

**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

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## 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 It supersedes BS 416-2:1990 and BS 6087:1990 which are withdrawn.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The committee has produced a national annex which identifies some of the most significant changes from the withdrawn British Standards BS 416-2 and BS 6087.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.**

This British Standard was published under the authority of the Standards Committee and comes into effect on 15 December 1999

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16741	30 November 2006	See national foreword
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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.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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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)
<b>A1</b> Text deleted <b>A1</b>		
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
<b>A1</b> Text deleted <b>A1</b>		
<b>A1</b> 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) <b>A1</b>

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 $\square_{A1}$ initial type test $\square_{A1}$

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.

### $\square_{AC1}$ 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.  $\square_{AC1}$

## 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.

#### **A1** 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

- **AC1** a range (including coated pipes, coated fittings and couplings) shall be **AC1** 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. **A1**

## 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.~~

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  $\pm 20$  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  $\pm 5$  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.

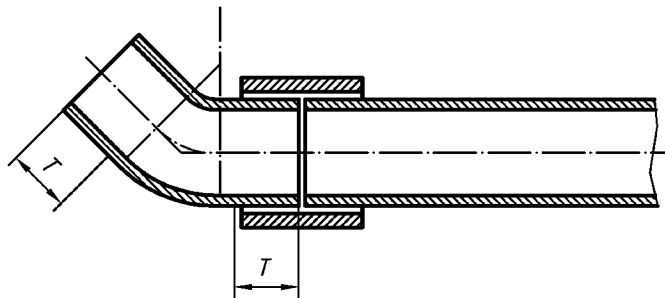


Figure 1

#### 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	
250	70	- 4
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 <sup>1)2)</sup>	Minimum tensile strength MPa	Minimum ring crush strength MPa	Maximum Brinell hardness HB
Pipes			
- grey cast iron	200	350 <sup>3)</sup>	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;

**[A1]** For a classification of **[AC1]** the range **[AC1]** 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 **[AC1]** the range **[AC1]** (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 **[AC1]** PCS<sub>range ext. coating</sub>, **[AC1]** 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, **[AC1]** PCS<sub>range ext. coating</sub> **[AC1]**:
  - if external coatings are substantial components, **[AC1]** PCS<sub>range ext. coating</sub>  $\leq 3$  MJ/kg; **[AC1]**
  - if external coatings are non-substantial components, **[AC1]** PCS<sub>range ext. coating</sub>  $\leq 4$  MJ/m<sup>2</sup> **[AC1]**. **[A1]**

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:  $\text{A}_1$  X 3 CrTi 17 or X 3 CrNb 17.  $\text{A}_1$

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 Ri 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  $\text{A}_1$  EN 681-1  $\text{A}_1$ ;
- 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 <sup>1)</sup>	0 to 0,5 <sup>2)3)</sup>	0 to 3 <sup>1)</sup>	0 to 0,5 <sup>2)3)</sup>
b) deflected	0 to 5 <sup>1)</sup>	--	0 to 3 <sup>1)</sup>	--
c) subject to shear force	0 to 1 <sup>1)2)</sup>	--	0 to 1 <sup>1)2)</sup>	--

<sup>1)</sup> 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.  
<sup>2)</sup> applicable to socketed joints only when they are to be buried.  
<sup>3)</sup> 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.

#### 4.8.3.2 Pipes

Pipes shall have an outside coating comprising a layer of metallic zinc covered by a finishing paint compatible with zinc. Both layers shall be works-applied. The zinc layer is usually applied by spraying on oxide-surfaced pipes free from rust or non-adhering particles or foreign matter such as oil or grease. The finishing paint may also be applied by other suitable methods.

When measured in accordance with 5.9.2:

- the mean mass of zinc per unit area shall be not less than  $130 \text{ g/m}^2$ , with a local minimum of  $110 \text{ g/m}^2$  ;
- the mean dry film thickness of the finishing layer shall be not less than  $70 \text{ }\mu\text{m}$ , with a local minimum of  $50 \text{ }\mu\text{m}$ , when using a bituminous paint; with other paints, lower thicknesses may be applied on fine grained zinc (such as from flame spraying).

