

Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings — Requirements, test methods and quality assurance

ICS 23.040.10; 23.040.40

National foreword

This British Standard is the UK implementation of EN 877:1999+A1:2006, incorporating corrigendum January 2008. It supersedes BS 416-2:1990 and BS 6087:1990 which are withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by A1 A1.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by CEN corrigendum January 2008 is indicated in the text by AC1 AC1.

The UK participation in its preparation was entrusted to Technical Committee PSE/10, Iron pipes and fittings.

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

The committee has produced a national annex which identifies some of the most significant changes from the withdrawn British Standards BS 416-2 and BS 6087.

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

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

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English version

**Cast iron pipes and fittings, their joints and accessories for the
evacuation of water from buildings – Requirements, test
methods and quality assurance**

Tuyaux et raccords en fonte, leurs assemblages et
accessoires destinés à l'évacuation des eaux des
bâtiments – Prescriptions, méthodes d'essais et assurance
qualité

Rohre und Formstücke aus Gußeisen, deren Verbindungen
und Zubehör zur Entwässerung von Gebäuden –
Anforderungen, Prüfverfahren und Qualitätssicherung

This European Standard was approved by CEN on 19 June 1998.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 203 "Cast iron pipes, fittings and their joints", the secretariat of which is held by AFNOR.

It is one of a series of standards for cast iron products for pipelines for various applications.

It deals with subjects covered by the International Standard ISO 6594. The major difference is the inclusion of requirements for joints and for product performance.

This standard is in conformity with the general requirements already established by CEN/TC 165 in the field of waste water engineering, as required by EN 476.

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 March 2000, and conflicting national standards shall be withdrawn at the latest by March 2000.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Foreword to amendment A1

This document (EN 877:1999/A1:2006) has been prepared by Technical Committee CEN/TC 203 "Cast iron pipes, fittings and their joints", the secretariat of which is held by AFNOR.

This Amendment to the European Standard EN 877:1999 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2007, and conflicting national standards shall be withdrawn at the latest by July 2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

Annex ZA includes the requirements of the Mandate given under the EU Construction Products Directive (89/106). Only if the requirements specified in Annex ZA are met, the CE marking will be affected.

Where evaluation of conformity is required for regulatory purposes Annex D applies.

For reasons of conformity with the rules for ENs and Mandate M/131 "Pipes, tanks and ancillaries not in contact with water intended for human consumption", EN 877:1999 has been amended by extension with the Annex ZA (see Resolution CEN/BT 113/1994 and CEN/BT 63/1996) and a modification of the Annex D for the evaluation of conformity. This amendment is described in the following pages.

In addition, the amendment of the following parts of EN 877:1999 became necessary.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, 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 United Kingdom.

1 Scope

This European Standard applies to cast iron pipeline components used for the construction of discharge systems for buildings and of drains, normally as gravity systems.

The range of nominal sizes extends from DN 40 to DN 600 inclusive.

This standard specifies the requirements for the materials, dimensions and tolerances, mechanical properties, appearance, standard coatings for cast iron pipes, fittings and accessories. It also indicates performance requirements for all components, including joints. Quality assurance is covered in an informative annex.

It covers pipes, fittings and accessories cast by any foundry process or manufactured by fabrication of cast components, as well as the corresponding joints.

2 Normative references

This European Standard incorporates by dated or undated reference provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the last edition of the publication referred to applies.

