BS EN 476:2011

BSI Standards Publication

General requirements for components used in drains and sewers

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National foreword

This British Standard is the UK implementation of EN 476:2011. It supersedes BS EN 476:1998, BS EN 773:1999 and BS EN 1293:1999, which are withdrawn.

The UK participation in its preparation was entrusted by Technical Committee B/505, Waste Water Engineering.

A list of organizations represented on this committee can be obtained on request to its secretary.

BSI, as a member of CEN, is obliged to publish EN 476:2011 as a British Standard. However, attention is drawn to the fact that, despite taking an active part in the discussions leading to the drafting of the standard, the UK committee consistently voted against it.

This was due to BS EN 476:2011 dictating what is specified in material-specific standards. This can cause problems where dimensional requirements and performance class intervals are specified, whereas the design needs for a specific material may require alternative values to be implemented instead.

The UK committee also had concerns that some parts of the definitive criteria in EN 476 are in conflict with national regulations. In particular, the committee sees the dimensioning of "Manholes with access for cleaning and inspection by personnel in only exceptional circumstances" as an invitation to accept potentially dangerous situations. This is contrary to established UK good practice (see Approved Document H (Drainage and waste disposal) to the Building Regulations and the National Annex to BS EN 752, clause NA.12) which demands that, should personnel need to enter a manhole, it should be designed for safe working, irrespective of how infrequently the need may arise.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

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EN 476

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English Version

General requirements for components used in drains and sewers

Exigences générales pour les composants utilisés pour les branchements et les collecteurs d'assainissement

Allgemeine Anforderungen an Bauteile für Abwasserleitungen und -kanäle

This European Standard was approved by CEN on 23 November 2010.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Foreword

This document (EN 476:2011) has been prepared by Technical Committee CEN/TC 165 “Waste water engineering”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2011, and conflicting national standards shall be withdrawn at the latest by July 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 476:1997, EN 773:1999 and EN 1293:1999.

The specifications of this standard have been based on the requirements for wastewater systems specified in EN 752 and EN 12056.

This document is the result of merging EN 476, EN 773 and EN 1293.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies general requirements for components inside and outside buildings (see EN 12056-1) such as pipes, fittings and manholes with their respective joints intended for use in discharge pipes, drains and sewers which operate as gravity systems allowing for a maximum pressure of 40 kPa.

It also specifies general requirements for components used in hydraulically and pneumatically pressurised discharge pipes, drains and sewers.

It provides basic specifications to be respected in material related product standards for these applications.

It is not applicable for the direct evaluation of products. It is applicable as a reference for drawing up a product specification, if there is no product standard available.

NOTE Where the term "inside buildings" is used in the context of components fixed inside buildings, it also includes discharge pipes and fittings fixed on external surfaces of buildings.

This European Standard covers components to be used in conveying in a satisfactory manner:

— domestic wastewater;

— rainwater and surface water; and

— other waste waters acceptable for discharge into the system (e.g. industrial wastewater).

This European Standard applies to components of circular and other cross sections.

This European Standard applies equally to components which are factory-made and to those constructed on site, where applicable.

This European Standard does not apply to components used for trenchless construction according to EN 14457 and for components used for renovation of drains and sewers according to EN 13380.

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.

EN 124, *Gully tops and manhole tops for vehicular and pedestrian areas — Design requirements, type testing, marking, quality control*

EN 681-1, *Elastomeric seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 1: Vulcanized rubber*

EN 681-2, *Elastomeric Seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 2: Thermoplastic elastomers*

EN 681-3, *Elastomeric seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 3: Cellular materials of vulcanized rubber*

EN 681-4, *Elastomeric seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 4: Cast polyurethane sealing elements*

EN 805:2000, *Water supply — Requirements for systems and components outside buildings*

EN 1085:2007, *Wastewater treatment — Vocabulary*

EN 13101, *Steps for underground man entry chambers — Requirements, marking, testing and evaluation of conformity*

EN 14396, *Fixed ladders for manholes*

EN 14801, *Conditions for pressure classification of products for water and wastewater pipelines*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1085:2007 and EN 805:2000 and the following apply.

3.1
hydraulically pressurised system
system where flow is caused by hydraulic pressure and where the pipe normally operates full

3.2
pneumatically pressurized system
system where flow is caused by pneumatic pressure which can be applied either as compressed air upstream or partial vacuum downstream and where the pipe normally operates full

3.3
nominal size
DN
numerical designation of size of component, which is a convenient integer approximately equal to a manufacturing dimension in millimetres and can apply to either the internal diameter (DN/ID) or the external diameter (DN/OD)

NOTE DN/OD pipes with solid or hollow spiral or annular profiled external surface and outside smooth spigot jointing dimensions, and with larger OD than the spigot may be designated by the spigot dimension.