NOTE: By agreement between the manufacturer and purchaser other external coatings which comply with the corresponding European standards or, in their absence, with International standards or with national standards or with an agreed technical specification, can be applied in accordance with the conditions of use, provided that sufficient protection against corrosion is obtained.

#### 4.8.3.3 Fittings and accessories

Fittings and accessories shall have a coating which should be identical in colour to that of the pipes and of a quality at least equivalent to that of the pipes, e.g. zinc-rich paints containing at least 90 % zinc by mass of dry film, or epoxy resin based coatings.

NOTE: See note to 4.8.3.2.

#### 4.8.4 Joints

##### 4.8.4.1 Materials

All parts of couplings or clamping components shall be made from cast iron (see 4.7.3), and coated in accordance with 4.8.3.3, or from austenitic stainless steel in accordance with EN 10088-1, EN 10088-2 and EN 10088-3, with at least 16,5 % chrome and 8,5 % nickel or equivalent, or from material of comparable resistance.

##### 4.8.4.2 Water tightness

For joints which are used exclusively for buried systems, the internal hydrostatic test pressure specified in table 4 lines a) and b) may be limited to 1 bar.

## **4.9 Rainwater systems installed outside buildings**

### **4.9.1 General**

The requirements given in 4.2 to 4.7.4 shall apply together with the modifications in 4.9.2 to 4.9.6.

### **4.9.2 Coatings**

The external coatings shall comply with 4.6.3 except for colour. The internal coatings may be identical to the external coatings.

### **4.9.3 Geometry**

Cross sections other than circular are permitted, as well as socketed components.

In the case of components with circular section the dimensions shall be those given in table 1. The dimensions specified in annex B are permitted by agreement between the manufacturer and the purchaser.

### **4.9.4 Nominal sizes**

For components with circular cross section see 3.9. For components with non circular cross section the nominal size shall approximately correspond to the diameter of the circle inscribed in the cross section of the profile, expressed in millimetres.

### **4.9.5 Lengths of pipes**

Pipes shall be normally produced with lengths of 1 m, 2 m or 3 m.

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

### **4.9.6 Joints**

Joints shall be watertight at least to non-pressurized gravity flow.

.....

## 4.10 Marking

### 4.10.1 General

**A1** If the manufacturer declares conformity of his products with this European Standard, pipes, fittings and accessories as well as the couplings or clamping components and the gaskets shall be legibly and indelibly marked and shall bear at least the following information: **A1**

- the manufacturer's name or mark;
- the identification of the production site;
- the period of manufacture, coded or not;
- the reference to this standard;
- the DN, or several DN where applicable;
- the design angle of fittings;
- the identification of the accredited third party, where applicable (see annex D and annex E).

NOTE: The last two items are not appropriate for gaskets.

In the case of pipes the above markings shall be applied at least once per metre length.

When the marking on fittings is cast-on, it shall be located outside the sealing zone *T* (see table 2).

When the dimensions of the component do not permit full marking, an abbreviated marking providing identification of the component shall be used.

**A1** NOTE See Annex ZA for regulatory marking. Where Annex ZA.3 requires the marking to be accompanied by the same information as required by this clause, the requirements of this clause are met. **A1**

### 4.10.2 Buried systems

In addition to the requirements of 4.10.1 pipes for buried systems shall be identified by specific colour or additional marking.

### 4.10.3 Rainwater systems installed outside buildings

Since rainwater systems installed outside buildings are frequently considered as part of the aesthetic appeal of a facade, it is permitted that the components are not marked and that marking is shown on or attached to the packaging.

## 5 Test methods

### 5.1 Surface condition

The surface condition (see 4.1.1) of the finished products (internal and external) shall be inspected visually with the aid of an appropriate light source.