EN 476	1997	General requirements for components used in discharge pipes, drains and servers for gravity systems
EN 598	1994	Ductile cast iron pipes, fittings, accessories and their joints for sewerage application - Requirements and test methods
EN 605	1992	Paints and varnishes - Standard panels for testing (ISO 1514:1984 modified)
EN 10002-1	1990	Metallic materials - Tensile testing - Part 1: Method of test (at ambient temperature)
EN 10003-1	1994	Metallic materials - Brinell hardness test - Part 1: Test method
EN 10088-1	1995	Stainless steels - Part 1: List of stainless steels
EN 10088-2	1995	Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip for general purposes
EN 10088-3	1995	Stainless steels - Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes
EN 10204	1991	Metallic products - Types of inspection documents
EN 45011	1989	General criteria for certification bodies operating product certification

prEN 1366-3	-	Fire tests for building elements and components - Fire resistance testing of service installations - Part 3: Penetration seals
EN ISO 6708	1995	Pipework components - Definition and selection of DN (nominal size) (ISO 6708:1995)
[A1] Text deleted [A1]		
ISO 185	1988	Grey cast iron - Classification
EN 20898-1	1991	Mechanical properties of fasteners - Part 1: Bolts, screws and studs (ISO 898-1:1988)
EN 20898-2	1993	Mechanical properties of fasteners - Part 2: Nuts with specified proof load values - coarse thread (ISO 898-2:1992)
ISO 1817	1985	Rubber, vulcanised - Determination of the effect of liquids
EN ISO 2409	1994	Paints and varnishes - Cross-cut test (ISO 2409:1992)
ISO 2808	1991	Paints and varnishes - Determination of film thickness
EN ISO 2812-1	1994	Paints and varnishes - Determination of resistance to liquids - Part 1: General methods (ISO 2812-1:1993)
ISO 4628-2	1982	Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 2: Designation of degree of blistering
ISO 4628-3	1982	Paints and varnishes - Evaluation of degradation of paint coatings - Designation of intensity, quantity and size of common types of defect - Part 3: Designation of degree of rusting
[A1] Text deleted [A1]		
[A1] EN 681-1		Elastomeric seals - Materials requirements for pipe joint seals used in water and drainage applications - Part 1: Vulcanized rubber
EN 13501-1		Fire classification of construction products and building elements - Part 1: Classification using test data from reaction to fire tests
EN 13823		Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item
EN ISO 1716		Reaction to fire tests for building products - Determination of the heat of combustion (ISO 1716:2002) [A1]

EN ISO 9001	2000	Quality management systems - Requirements (ISO 9001:2000)
EN ISO 11925-2		Reaction to fire tests - Ignitability of building products subjected to direct impingement of flame - Part 2: Single-flame source test (ISO 11925-2:2002)
ISO 7253	1984	Paints and varnishes - Determination of resistance to neutral salt spray
ISO 7724-1	1988	Paints and varnishes - Colorimetry - Part 1: Principles
ISO 7724-2	1988	Paints and varnishes - Colorimetry - Part 2: Colour measurement
ISO 7724-3	1988	Paints and varnishes - Colorimetry - Part 3: Calculation of colour differences

3 Definitions

For the purposes of this European Standard, the following definitions apply:

3.1 discharge system for buildings

System of pipes, fittings, accessories and joints used to collect and drain waste water and rainwater from a building; it comprises discharge pipes, stack ventilation and rainwater pipes, installed within the limits of a building or attached to the building.

3.2 drain

System of pipes, fittings, accessories and joints installed outside the limits of a building in order to connect the discharge system of this building to a sewer or a septic tank.

3.3 sewer

System of pipes designed to collect waste water and rainwater from buildings and surface water and to convey them to the point of disposal or treatment.

3.4 cast iron

Alloy of iron and carbon in which graphite can be present in different forms.

3.5 pipe

Casting of uniform bore, straight in axis, normally having plain ends but which can also be socketed.

3.6 fitting

Cast iron component, other than a pipe, which allows a deviation, a change of direction or diameter, including flanged and access components.

3.7 accessory

Any casting other than a pipe or fitting used in a pipeline, e.g. inspection/junction chambers.

3.8 joint

Connection between the ends of pipes and/or fittings, including the coupling or clamping component, with sealing effected by elastomeric gasket(s).

3.9 nominal size (DN)

An alphanumeric designation of size for components of a pipework system, which is used for reference purposes. It comprises the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections [EN ISO 6708].