3.4
external diameter
OD
mean external dimension of the pipe barrel at any cross section where for pipes with external profiles on the barrels, the external diameter is the maximum diameter when viewed in cross section

3.5
internal diameter
ID
mean internal dimension of the pipe barrel at any cross section

3.6
pipe barrel
cylindrical part of the pipe with a uniform longitudinal profile excluding socket and spigot

3.7
invert
lowest point of the internal surface of the barrel of a pipe or channel at any cross section

3.8
rigid pipe
pipe, the load carrying capacity of which is limited by breaking or overstressing, without significant deformation of its cross section

3.9
semi-rigid pipe
pipe whose load carrying capacity is limited either by deformation/overstressing (flexible behaviour) or by breaking (rigid behaviour) depending on its ring stiffness

3.10
flexible pipe
pipe, the load carrying capacity of which is limited by diametral deformation under load to the ultimate design criteria without breaking or overstressing

3.11
joint
connection between the adjacent ends of two components including the means of sealing

3.12
adjustable fitting
fitting which is designed to permit specific angular deflection at the time of installation (for pressurized and vacuum systems)

3.13
adjustable joint
joint which permits significant angular deflection at the time of installation but not thereafter

3.14
flexible joint
joint which permits angular deflection

3.15
rigid joint
joint that does not permit angular deflection

3.16
restrained joint
joint in which a means is provided to prevent separation

3.17
proof load
specified test load which a component withstands where the related requirements of the product standard are met

3.18
ultimate load
load which causes failure of a component (under test) which shall be as specified in product standards

3.19
crushing strength
load per unit length a rigid pipe is required to withstand in kN/m

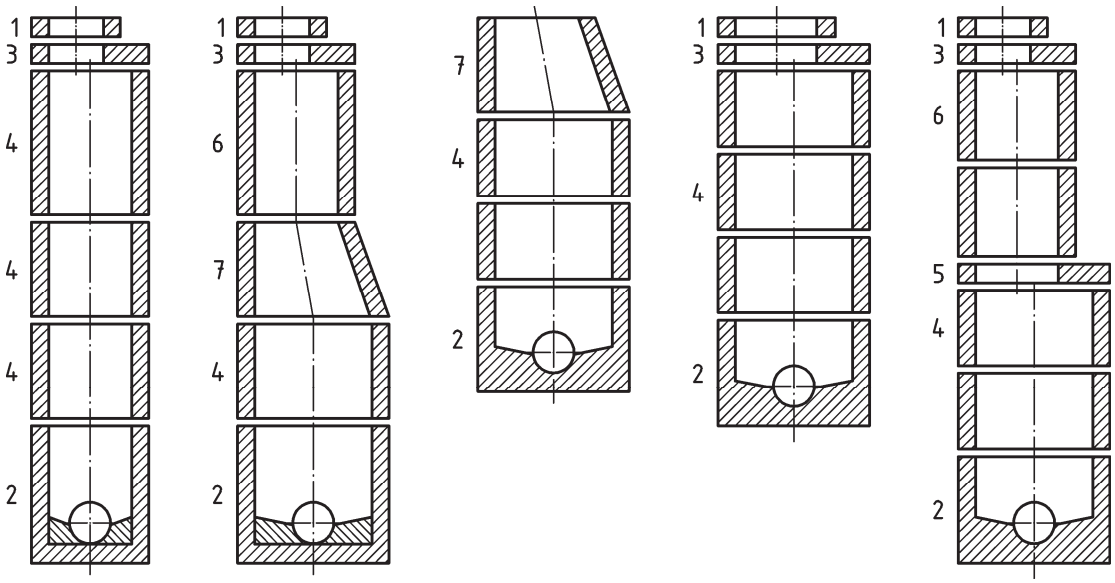
3.20
ring stiffness
resistance of a pipe to diametral deflection in response to external loading applied along one diametric plane given as follows:

$$S = \frac{E \cdot I}{D_{\mathrm{m}}^3}$$

3.21
manhole
chamber with a removable cover constructed on a drain or sewer to permit entry by personnel

[EN 752:2008, 3.41]

NOTE Examples are given in Figure 1.



Key

1 adjusting unit
2 base unit
3 cover slab
4 chamber unit
5 reducing slab
6 shaft unit
7 taper

NOTE 1 Joint details have been omitted for clarity

NOTE 2 Precast base slabs of structures can be integral with the base unit or a separate slab incorporating construction joints.

Figure 1 — Description of manhole and inspection chamber components

3.22
inspection chamber
chamber with a removable cover constructed on a drain or sewer that permits the introduction of cleaning and inspection equipment from surface level, but does not provide access for personnel

[EN 752:2008, 3.34]

4 Symbols and abbreviations

DN/ID nominal size related to the internal diameter

DN/OD nominal size related to the external diameter

PFA allowable operating pressure [EN 805:2000]

PMA allowable maximum operating pressure [EN 805:2000]

PEA allowable site test pressure [EN 805:2000]

D_m diameter of the neutral axis of the pipe wall, in metres

E modulus of elasticity in flexure in the circumferential direction in kilonewtons per square metre

I second moment of area of the pipe wall in the longitudinal direction, per unit length, in metres to the fourth power per metre

S the ring stiffness of the pipe in kilonewtons per square metre

r radius for bends

α angle of bends

β angle of branches

5 Dimensional requirements

5.1 General

Product standards may include specifications which are more stringent, but not less stringent than those in this standard.

5.2 Dimensions of pipes and fittings

5.2.1 Nominal sizes

Nominal sizes DN shall be given in product standards as DN/ID or DN/OD and shall preferably be selected from Table 1 or Table 2 for reasons of interchangeability. Other nominal sizes can be specified in product standards.