### 5.2 Dimensions

#### 5.2.1 External diameter (DE)

The external diameter shall be measured on coated pipes and fittings, to an accuracy of 0,2 mm, at a distance of at least 20 mm from the end faces of the product. Two measurements shall be taken at right angles at each cross section and each measurement shall be within the tolerances given in table 1 and for ovality, in accordance with 4.2.5. For nominal sizes  $\geq$  DN 400, the external diameter may be measured by means of a circumferential tape or controlled by pass-fail gauges.

For fittings, measurements shall be taken at least along the length  $T$  of the sealing zone (see table 2).

In the case of pipes, additional measurements may be made, if necessary, along the pipe length.

NOTE: Production control may be carried out with pass-fail gauges.

#### 5.2.2 Wall thickness

Wall thicknesses shall be measured on coated pipes and fittings to an accuracy of 0,1 mm by suitable equipment e.g. with spherical end calipers. Measurements shall be taken on each end of the product in at least two diametrically opposed positions and each measurement shall be at least equal to the minimum wall thickness given in table 1. In the case of coatings having a thickness greater than 400  $\mu\text{m}$  the difference between the actual coating thickness and 400  $\mu\text{m}$  shall be added to the minimum wall thickness as given in table 1.

If necessary, additional measurements along the length of the pipes may be made, e.g. by means of ultrasonics having an accuracy of 0,1 mm; in this case, it is necessary to calibrate the test equipment and to add the external and internal thicknesses of the coatings to the thickness measured.

#### 5.2.3 Internal diameter

In general, the internal diameter will not be measured and compliance with 4.2.4 shall be demonstrated by calculation from the measurements taken for external diameter and wall thickness of pipes (see 5.2.1 and 5.2.2).



#### 5.2.4 Ovality

The control of ovality shall be in accordance with 5.2.1.

#### 5.2.5 Straightness of pipes

The pipe shall be rolled on two gantries or rotated around its axis on rollers, which in each case are separated by not less than two-thirds of the pipe length. The point of maximum deviation from the straight axis shall be determined and the deviation measured at that point shall not exceed the limit given in 4.2.6.

#### 5.2.6 End faces

The perpendicularity of the planes of the end faces with the axes of symmetry of the products shall be measured by appropriate equipment to an accuracy of 30' and shall be within the tolerances specified in 4.2.7.

#### 5.2.7 Lengths

The lengths of pipes, fittings and of the sealing zones shall be measured with suitable equipment to an accuracy of 1 mm, preceded by the test in accordance with 5.2.6. The results shall conform to 4.2.8 or 4.2.9.

#### 5.2.8 Angle of fittings

The angle(s) of fittings shall be determined to an accuracy of 30'.

### 5.3 Mass

The masses of the finished products shall be checked by weighing to an accuracy of within:

- 0,01 kg, for masses up to 1 kg;
- 0,1 kg, for masses greater than 1 kg up to 20 kg;
- 0,5 kg, for masses greater than 20 kg up to 100 kg;
- 1,0 kg, for masses greater than 100 kg.

## 5.4 Tensile strength of pipes and fittings

### 5.4.1 General

For products made of spheroidal graphite cast iron (see 4.5) the tensile strength shall be measured in accordance with 6.3 of EN 598: 1994. For products made of grey cast iron or any other type of cast iron (see 4.5) the determination of tensile strength shall be carried out in accordance with 5.4.2 or 5.4.3.