NOTE: In this standard, it is the bore.

3.10 length

Effective length of a pipe or fitting

NOTE: For flanged pipes and fittings, the effective length is equal to the overall length. For spigot and socket pipes and fittings, the effective length is equal to the overall length minus the spigot insertion depth as given in the manufacturer's catalogues.

3.11 initial type test

Proof of design test which is carried out once to demonstrate compliance with the requirements of this standard and which is repeated only after significant change in manufacture, design or material.

3.12 manufacturer

Legal entity, manufacturing and selling systems as defined in 3.1 and 3.2, presenting them as his own work, i.e. showing on all products his manufacturing mark and/or name.

3.13 range of products

Group of products produced by one manufacturer for which the test results for one or more characteristics from any one product within the range are valid for all other products within this range. 

4 Technical requirements

4.1 General

4.1.1 Introduction

The general requirements for pipes, fittings, joints and accessories are defined in 4.1 to 4.7 and in 4.10. Additional requirements are given in 4.8 for buried systems and in 4.9 for rainwater systems to be installed outside buildings.

NOTE: Information on manufacturing criteria and quality assurance is given in annex D.

4.1.2 Surface condition

Pipes, fittings and accessories shall be free from defects (superficial and other defects) which could be detrimental to their correct operation or long service life as defined in this standard.

4.1.3 Reaction to fire

Uncoated cast iron pipes and fittings, their joints and accessories are Class A1 CWFT according to CEC Decision 96/603/EC as amended.

Considering the products in their end-use conditions (assembled into a discharge system), internal coatings are not relevant as they are not exposed to fire (a very low quantity of smoke is possible but it will go outside buildings through stack vents). Gaskets of joints are not relevant either as in the end-use conditions they are not exposed to fire and represent a very low quantity of organic material.

According to EN 13501-1, as the gross calorific potential (PCS) of the products in their assembled state (pipes, fittings, joints, their components and materials), due to their densities and weight quantities, will always satisfy the requirement on PCS for the product as a whole ($\leq 3,0$ MJ/kg), the reaction to fire classification shall be obtained as follows:

- external coatings, if containing more than 1 % by weight or volume (whichever is the more onerous) of homogeneously distributed organic material, shall satisfy the requirements of 4.6.3 on ignitability or gross calorific potential, depending on the intended class of reaction to fire

and

-  a range (including coated pipes, coated fittings and couplings) shall be  tested according to EN 13823 (SBI), using the mounting adaptations given in Annex H, and shall satisfy the requirements of classification criteria and additional classifications listed in EN 13501-1 for the intended class of reaction to fire.

NOTE See F.2.

4.1.4 Noise protection

For installed networks, there may be national installation regulations concerning noise protection, and manufacturers could provide information about solutions for requirements (see also Annex F).

NOTE 1 For installed networks, there can be national installation regulations concerning noise protection, and manufacturers could provide information about solutions for requirements (see also Annex F).

NOTE 2 Noise protection is not mandated under CPD. There are no national regulations concerning noise in direct relation to the product.

4.1.5 Dangerous substances (regulated substances)

The materials which the products are made from shall not release dangerous substances (regulated substances) in excess of the maximum permitted levels specified by a relevant European Standard for the materials or permitted by national regulations in the territory of destination. 

4.2 Dimensions

4.2.1 Nominal size (DN)

The nominal sizes shall be as given in column 1 of table 1.

4.2.2 External diameter (DE)

The standard external diameters (DE) of pipes and fittings, as well as the tolerances applicable to these, shall comply with the values given in table 1, when measured in accordance with 5.2.1. When, by agreement between manufacturer and purchaser, specific coatings are supplied for special applications, other tolerances are permitted. Due regard shall be given to 4.7, in this case.

