with ISO 9969.

7.3 Shafts with a square, rectangular or irregular cross-section

7.3.1 Procedure

7.3.1.1 Assemble the test piece symmetrically in the test apparatus. The line of loading and support for non-circular sections shall be at the centre of the longest side.

7.3.1.2 Determine the datum for deflection at zero load without applied force at three points of measurement. One of the measuring points shall be in the middle of the test piece, the other two points being near either end.

7.3.1.3 Apply sufficient force to obtain a deflection of 2 % to 6 % of the shaft. The rate of loading shall be uniform such that the force required to generate the deflection is applied within a period of 3 min to 6 min. The centre of loading shall be so arranged that the vertical deflection of the test piece at the three points of measurement differs by not more than 0,5 % of the nominal dimension of the shaft (between the loading plates) along the line of deformation. If the test piece incorporates a change in cross-section on the inside of the shaft, the deflection shall be determined on the short side of the smallest cross-section for a square or rectangular section.

NOTE This is comparable to $0,03d_f$ from ISO 9969.

7.3.1.4 Repeat the test on another two test pieces, ensuring that they are deflected in different planes each 120° apart from the first test piece, if circular or 90° , if square or rectangular.

8 Calculation

8.1 Shafts with a circular and regular cross-section

The ring stiffness shall be calculated as described in ISO 9969.

8.2 Shafts with square, rectangular or irregular cross-section

Calculate the ring stiffness, S , in Pascals, from Equation (1):

$$S = \frac{0,0186}{\bar{L}} \times \frac{\bar{F}}{\bar{Y}} \times S_f \quad (1)$$

where

\bar{F} is the arithmetic mean of the three forces, in newtons;

\bar{L} is the arithmetic mean of the three specimen lengths, in metres;

\bar{Y} is the arithmetic mean of the three deflections, in metres;

S_f is the shape factor, the value of which depends upon the shape of the test piece section as follows:

- a) for circular sections: $S_f = 1,0$;
- b) for square or rectangular sections:

$$S_f = 0,56 \sqrt{\frac{L^4 + (4L^3 \times l)}{L^3 (L + l)}} \quad (2)$$

where

L is the length, in metres, of the long side;

l is the length, in metres, of the short side.

If the shaft incorporates a change in cross-section on the inside of the shaft, the value of S_f used shall be the mean value of that for the maximum dimension and that for the minimum dimension.

9 Test report

The test report shall include the following information:

- a) reference to this International Standard, i.e. ISO 13268:2010, and the referring standard;
- b) all details necessary for complete identification of the shaft tested, including:
 - 1) name and address of the manufacturer;
 - 2) type of shaft (including the material and method of sealing);
 - 3) dimensions;
 - 4) date of production;
 - 5) age of the shaft at the date of the test;
 - 6) length of the three test pieces;
- c) test temperature;
- d) time taken to apply the load needed to generate the deflection for each test piece;
- e) calculated value of the ring stiffness, S , to three decimal places;
- f) any factor that might have affected the results, such as any incident or any operating detail not specified in this International Standard;
- g) date of the test.

Bibliography

- [1] EN 476:1997, *General requirements for components used in discharge pipes, drains and sewers for gravity systems*

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ICS 23.040.20; 23.040.45; 91.140.80; 93.030

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