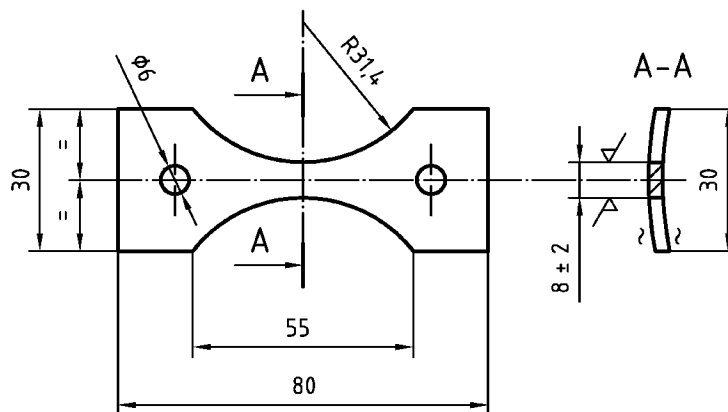
### 5.4.2 Determination of tensile strength (method A) on grey cast iron pipes and fittings

#### 5.4.2.1 Samples

In order to obtain results which are as representative as possible of the finished products, the tensile tests shall be performed on samples taken from pipes or fittings. The sample shall be cut parallel with the axis of the pipe or fitting.

The test piece cut from the sample shall be in accordance with figure 2.

dimensions in millimetres



section A-A

~ not machined

Figure 2

#### 5.4.2.2 Equipment and test method

The testing machine shall have appropriate equipment to permit the application of the test force without slip.

The testing machine shall be able to develop a force which is sufficient to break the test pieces whilst indicating the load applied.

The accuracy of the testing machine shall be in accordance with clause 9 of EN 10002-1: 1990.

The speed of load application shall be as constant as possible in accordance with 10.1 of EN 10002-1: 1990.

The tensile strength shall be calculated by dividing the force indicated at rupture by the area of the initial cross-section of the test piece. The cross section (width and thickness) shall be measured with an accuracy of 0,1 mm before the test.

#### 5.4.3 Determination of tensile strength (method B) of grey cast iron fittings

The determination of tensile strength shall be carried out in accordance with ISO 185. The accuracy of the testing machine shall be in accordance with clause 9 of EN 10002-1: 1990.

#### 5.4.4 Validity of tensile strength tests

##### 5.4.4.1 Pipes and fittings of grey cast iron; method A (see 5.4.2)

The results of the tensile tests shall be in accordance with the requirements of table 3. However the test is declared valid if the following conditions are fulfilled:

- for pipes: the average of three values taken on one day's production shall be at least 200 MPa and at maximum one value may be between 180 Mpa and 200 MPa;
- for fittings: all values shall be at least 150 MPa.

A test can be cancelled if the unsatisfactory results obtained are due, not to the quality of the cast iron itself, but to any of the following reasons:

- incorrect mounting of the test piece or abnormal operation of the testing machine;
- fault in machining of the test piece;
- fault in the casting of the test piece appearing before or after fracture.

Under these conditions, a new test piece shall be taken from the same batch, and the results for the faulty test shall be cancelled.

#### 5.4.4.2 Fittings of grey cast iron; method B (see 5.4.3)

Clauses 8 and 9 of ISO 185: 1988 shall apply.

#### 5.4.4.3 Pipes and fittings of spheroidal cast iron (see 5.4.1)

6.3 of EN 598: 1994 shall apply.

### 5.5 Brinell hardness

The Brinell hardness test shall be carried out in accordance with EN 10003-1, on the outer face of either the product or a sample taken from the product.

The surface to be tested shall be suitably prepared by means of light local grinding and the test results shall conform to table 3.

### 5.6 Ring crush test for grey cast iron pipes

The test shall be carried out on rings at least 60 mm long, cut square to the axis from uncoated pipe barrels.

The obtained rings shall be crushed between parallel platens (without V-support) of a length greater than that of the ring.

The ring crush strength shall be calculated by the following formula:

$$\sigma = \frac{3F(DE - e)}{\pi l e^2}$$

where

- $\sigma$  is the ring crush strength, in megapascals;
- $F$  is the load applied at fracture, in newtons;
- $l$  is the mean length of the ring, in millimetres;
- $DE$  is the mean external diameter of the ring measured before testing, in millimetres;
- $e$  is the mean wall thickness of the ring measured at fracture position in millimetres.