Table 1: Dimensions of pipes and fittings

Dimensions in millimetres

DN	External diameter DE		Wall thickness	
	Nominal value	Tolerance	Nominal value	Minimum value
40	48	+2 -1	3,0	2,5
50	58	+2 -1	3,5	3,0
70	78	+2 -1	3,5	3,0
75	83	+2 -1	3,5	3,0
100	110	+2 -1	3,5	3,0
125	135	+2 -2	4,0	3,5
150	160	+2 -2	4,0	3,5
200	210	+2,5 -2,5	5,0	4,0
250	274	+2,5 -2,5	5,5	4,5
300	326	+2,5 -2,5	6,0	5,0
400	429	+2 -3	6,3	5,0
500	532	+2 -3,5	7,0	5,2
600	635	+2 -4	7,7	5,8

NOTE 1: In countries where the nominal sizes DN 60 and DN 80 are still mentioned in application standards these nominal sizes can still be used.

~~NOTE 2: Other dimensions are given in 4.8 for buried systems and in 4.9 for rainwater systems installed outside buildings.~~

4.2.3 Wall thickness

Wall thicknesses of pipes and fittings shall comply with the values given in table 1, when measured in accordance with 5.2.2.

4.2.4 Internal diameter

In order to ensure the hydraulic function, the internal diameter of pipes when measured in accordance with 5.2.3, shall be not less than:

- 0,975 DN for nominal sizes equal to or greater than DN 70;
- 0,950 DN for nominal sizes less than DN 70.

4.2.5 Ovality

When measured in accordance with 5.2.4 the ovality of the pipes and of the sealing zones of fittings (see 4.2.9) shall remain within the tolerances on DE shown in table 1 for DN 40 to DN 300 and shall not exceed 1 % for DN 400 to DN 600 (see 3.32 of EN 598:1994).

4.2.6 Straightness of pipes

When measured in accordance with 5.2.5 the pipes shall be straight with a maximum deviation of:

- 0,15 % of their length for nominal sizes greater than DN 70;
- 0,20 % of their length for nominal sizes equal to or less than DN 70.

4.2.7 End faces

The end faces of the products shall be free from faults which may impair their fitness for use and their planes shall be perpendicular with the axes of symmetry of the products. When measured in accordance with 5.2.6, the maximum deviation from the right angle shall be:

- 3° for nominal sizes DN 40 to DN 200;
- 2° for nominal sizes DN 250 to DN 600.

4.2.8 Length of pipes

Pipes shall be normally produced with a length of 3 m.

NOTE: Other lengths are permitted and can be supplied with special identification by agreement between the manufacturer and the purchaser.

When measured in accordance with 5.2.7 the length of all pipes shall be within a tolerance of ± 20 mm.

4.2.9 Lengths of fittings and sealing zones

Lengths of fittings shall be given in the manufacturers' catalogues. When measured in accordance with 5.2.7 the lengths of fittings shall be within a tolerance of ± 5 mm.

The ends of the fittings shall have sealing zones straight in axis and free from marking and free from defects which could impair the fitness for use.

The length T (see figure 1) of this sealing zone shall comply with the values given in table 2.

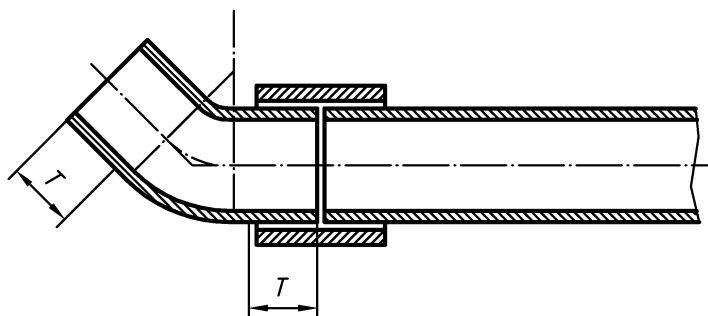


Figure 1

4.2.10 Geometry of fittings and accessories

The geometry of fittings and accessories is not standardized at this stage. Fittings and accessories of geometry presently used in various countries are in conformity with this standard as long as they comply with all other technical requirements of this standard.