Table 1 — Preferred nominal sizes DN/ID

Gravity systems **DN/ID**	**Hydraulically pressurized systems** **DN/ID**	**Pneumatically pressurized systems** **DN/ID**
30, 40, 50, 60, 70, 80, 90, 100, 125, 150, 200, 225, 250, 300, 350, 375, 400, 450, 500, 600, 700, 800, 900, 1 000, 1 200, 1 250, 1 400, 1 500 1 600, 1 800, 2 000, 2 200, 2 500, 2 800, 3 000, 3 500, 4 000	20, 25, 30, 40, 50, 60, 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1 000, 1 100, 1 200, 1 250, 1 300, 1 400, 1 500, 1 600, 1 800, 2 000, 2 100, 2 200, 2 400, 2 500, 2 600, 2 800, 3 000, 3 200, 3 500, 4 000	**30, 40, 50, 60, 80, 100, 125, 150, 200**
NOTE For each material, it is intended to limit the number of nominal sizes.		

Table 2 — Preferred nominal sizes DN/OD

Gravity systems DN/OD	Hydraulically pressurized systems DN/OD	Pneumatically pressurized systems DN/OD
32, 40, 50, 63, 75, 90, 100, 110, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1 000, 1 200, 1 400, 1 600, 1 800, 2 000	22, 25, 28, 32, 40, 50, 63, 75,90, 100, 110, 125, 140, 160, 180, 200, 225, 250, 280, 315, 355, 400, 450, 500, 560, 630, 710, 800, 900, 1 000	32, 40, 50, 63, 75, 90, 100, 110, 125, 140, 160, 180, 200
NOTE For each material, it is intended to limit the number of nominal sizes.		

For non circular cross sections dimensions can be specified in product standards.

5.2.2 Internal diameters and tolerances

Product standards shall specify:

— internal diameters and tolerances; or

— external diameters, wall thicknesses and tolerances; or

— minimum internal diameter.

Maximum tolerances on the internal diameter ID are listed in Table 3.

Table 3 — Maximum tolerances on internal diameters

Nominal size	Gravity, hydraulically and pneumatically pressurized systems	
	Tolerances on mean internal diameter mm	Tolerances on individual internal diameter mm
DN ≤ 100	± 0,05 × DN	± 0,1 × DN
100 < DN ≤ 250	± 5	± 10
250 < DN ≤ 600	± 0,02 × DN	± 0,04 × DN
DN > 600	± 15	± 30
NOTE DN can be applied to either DN/ID or DN/OD.		

5.2.3 Geometrical characteristics of pipes

Pipe straightness shall be within tolerances specified in product standards (see 7.1.5).

Pipes for pressurised systems may also be delivered in coils. Product standards shall specify the minimum radius of the coils instead of straightness.

The angle between the planes of the end faces of the pipe and the relevant axis shall be 90° with a tolerance such that the function of the pipe joint shall not be impaired (see 7.1.6).

A range of pipe lengths can be specified in product standards.

Product standards shall specify tolerances on pipe lengths, even if the lengths themselves are not specified.

For pressurised systems, tolerances on the wall thickness shall be specified in product standards.

5.2.4 Geometrical characteristics of fittings

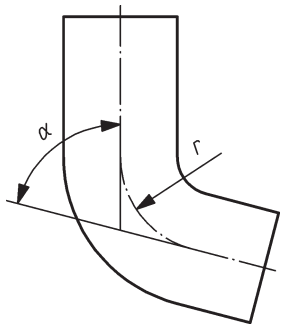
5.2.4.1 General

Angles of fittings shall be specified in the product standards. Where applicable, tolerances on angles shall be specified in product standards.

5.2.4.2 Bends

Angles α for bends (see Figure 2) shall be specified in product standards. Angles α should preferably be selected from 11°15', 15°, 20° to 22°30', 30°, 45°, 60° 67° to 70° and 87° to 90°. Other angles α may be specified in product standards.

NOTE Radii r for bends (e.g. swept and unswept) should be specified in product standards.



Key

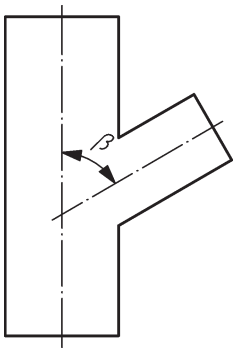
α angle of bend

r radius of bend

Figure 2— Illustrations of angle α and radius of bends r

5.2.4.3 Branches

Angles β for branches (see Figure 3) specified in product standards should preferably be selected from 45°, 60° to 70° or 87° to 90°.



Key

β angle of branches

Figure 3 — Illustrations of angle β of branches

5.3 Dimensions of manholes and inspection chambers

5.3.1 General

Dimensions of manholes with access for personnel shall comply with the safety requirements in force at the place of installation. In the absence of local regulations the diameter of the clear opening of the manhole cover according to EN 124 shall be ≥ 600 mm (see Figure 4). For manholes where steps or ladders are integrated during production, the load requirements and test methods shall be specified in accordance with EN 13101 or EN 14396 respectively.

5.3.2 Manholes with access for cleaning and inspection by personnel

Manholes for all maintenance works with access for personnel shall have internal diameter (ID) and dimensions according to Figures 4 a) and b), or a nominal size for rectangular sections of 750 mm × 1 200 mm or greater or square sections of 1 000 mm × 1 000 mm or greater, or a nominal size for elliptical sections of 900 mm × 1 100 mm or greater.