All dimensions shall be measured to an accuracy of 0,1 mm.

The average of three values taken of one day's production shall be in accordance with table 3 and only one value shall be allowed to be a maximum of 5 % below the value given in table 3.

## 5.7 Coatings

### 5.7.1 General

All tests or measurements shall be made on finished products or on standard panels (the latter in accordance with EN 605), after drying and/or polymerization of the coatings (see annex D, clauses D.2 and D.3).

### 5.7.2 Internal coatings

#### 5.7.2.1 Resistance to salt spray

The tests shall be carried out in accordance with ISO 7253 and after the test period of at least 350 h (see 4.6.2) the samples shall be rinsed with demineralized water to remove salt residues.

The coatings shall then be examined immediately for blistering and rusting, the degrees of which shall not exceed those defined in 5.7.2.7.

#### 5.7.2.2 Resistance to waste water

Standard panels in accordance with EN 605 shall be immersed for 30 d in waste water at a temperature of  $(23 \pm 3)$  °C with the composition given in table 5.

**Table 5: Typical composition of waste water**

Constituents	mg/l
Starch	50
Sodium stearate	32
Sodium acetate	56
Glycerine tri-stearate	15
Urea	13
Ammonium sulphate	70
Proteins	90
Potable water	balance

At the end of the immersion period, the test panels shall be rinsed with demineralized water and dried. They shall be examined immediately for blistering or damage. After 24 h at ambient temperature of  $(23 \pm 3)$  °C the test panels shall be examined again.

No loss of adhesion and no rusting shall be accepted.

### **5.7.2.3 Chemical resistance**

The tests shall be carried out in accordance with EN ISO 2812-1 using standard panels complying with EN 605. These samples shall be immersed for 30 d in the following test liquids:

- a solution of sulfuric acid at pH 2, for the first sample;
- a solution of sodium hydroxide at pH 12, for the second sample.

Both solutions shall be held at  $(23 \pm 3)$  °C. The pH shall be continuously monitored and the solutions renewed as soon as the pH has changed by more than 0,3 from the initial value.

At the end of the immersion period the samples shall be rinsed and examined for blistering, the acceptable degree being dimension 3, class 3 according to ISO 4628-2. In addition a cross-cut test in accordance with EN ISO 2409 shall be carried out, in accordance with 5.7.2.5 and the result shall meet level 1 of EN ISO 2409.

The supplier of the coating material shall demonstrate compliance with these requirements for his material.

### **5.7.2.4 Coating thickness**

The tests shall be carried out using test equipment in accordance with method 6 of ISO 2808: 1991 following the procedures below:

- for a pipe: mean value of at least ten measurements, excluding the first 20 mm at each end;
- for a fitting: mean value of at least five measurements spread over the surface of the fitting or of a standard panel which has followed the fitting coating cycle (panel in accordance with EN 605).

The obtained value shall be not less than the minimum factory applied thickness specified by the manufacturer (see 4.6.1) and shall not exceed 400 µm except for specific coatings for special applications (see 4.6.2).

### **5.7.2.5 Adhesion**

The adhesion of the coating shall be checked by a cross-cut test in accordance with EN ISO 2409, in the following way:

- test sample: section 150 mm long cut from a coated pipe or fitting preferably of a size at least DN 100;
- number of cuts: 6;
- spacing of the cuts: 2 mm (3 mm for coatings which have a minimum thickness specified by the manufacturer equal or greater than 120 µm).

The results shall conform to 4.6.2.

### 5.7.2.6 Resistance to hot water

The test shall be performed on coated pipes and fittings or on sections 150 mm long, cut from these products. The end and/or the cut faces shall be sealed to ensure suitable protection.

The samples shall be immersed for 24 h in a water bath held at  $(95 \pm 2)^\circ\text{C}$ . The internal coating shall then be examined immediately for degree of blistering which shall not exceed dimension 3, class 3 in accordance with ISO 4628-2.