Table 2: Sealing zone of fittings

DN	Length T of sealing zone mm	Lower deviation on T ^{*)} mm
40	30	- 5
50	30	
70	35	
75	35	
100	40	
125	45	
150	50	
200	60	- 4
250	70	
300	80	
400	80	
500	80	
600	80	
*) Upper deviations are not given and sealing zones with a length greater than T are permitted.		

4.2.11 Angles of fittings

Fittings shall be designed to the angles specified below with a design tolerance of $\pm 2^\circ$:

- bends: 15°; 22°; 30°; 45°, 68°; 88°;
- single/double branches: 45°; 68°; 88°.

4.2.12 Access components and traps

The minimum dimension of the openings of access components up to DN 150 inclusive, shall be at least equal to the whole number of the nominal size in millimetres. For access components over DN 150, the minimum dimension of the opening shall be at least 150 mm.

The height of water seal of traps shall be at least 50 mm.

4.3 Interconnection

Products of the same DN in accordance with this standard (see table 1) can be connected with each other.

4.4 Mass

The nominal masses of finished products (pipes, fittings and accessories) shall be given in the manufacturers' catalogues. When the mass is measured in accordance with 5.3, the lower deviation shall not exceed 15 % of the nominal mass.

4.5 Material characteristics of pipes, fittings and accessories

4.5.1 Cast iron

Pipes, fittings and accessories shall be manufactured from:

- grey cast iron in accordance with ISO 185; or
- spheroidal graphite cast iron in accordance with EN 598; or
- any other type of cast iron in accordance with 4.5.2.

4.5.2 Mechanical properties

Pipes, fittings and accessories shall have the mechanical properties given in table 3.

Table 3: Mechanical properties of pipes, fittings and accessories

Type of casting and material ¹⁾²⁾	Minimum tensile strength MPa	Minimum ring crush strength MPa	Maximum Brinell hardness HB
Pipes			
- grey cast iron	200	350 ³⁾	260
- spheroidal graphite cast iron	420	--	230
Fittings and accessories			
- grey cast iron	150	--	260
- spheroidal graphite cast iron	420	--	250
1) Other types of cast iron shall satisfy the criteria laid down for grey cast iron. 2) Tensile and ring crush strength for other products see annex A. 3) 332 MPa for nominal sizes equal to or greater than DN 250.			

The modulus of elasticity E shall be given by the manufacturer. It is normally at least 110 GPa for grey cast iron and at least 170 GPa for spheroidal graphite cast iron.

4.6 Coatings for pipes, fittings and accessories

4.6.1 General

The cast iron components shall be coated internally and externally. Before applying the coatings, the surfaces shall be dry and free from rust or non-adhering products or foreign matter, e.g. oil, grease.

Points of contact inherent in the coating application systems are permitted.

These coatings shall not become sticky when they are subjected to temperatures which can reach 100 °C. They shall maintain an acceptable appearance up to installation and permit the application of additional external finishing coatings.

The manufacturer shall specify the minimum factory applied thicknesses of the dry internal and external coatings on the finished products and shall demonstrate that these coatings conform to 4.6.2 or 4.6.3 respectively.

NOTE: Specific requirements for coatings for buried systems and rainwater systems installed outside buildings are given in 4.8.3 and 4.9.2 respectively.

4.6.2 Internal coatings

When tested in accordance with 5.7.2 the materials for internal coatings shall conform to the following requirements:

- resistance to salt spray : at least 350 h in accordance with ISO 7253;
- resistance to waste water : at least 30 d at 23 °C;
- chemical resistance
from pH 2 to pH 12 : at least 30 d at 23 °C.

When tested in accordance with 5.7.2, the internal coatings on finished products shall conform to the following requirements:

- dry coating thickness : not greater than 400 µm (except for specific coatings for special applications), and at least the minimum factory applied thickness to be specified by the manufacturer (see 4.6.1);
- adhesion : in accordance with level 1 of EN ISO 2409;
- resistance to hot water : 24 h at 95 °C;
- resistance to temperature cycling : 1500 cycles between 15 °C and 93 °C.