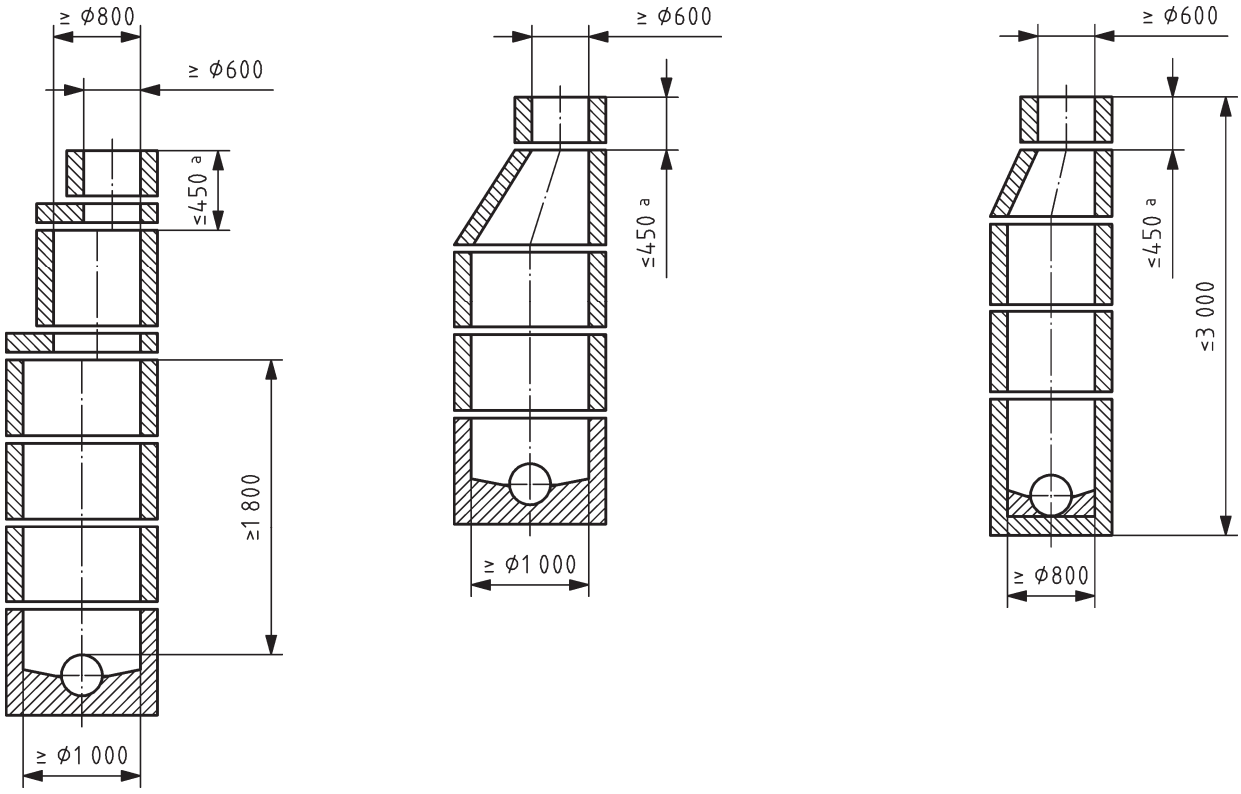
NOTE National or local regulations or the relevant authority can specify larger minimum dimensions e.g. for the access.

5.3.3 Manholes with access for cleaning and inspection by personnel in only exceptional circumstances

Manholes for the introduction of cleaning equipment, inspection and test equipment with exceptional possibility of access for a man equipped with a harness, shall have internal diameter (ID) and dimensions according to Figure 4 c) or a nominal size for rectangular sections of 750 mm × 1 000 mm or greater or square sections of 800 mm × 800 mm or greater, or a nominal size for elliptical sections of 800 mm × 1 000 mm or greater.

NOTE National or local regulations or the relevant authority can specify larger minimum dimensions e.g. for the access.

Dimensions in millimetres



a) **b)** **c)**

[a] The 450 mm shaft depth (including the straight part of the taper, if applicable) is required to allow the first step or ladder rung to be in an accessible position. For septic tanks or separators, this dimension can be increased up to 600 mm.

Figure 4 — Dimensions of circular manholes

5.3.4 Inspection chambers

Inspection chambers having DN/ID's less than 800 permit the introduction of cleaning, inspection and test equipment, but do not provide access for personnel.

5.4 Interconnection

Product standards shall state whether or not components within dimensional series (or tolerances) are capable of interconnection.

Where such interconnection is not confirmed, product standards shall specify which means (e.g. adaptors) are required to effect interconnection.

6 Performance requirements

6.1 Mechanical resistance of pipes and fittings

6.1.1 Mechanical strength of pipes and fittings in the cross section

Mechanical strength requirements according to Table 4 shall be specified in product standards. Depending on the material, additional requirements can be necessary.

Table 4 — Mechanical requirements of pipes and fittings in the cross section

Drains and sewers		Requirements to be specified in product standards
Gravity	outside buildings	Minimum crushing strength or minimum ring stiffness values or both requirements and/or any other relevant requirements such as creep values. Strength classes (kN/m) or stiffness classes (kN/m^2), if more than one, shall be separated by at least 20 % of the next class.
	inside buildings	Appropriate strength requirements for pipes shall be specified in product standards.
Pressurised [a]	hydraulically	Pipes, fittings and joints shall be capable of withstanding a transient pressure of 80 kPa below atmospheric, approximately 20 kPa absolute pressure. Crushing strengths, strength or stiffness classes, bending moment resistance, long-term hydrostatic strength.
	pneumatically	

[a] Where appropriate, pressure classes for components shall be given in product standards. When product standards specify pressure classes, the related PMA, PFA and PEA values shall be given (see EN 14801).