### 5.7.2.7 Resistance to temperature cycling

The test assembly shall be subjected to 1500 cycles of passage of hot and cold water in accordance with following schedule:

- $(30 \pm 1)$  l of water at a temperature of  $(93 \pm 2)^\circ\text{C}$  over a period of 1 min, at a constant rate of flow;
- rest and drain period of 1 min;
- $(30 \pm 1)$  l of water at a temperature of  $(15 \pm 5)^\circ\text{C}$  over a period of 1 min, at a constant rate of flow;
- rest and drain period of 1 min.

The water temperature shall be measured at the point of entry.

An example of a typical test set-up is given in figure 3.

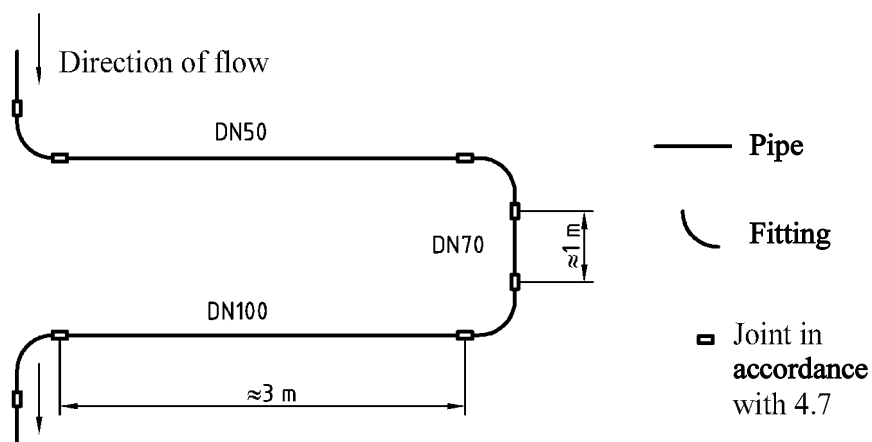


Figure 3

After stopping the test, the pipes and fittings shall be washed immediately to eliminate any stains.

The pipes shall then be sectioned lengthwise and the internal coatings examined for degree of blistering and rusting which shall not exceed the following levels:

- degree of blistering: dimension 3, class 3 according to ISO 4628-2;
- degree of rusting: Ri 2 according to ISO 4628-3.

### 5.7.3 External coatings

#### 5.7.3.1 Colour

The values  $L$ ,  $a$ ,  $b$  and  $\Delta E$  shall be determined in accordance with ISO 7724-2 and ISO 7724-3 and conformance with 4.6.3 shall be demonstrated by the supplier of the coating material.

#### 5.7.3.2 Compatibility with other paints

The supplier of the coating material shall demonstrate that the coating accepts paints normally used on metallic structures (see 4.6.3). This shall be done by tests carried out on steel panels in accordance with EN 605 coated with the dry external coating defined in 4.6.3. Each of the following two types of finishing paints shall be applied by brush on the test panels with a dry thickness of  $(50 \pm 10) \mu\text{m}$ , according to a procedure (which may include a primer) supplied by the manufacturer:

- alkyd - resin based paints, drying in air;
- aqueous phased acrylic and copolymeric resin based paints containing anti-corrosion inhibitors.

After a drying period of 7 d at ambient temperature, a cross-cut test in accordance with 5.7.2.5 shall be carried out and the results shall comply with 4.6.3.

#### **A1** 5.7.3.3 Reaction to fire – external coatings

— Ignitability:

This property shall be tested in accordance with EN ISO 11925-2.

— Gross calorific potential:

For pipes and fittings where the manufacturer is claiming a reaction to fire class A2 **AC1** *Text deleted* **AC1**, each external coating shall be tested according to EN ISO 1716 in order to obtain its gross calorific potential value (PCS).