4.6.3 External coatings

The external coatings on finished products which are only considered as a primary coat shall not be readily flammable and shall be free from toxic heavy metals.

When tested in accordance with 5.7.3 the materials for external coatings shall conform to the following requirements :

- colour: definition by trichromatic coordinates:
 $L = 37$; $a = 24$; $b = 16$; $\Delta E = 4,0$ in accordance with ISO 7724-1, ISO 7724-2 and ISO 7724-3 (approximately reddish-brown);
- compatibility with other paints: paints normally used on metallic structures;

For a classification of AC_1 the range AC_1 within classes E to B (see EN 13501-1, table on “classes on reaction to fire on performance for construction products excluding floorings”), each coating shall conform to the following requirements when tested in accordance with 5.7.3.3:

- ignitability: requirements of classification criteria and additional classifications listed in EN 13501-1 specific to the class.

For an A2 classification of AC_1 the range AC_1 (see EN 13501-1, table on “classes on reaction to fire on performance for construction products excluding floorings”), the gross calorific potential of the external coatings, noted $\text{PCS}_{\text{range ext. coating, AC}_1}$ shall conform to the requirements of EN 13501-1 on external components when tested and calculated in accordance with 5.7.3.3:

- gross calorific potential of external coatings, $\text{PCS}_{\text{range ext. coating, AC}_1}$:
- if external coatings are substantial components, $\text{PCS}_{\text{range ext. coating, AC}_1} \leq 3 \text{ MJ/kg; AC}_1$
- if external coatings are non-substantial components, $\text{PCS}_{\text{range ext. coating, AC}_1} \leq 4 \text{ MJ/m}^2 \text{ AC}_1, \text{A}_1$

When tested in accordance with 5.7.3 the external coatings on finished products shall conform to the following requirements:

- dry coating thickness: minimum factory applied thickness to be specified by the manufacturer (see 4.6.1);
- adhesion: in accordance with level 2 of EN ISO 2409.

4.7 Joints

4.7.1 General

The joints are intrinsic components of the manufacturer's discharge systems. They shall permit correct connection between the ends of pipes and/or fittings and accessories in accordance with this standard.

Taking into account the different applications of cast iron pipework systems, various joint designs are permitted provided that they satisfy the requirements of this standard. The joints shall incorporate one or more elastomeric gasket(s) to ensure leaktightness and prevent direct contact between the ends of pipework components.

4.7.2 Dimensions

The effective width of the sealing zone of joints shall not exceed the dimension $2T$ as shown in figure 1 and table 2. The overall dimensions of the joints are also limited by the dimensions and angles of the fittings.

The drawings of the joints shall give the main dimensions and tolerances of the joint and of its components.

4.7.3 Materials

4.7.3.1 Couplings or clamping components shall usually be made from:

- a) cast iron according to table =3= (for fittings and accessories);
- b) stainless steels in accordance with EN 10088-1, EN 10088-2 and EN 10088-3; in order to ensure resistance to corrosion and a stabilization against the effects of intergranular corrosion, only the following types shall be permitted:

- austenitic steels: all grades;
- ferritic and martensitic steels: X 3 CrTi 17 or X 3 CrNb 17 .

Cast iron couplings or clamping components shall be coated according to 4.6, at least on the surfaces not covered by the gaskets.

4.7.3.2 When other materials are used, they shall meet the following requirements:

- the materials shall conform to the corresponding materials standards;
- the components shall be suitably coated and withstand a salt spray test of at least 350 h in accordance with ISO 7253, the acceptable levels of blistering being dimension 3, class 3 in accordance with ISO 4628-2 and rusting being R_i not greater than 2 in accordance with ISO 4628-3;
- for steel bolts and nuts the minimum strength class shall be 8.8 for bolts and 8 for nuts in accordance with EN 20898-1 and EN 20898-2 respectively;
- the joints shall conform to 4.7.