Pipes and, where appropriate, fittings shall be classified according to their characteristic structural behaviour. This behaviour can depend on:

— the material, particularly its ability to either deform, and/or crack and/or rupture at failure under load;

— the geometry, diameter, shape and wall thickness;

— the internal pressure in service (if applicable);

— the mechanical characteristics of the surrounding materials and support, after installation.

The load bearing capacity of components shall take into account all their relevant factors for safe and reliable operation in systems, in particular:

— the minimum and maximum operation temperatures and the temperature-induced loads;

— the effects of constant or variable long term loading on the material properties;

— the effects of potential hazards such as ground subsidence;

— the effects of buoyancy, where it may occur.

As such, product standards shall specify:

— the minimum and maximum operation temperatures (see 6.5) related to mechanical and internal pressure strength stated;

— material properties, e.g. creep, fatigue; and

— longitudinal bending resistance.

Product standards shall state methods by which resistance to internal and external loadings is assessed. This can be specified by crushing strength test, maximum load deformation test, internal and external pressure strength tests or by calculation. Values shall be declared.

Pipes can be defined as "flexible", "semi-rigid" or "rigid" as defined in Clause 3.

The failure load for flexible, semi-rigid or rigid pipes causes excessive deformation or rupture or unacceptable cracking of the pipes and can lead for example to: buckling of the wall, significant creep in the material, unacceptable cracking of coatings, loss of tightness in joints and reduction in hydraulic capacity.

6.1.2 Longitudinal bending moment resistance

Long rigid or semi-rigid pipes of small diameters shall have a satisfactory longitudinal bending moment resistance. The values shall be specified in product standards and expressed in kN/m (see 7.3).

6.2 Mechanical resistance of manholes, shafts and inspection chambers above the base unit

6.2.1 General

For manholes and inspection chambers appropriate strength requirements shall be specified in product standards. Mechanical behaviour of manholes can be specified by testing and/or calculation taking into account the long term behaviour. Crushing strength (kN/m), and/or axial load (kN/unit) and/or ring stiffness (kN/m^2) classes if more than one, shall be separated by at least 20 % of the next lower class.

6.2.2 Circular sections

Circular sections shall have minimum crushing strengths and/or stiffness values, whichever is applicable, stated in product standards (see 7.2.2.1).

Rigid circular sections shall have a minimum crushing strength of 25 kN per metre length per metre internal diameter for nominal sizes less than or equal to DN 1000. For nominal sizes greater than DN 1000 the minimum crushing strength shall be 25 kN per metre length, or 30 kN per metre length if tested in a vertical position (see 7.2.2.1).

Flexible circular sections for use in carriageways, hard shoulders and parking areas shall have a minimum initial stiffness value of 2,0 kN/m^2.

6.2.3 Other shapes

Requirements for other shapes of construction shall be comparable to the requirements of 6.2.2 (see also 7.2.2.1).

6.2.4 Tapers, reducing and cover slabs

Requirements for tapers, reducing and cover slabs shall be specified in product standards. Tapers for manholes shall withstand the test load in accordance with EN 124 according to their place of installation (see 7.2.2.3).

Reducing slabs for manholes shall withstand an ultimate load of at least 300 kN or a proof load of 120 kN (see 7.2.2.2) when used in carriageways, hard shoulders and parking areas.

When load-distribution slabs are necessary, dimensions and performance requirements shall be specified in product standards.

6.3 Tightness

6.3.1 Test pressure

Pipes, manholes, inspection chambers, fittings and joints shall be designed and manufactured to ensure tightness throughout design life under the design loading conditions. The internal test pressure shall be according to Table 5.

Product standards shall specify the respective tests.

Table 5 — Internal test pressure

Drains and sewers		**Test pressure**
gravity	outside buildings	internal water pressure 0 kPa rising to 50 kPa [a,b]
	inside buildings	internal water pressure 0 kPa rising to 50 kPa and internal air pressure of 0 kPa to 1 kPa [c]
	manholes	minimum internal water pressure 50 kPa
	inspection chambers	for depths ≤ 2 m: water equal to the total filling for depths > 2 m: water internal pressure minimum 50 kPa
pressurised	hydraulically	maximum internal water pressure ≥ PEA of the component under static conditions[d] and minimum internal transient pressure ≥ 80 kPa below atmospheric (approximately 20 kPa absolute pressure) [e]
	pneumatically	maximum internal water pressure ≥ PEA (water) of the component under static conditions [d] and minimum internal transient pressure ≥ 80 kPa below atmospheric (approximately 20 kPa absolute pressure) [e]

[a] Moisture adhering to the external surfaces shall not constitute leakage.

[b] Where the watertightness of the joint assembly is mainly dependent on internal pressure, an additional external hydrostatic pressure test or a partial vacuum test shall be carried out.

[c] The above requirement does not apply to rainwater systems fixed externally to the building.

[d] Where the watertightness of the joint assembly is mainly dependent on external pressure, an additional external hydrostatic pressure test or a partial vacuum test shall be carried out.

[e] Where the airtightness and watertightness of the joint assembly is mainly dependent on internal air pressure below atmospheric, an additional external hydrostatic pressure test or a partial vacuum test shall be carried out.

6.3.2 Seals for joints

Sealing materials shall conform to the requirements according to EN 681-1, EN 681-2, EN 681-3 or EN 681-4 as appropriate.