To classify **AC1** the range and be representative of final use, the PCS of external coatings for the range, noted  $\text{PCS}_{\text{range ext. coating}}$  **AC1**, shall be calculated. The method of calculation is detailed in Annex G. **A1**



### 5.7.3.4 Coating thickness

The dry coating thickness shall be measured in accordance with 5.7.2.4 and the result shall at least conform to the minimum factory applied thickness as specified by the manufacturer (see 4.6.1).

### 5.7.3.5 Adhesion

The test procedure and criteria shall be in accordance with 5.7.2.5 and 4.6.3 respectively.

## 5.8 Joints

### 5.8.1 Dimensions

The dimensions of the couplings and their components, including the elastomeric gaskets, shall be measured to an accuracy appropriate to the size of the various dimensions. They shall be in accordance with the drawings of the supplier of the coupling and with 4.7.2.

### 5.8.2 Elastomeric gaskets

#### 5.8.2.1 Material type tests

**A<sub>1</sub>** Elastomeric gaskets shall be tested in accordance with **EN 681-1** (see 4.7.3). **A<sub>1</sub>** In addition they shall be tested by immersion in the emulsion specified in table 6, combined with the determination of increase in volume and of ozone resistance.

**Table 6: Test liquid for elastomeric gaskets**

Constituents
5 parts olive oil, cold-pressed, 1st pressing 2 parts emulsifier comprising, by mass, the following: <ul style="list-style-type: none"> <li>- 15 % non-ionic surface active agent;</li> <li>- 5 % citric acid (free of water);</li> <li>- 17 % Sodium-cumene-sulfonate solution (45 % concentration);</li> <li>- 63 % demineralized water</li> </ul> 93 parts distilled water

The immersion test shall be carried out in four successive cycles, each made up of 24 h of immersion in the emulsion specified in table 6 at ambient temperature, followed by 24 h in a drying oven at 100 °C, the total test period being 8 d.

The ratio of volumes between elastomer and test liquid shall be between 1/80 and 1/90.

After each cycle the test sample shall be rinsed and dried and the test liquid shall be prepared anew for the next cycle.

The increase in volume shall be determined after each cycle in accordance with ISO 1817. The value found after the fourth cycle shall not exceed 45%.

**[A1]** The ozone resistance shall be determined after the fourth cycle in accordance with **EN 681-1**, applying an ozone concentration of 50 pphm. **[A1]** No cracking (degree of cracking 0) shall appear on the test sample.

The supplier of the couplings and/or gaskets shall demonstrate compliance with 5.8.2.1 for his material.

#### **5.8.2.2 Production tests**

For production testing, the immersion test in accordance with 5.8.2.1 may be replaced by checking that there is no change in the nature of the elastomer, e.g. by the determination of the ash content, with respect to initial values.

#### **5.8.3 Suitability for use**

Conformance with 4.7.4 shall be assessed for each type and each DN (see 5.8.4.2).

#### **5.8.4 Water tightness of joints to positive internal pressure**

##### **5.8.4.1 General**

The tests shall be carried out at ambient temperature on coated products on at least one DN by type of joint and ranges of DN defined in table 7.

**Table 7: Ranges of DN**

DN ≤ DN 200
DN > DN 200

All tests shall be carried out on assembled joints comprising a coupling, jointed with one pipe having maximum external diameter and a second pipe having minimum external diameter, each pipe being at least 1 m long. These maximum and minimum diameters may be obtained by machining.

The test apparatus (see figure 4) shall be capable of providing suitable axial and lateral restraints whether the joint is in the aligned position, or deflected, or subjected to shear. One of the pipe ends of the assembled joint shall bear on a flat support at approximately 50 mm from the joint.