4.7.3.3 The elastomeric gaskets shall:

- conform to EN 681-1 ;
- satisfy the type test defined in 5.8.2.1, except in the case of special joints (e.g. restrained) and/or specific applications (e.g. resistance to certain fluids) where other elastomers may be used.

4.7.3.4 The manufacturer shall specify the materials used for the different joint parts and shall be able to present inspection documents drawn up either by himself or by his subcontractors (see EN 10204).

4.7.4 Suitability for use

All parts of the joints shall be free from defects likely to compromise their suitability for use. Sharp edges should be avoided.

Couplings and clamping components shall be designed so that they satisfy the water tightness requirements of table 4 line a) without any permanent changes (e.g. deformation, cracks, damaged threads) which could impair the performance of the joint.

The manufacturer's instructions shall contain all information concerning the application and installation of the joints and, if necessary, information on the torque for tightening the bolts.

4.7.5 Water tightness

When tested in accordance with 5.8.4 and 5.8.5, on test apparatus preventing any excessive axial displacement and subjected to the test conditions and hydrostatic pressures given in table 4, the joints shall exhibit no visible leakage.

Table 4 specifies the hydrostatic test pressures for the following test conditions:

- a) joint with pipes aligned;
- b) joint with pipes deflected to an angle of at least:
 - 3° for nominal sizes up to and including DN 200;
 - 1°45' for nominal sizes greater than DN 200.
- c) joint subject to a shear force of at least 10 DN in newtons, with pipes aligned.

Table 4: Water tightness of joints- performance requirements

Test condition	Hydrostatic test pressure in bar			
	DN ≤ DN 200		DN > DN 200	
	internal	external	internal	external
a) aligned	0 to 5 ¹⁾	0 to 0,5 ²⁾³⁾	0 to 3 ¹⁾	0 to 0,5 ²⁾³⁾
b) deflected	0 to 5 ¹⁾	--	0 to 3 ¹⁾	--
c) subject to shear force	0 to 1 ¹⁾²⁾	--	0 to 1 ¹⁾²⁾	--
¹⁾ 0 to 0,5 bar water pressure for joints which will only carry limited pressures because of their intended use and installation; 0 to 0,1 bar water pressure for joints connecting to sanitary ware, e.g. WC, washbasin. ²⁾ applicable to socketed joints only when they are to be buried. ³⁾ does not apply to nominal sizes less than DN 100 and does not apply to joints connecting to sanitary ware, e.g. WC, washbasin. NOTE: 1 bar = 100 kPa = 0,1 MPa				

4.7.6 Air tightness

In order to ensure a seal against odours, all joints shall be tight against positive internal air pressure of 0 mbar to 10 mbar when tested in accordance with 5.8.6.

4.7.7 Temperature resistance

When tested in accordance with 5.8.7 the joints shall conform to the following requirements:

- resistance to temperature cycling: 1500 cycles between 15 °C and 93 °C;
- resistance to hot water: 24 h at 95 °C.

These requirements shall not apply to joints for rainwater systems installed outside buildings or joints connecting to WC and urinals.

4.8 Buried systems

4.8.1 General

The requirements given in 4.2 to 4.7 shall apply, together with the modifications given in 4.8.2 to 4.8.4

For marking see 4.10.2.

4.8.2 Dimensions

The dimensions shall be as given in table 1.

NOTE: Other dimensions as given in annex A are permitted by agreement between the manufacturer and the purchaser.

4.8.3 External coatings

4.8.3.1 General

Coatings in accordance with 4.8.3.2 or 4.8.3.3 shall be used instead of those specified in 4.6.3. Pipes and fittings with these coatings may be buried in contact with the majority of soils. Further information on the field of use of these buried systems is given in annex C.

The coatings applied shall be dense, continuous and free from such defects as bare patches or lack of adhesion.