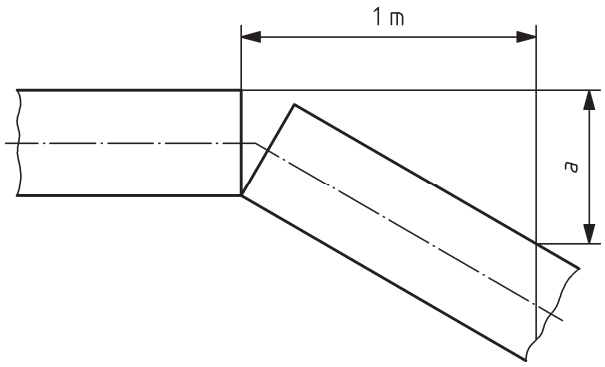
The seals shall be designed in such a way as to ensure long term tightness, taking into account the properties of the sealing materials (e.g. elasticity, strength, relaxation, temperature sensitivity) and the possibility of movements during the design lifetime of the system.

6.3.3 Rigid joints

Product standards shall state the performances of rigid joints and shall specify the necessary test methods assessing their tightness.

6.3.4 Joint deflection

When tested with the specified joint deflection value, *a*, in accordance with Table 6 and illustrated in Figure 5, flexible joints, adjustable joints and adjustable fittings which include flexible joints shall be watertight and airtight (if applicable).



Key

a joint deflection value in mm

Figure 5 — Joint deflection value

Table 6 — Minimum joint deflection *a*

Dimensions in millimetres

DN	Gravity systems *a*	Pressurised systems *a*	
		semi flexible	flexible
DN < 300	30	30	60
300 ≤ DN ≤ 600	20	20	40
600 < DN ≤ 1 000	10	10	20
DN > 1 000	10 × 1 000/DN	10 × 1 000/DN	20 × 1 000/DN

6.3.5 Joint shear load

Flexible joints, adjustable joints and adjustable fittings which include flexible joints shall be watertight when tested under the following conditions:

— the joint subjected to a shear force expressed in newtons at least 10 × DN or where appropriate (e.g. flexible pipes), to a diametral deflection applied to the spigot near the joint of at least 5 % of the external pipe diameter;

— or a combination of the joint shear load and joint deflection in accordance with 6.3.4.

Product standards shall state test methods by which watertightness is assessed.

6.3.6 Restrained joints

Restrained joints (see 3.16) shall be capable of withstanding the end thrust due to internal pressure and, where applicable, due to temperature fluctuation and the longitudinal contraction of the pipe under internal pressure due to the Poisson effects. Where available, performances of restrained joints shall be specified in product standards.

6.4 Continuity of invert

When tested in the factory, joints shall have a continuity of invert within the following calculated maximum tolerances:

— ≤ DN/OD 315 or DN/ID 300: 6 mm step;

— > DN/OD 315 or DN/ID 300: 0,02 mm × DN, no step to be greater than 30 mm.

Product standards shall detail the dimensions or the method of calculation or the test method by means of which compliance with this clause shall be demonstrated.

6.5 Temperature

Pipes, fittings and joints shall be suitable for a continuous water discharge at temperatures according to Table 7. Temperature resistance tests may be specified in product standards.

Table 7 — Temperature resistance

Drainage system		Maximum temperature
gravity	outside buildings	Pipes, fittings and joints shall be suitable for a continuous water discharge temperature of 45 °C in the case of ≤ DN 200, or of 35 °C for > DN 200.
	inside buildings	Pipes, fittings and joints excluding rainwater systems shall be suitable for a maximum intermittent wastewater temperature of 95 °C, at the point of entry to the pipe system (see 7.4.3.3).
	manholes and inspection chambers	Connecting points: 45 °C in the case of ≤ DN 200, or of 35 °C for > DN 200.
pressurised	hydraulically	Pipes, fittings and joints, at an ambient temperature of 10 °C, shall be suitable for a continuous water discharge temperature of 45 °C in the case of ≤ DN 200, or of 35 °C for > DN 200.
	pneumatically	Pipes, fittings and joints, at an ambient temperature of 10 °C, shall be suitable for a continuous water discharge temperature of 45 °C.

6.6 Dimensional stability

Rigid pipes and fittings and pipe joints shall be dimensionally stable, when installed. For flexible and semi-rigid pipes and fittings, the practical admissible deformation when installed, shall be stated in product standards by giving both short-term and long-term values. A test for ring flexibility shall be stated in product standards, where appropriate.

6.7 Smoothness of bore

The interior surfaces of pipes and fittings shall be of an even texture inherent to the method of manufacture and free from visible defects that may adversely affect their hydraulic performance. Where appropriate, product standards shall specify the acceptable imperfections, or specific hydraulic performance test for which consideration shall be given to the effects of joint geometry.

6.8 Appearance

Pipes, fittings and joints shall be free from defects which could impair their performance in service.

6.9 Corrosion resistance

Components shall be resistant to corrosion by domestic wastewater, surface water and the effects of soil and ground water. Corrosion resistance tests can be specified in product standards.

6.10 Abrasion resistance

Pipes and fittings shall be resistant to abrasive effects of hard particles in domestic wastewater and surface water. Abrasion resistance tests can be specified in product standards.

6.11 Coatings and linings

Where appropriate, coatings, linings or other protective measures shall be specified in product standards.

6.12 Long-term behaviour

Where appropriate, long-term behaviour of components shall be specified in product standards.

6.13 Durability

Product standards shall give details of characteristics which are relevant to the durability of the finished product.

6.14 Sealing elements

Sealing elements as specified by the component manufacturer shall usually be supplied together with the components.

6.15 Resistance against cleaning operations

Product standards shall provide justifying statements concerning components for resistance against cleaning operation.

6.16 Handling

When equipped with handling devices (anchors, handling rings), product standards shall provide justifying statements concerning pipes, fittings and manholes in order to ensure their safe handling.

7 Test methods

7.1 Measurement of dimensions

7.1.1 Mean internal diameter of barrels

Where measurement of internal diameter is a requirement of the product standard, it shall be carried out near to all ends of the component. At least two measurements shall be taken near each end and the mean internal diameters calculated. The measurements shall be taken at approximately equal angular spacing. If an internal circumferential tape is used, one measurement near each end is sufficient.

7.1.2 Mean external diameter of barrels

Where measurement of external diameter is a requirement of the product standard, it shall be carried out near all ends of the component in a similar manner to that in 7.1.1, or by calculation from the circumference near all ends of the component.

7.1.3 Spigots and sockets

Where measurement of spigots and sockets is a requirement of the product standard, it shall be carried out at the outside diameter of the spigot and the inside diameter of the socket. At least two measurements shall be taken near each end and the mean diameters calculated. If a circumferential tape is used, one measurement is sufficient.

7.1.4 Wall thickness of barrels

Where measurement of wall thickness is a requirement of the product standard, it shall be carried out near all ends of the component. Thickness of circular pipes shall be measured near each end with a minimum of three points. Thickness of non circular pipes shall be measured near each end with a minimum of four points. The measurements shall be taken at approximately equal angular spacing. Alternatively minimum and maximum values shall be determined near each end.

7.1.5 Deviation from straightness of barrels

Where measurement of deviation from straightness is a requirement of the product standard, the method of measurement shall be stated. Deviation shall be measured at the centre point of a line of length not less than two thirds of barrel length.

7.1.6 Deviation from squareness of the ends of the pipes

Where measurement of deviation from squareness is a requirement of the product standard, the method of measurement shall be stated.

7.2 Load bearing capacity tests

7.2.1 Load bearing capacity tests for pipes

7.2.1.1 Crushing test

The test shall be carried out on rigid pipes on a test machine having:

— a load recording facility;

— a stiff loading beam the lower face of which is a bearer having an elastomeric bearing strip of thickness from 10 mm to 40 mm and hardness between 45 IRHD and 65 IRHD (International Rubber Hardness Degree) in accordance with ISO 48.

The maximum width of the bearing strip shall be in accordance with Table 8.

Table 8 — Maximum width of the elastomeric bearing strip

Nominal Diameter	Maximum width of the elastomeric bearing strip mm
DN ≤ 400	50
400 < DN ≤ 1 200	100
DN > 1 200	150

A lower bearer on which is located a V-shaped support which is either covered with or has two bearing strips of elastomeric material having the same thickness and hardness as that on the loading beam. The included angle (β) of the V shall not be less than 150°.

The test consists of subjecting a complete pipe or pipe section to the action of a uniformly distributed load. For example, bearers may be divided into sections to achieve uniform distribution.

The test load shall be applied symmetrically over the entire bearer length. The position of the load may be adjusted to maintain stability.

During application of at least the final third of the specified load, the rate of increase of load shall be constant and this period of loading shall be at least 30 s.

Where the cross section of the pipe does not allow the test method to be used, the product standard shall state an appropriate test method to obtain a comparable load bearing capacity.

The maximum allowable tolerance of the testing machine load shall be specified in the product standard.

7.2.1.2 Ring stiffness test

This test shall be carried out on flexible pipes on a test machine, having load and deformation recording facilities. The product standard shall state whether the bearer and the beam shall be flat steel plates (with no bearing faces or strips) or as described in 7.2.1.1.

The method of determination of ring stiffness and creep value shall be specified in each product standard.

7.2.2 Load bearing capacity tests for sections of manholes and shafts

7.2.2.1 General

Components shall be tested in accordance with 7.2, except that for convenience, it is permitted to carry out the test in the vertical position.

7.2.2.2 Load bearing capacity test for reducing slabs

The test shall be carried out on a test machine having a load recording facility.

During application of at least the final third of the specified load, the rate of increase of load shall be constant and this period of loading shall be at least 30 s. The load shall be applied to a complete reducing slab, until either the proof or ultimate load, as required, is achieved.

7.2.2.3 Load bearing capacity test for tapers

Where a loading test for tapers is a requirement in the product standard, a test method shall be given in the product standard.

7.3 Longitudinal bending moment resistance test for pipes

Where longitudinal bending moment resistance is required, the following test criteria shall be specified in the product standard:

— the test shall be carried out on a test machine having a load recording facility;

— the pipe to be tested shall be supported at each end and symmetrically loaded (3 or 4 point loading) so that it will break with one circumferential crack;

— the span shall be not less than 5 × DN, expressed in millimetres;

— the supports shall be designed to produce vertical reactions only.

7.4 Tightness tests

7.4.1 Tightness test of pipes, fittings, manholes and inspection chambers

The test method, the test period and the test requirements (e.g. water addition to maintain the test pressure) shall be stated in product standards taking into account the requirements specified in Table 9 and Table 10.

Table 9 — Tightness test of pipes, fittings, manholes and inspection chambers

Drainage system		**Test method**
gravity	outside buildings	The watertightness test shall be carried out at ambient temperature, under hydrostatic pressure as stated in Table 5 for a period of at least 15 min (preconditioning time not included). The test pieces shall be clamped into a suitable test apparatus, shall be filled with water slowly and vented completely. They may be preconditioned with water prior to testing.
	inside buildings	The watertightness test shall be carried out on one or more pipes or pipe sections at ambient temperature, under hydrostatic pressure as stated in Table 5 for a period of at least 15 min (preconditioning time not included). The test pieces shall be clamped into a suitable testing apparatus, shall be filled with water slowly and completely vented. They may be preconditioned with water prior to testing.
pressurised	hydraulically	The test shall be carried out on one or more pipes or pipe sections at ambient or elevated temperature, under hydrostatic pressure as stated in Table 4 and Table 5 for a period of at least 15 min (preconditioning time not included). Where applicable, a test shall be carried out on one or more pipes or pipe sections, under partial vacuum.
	pneumatically	The test shall be carried out under pressure below atmospheric for at least one hour on one or more pipes or pipe sections at ambient or elevated temperature as stated in Table 5.

7.4.2 Tightness test of joints

Table 10 — Tightness test of joints

Drainage system		Test method
gravity	outside buildings	These tests are for joints between two pipes, and a pipe and a manhole base or an inspection chamber base. The tests shall be carried out on pipes or pipe sections jointed and supported in such a way that they can move in relation to each other to the limits of the requirements stated in product standards for a period of at least 5 min (preconditioning time not included). These shall include tests for joint deflection and shear or a combination of both, under hydrostatic pressure as stated in Table 5. Where appropriate, shear shall be replaced by diametral deflection. Minimum joint deflection values, *a*, shall be in accordance with the values according to Table 6.
	inside buildings	These tests are for joints between two pipes, and a pipe. The tests shall be carried out on pipes or pipe sections jointed and supported in such a way that they can move in relation to each other to the limits of the requirements stated in product standards for a period of at least 5 min (preconditioning time not included). These shall include tests for joint deflection and shear or a combination of both, under hydrostatic pressure as stated in 7.4.3. Where appropriate, shear shall be replaced by diametral deflection. Minimum joint deflection values, *a*, shall be in accordance with the values according to Table 6.
pressurized	hydraulically	The tests shall be carried out on two pipes or pipe sections jointed and supported in such a way that they can move in relation to each other to the limits of the requirements stated in product standards. The test conditions shall be as specified in Table 5. It is permissible for product standards to combine the tightness tests of pipes and joints. Test methods for restrained joints shall be specified in product standards, where appropriate.
	pneumatically	The tests shall be carried out on two pipes or pipe sections jointed and supported in such a way that they can move in relation to each other to the limits of the requirements stated in product standards. The test conditions shall be as specified in Table 5. It is permissible for product standards to combine the tightness tests of pipes and joints. Test methods for restrained joints shall be specified in product standards, where appropriate.

7.4.3 Test methods for discharge components for use inside buildings

7.4.3.1 Watertightness test

The watertightness test shall be carried out on one or more pipes or pipe sections at ambient temperature, under hydrostatic pressure as stated in Table 5. The test pieces shall be clamped into a suitable testing

apparatus. They shall be filled with water and completely vented. They may be preconditioned with water prior to testing.

The test method, the test period, the water addition to maintain the test pressure and where applicable the angular deflection shall be stated in product standards.

7.4.3.2 Airtightness test

Product standards shall state a test method to assess the compliance of the joint assembly with the requirement of Table 5.

7.4.3.3 Elevated temperature cycling test

An elevated temperature cycling test shall be carried out on a test assembly, including pipes and fittings, defined in product standards in a condition as installed. The test assembly shall be subjected to the passage of hot and cold water according to the following schedule for 1 500 cycles:

a) (30 ± 1) l of water at a temperature of (93 ± 2) °C over a period of 1 min, at a constant rate of flow;

b) rest and drain period of 1 min;

c) (30 ± 1) l of water at a temperature of (15 ± 5) °C over a period of 1 min, at a constant rate of flow;

d) rest and drain period of 1 min.

The water temperature shall be measured at the point of entry. When filled with water (15 ± 5) °C to a pressure of 35 kPa at the lowest point and a minimum of 5 kPa at the inlet point, the test assembly shall not leak either before or after thermal cycling. Product standards shall specify the maximum value of sagging, if applicable.

8 Marking, labelling and packaging

Product standards shall specify the marking requirements. Each component or, where this is not possible, each package of components, shall be marked indelibly and in a clearly visible manner and identification of the component shall be made in such a way that no doubt is possible.

Marking shall include at least the following information:

— European Standard number (product standard number);

— identification of manufacturer and site of production;

— identification of date or period of manufacture;

— identification of Third Party Certification Body (if applicable);

— identification of classes, where applicable;

— identification of use, where applicable.

Bibliography

[1] EN 752:2008, *Drain and sewer systems outside buildings*

[2] EN 12056 (all parts), *Gravity drainage systems inside buildings*

[3] EN 13380, *General requirements for components used for renovation and repair of drain and sewer systems outside buildings*

[4] EN 14457, *General requirements for components specifically designed for use in trenchless construction of drains and sewers*

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