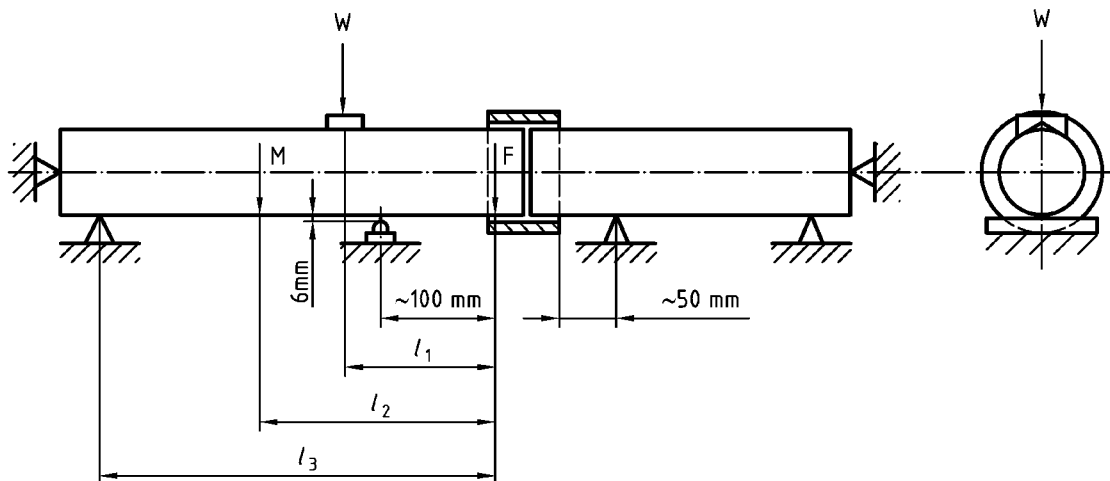


Figure 4

The test assembly shall be filled with water and suitably vented of air. The hydrostatic pressure shall be raised steadily and held at every stage in accordance with table 8 until it reaches the test pressure given in table 4, depending on the test condition.

Throughout the duration of the test, all necessary safety precautions should be taken; the joint shall show neither leakage nor changes which may impair the performance of the joint.

Table 8: Rates and stages of increase in hydrostatic pressure

Test pressure bar	Rate of increase in pressure bar/min.	Level and duration of pressure stages	
		Level bar	Duration min
> 0,5	$\leq 10$	0 0,5 test pressure (see table 4)	5 10 $\geq 15$
$\leq 0,5$	$\leq 0,1$	0 0,05 test pressure (see table 4)	5 10 $\geq 15$

NOTE: At each stage the pressure shall be kept constant for the specified period.

#### 5.8.4.2 Aligned position (see table 4, test condition a)

Contrary to the requirements of 5.8.4.1, this test shall be carried out for each type and each DN in order to demonstrate not only water tightness, but suitability for use of the joints (see 5.8.3).

#### 5.8.4.3 Angular deflection (see table 4, test condition b)

Angular deflection shall be achieved in a horizontal plane, using the test assembly according to figure 4. The angle of deflection shall conform to 4.7.5 b).

#### 5.8.4.4 Shear force (see table 4, test condition c)

When tested under shear force the vertical load  $W$  (see figure 4) shall be applied by means of a V-shaped block with an angle of  $120^\circ$ , located at a distance  $l_1$  from the joint. The displacement of the joint shall be limited to 6 mm by means of an appropriate support situated approximately 100 mm from the near face of the coupling.

The vertical load  $W$  shall be such that the resulting shear force  $F$  is equal to the value specified in 4.7.5 c), taking into account the mass  $M$  of the pipe and its contents and the geometry of the test assembly:

$$W = \frac{F l_3 - M (l_3 - l_2)}{l_3 - l_1}$$

where  $l_1$ ,  $l_2$  and  $l_3$  are as shown in figure 4.

### 5.8.5 Water tightness of joints to positive external pressure

This test shall be carried out in accordance with table 4, test condition a).

The test procedure in accordance with 5.8.4.1 shall apply except that an appropriate test apparatus shall be used, e.g. as shown in figure 5 and that the pipe sections may be shorter than 1 m.

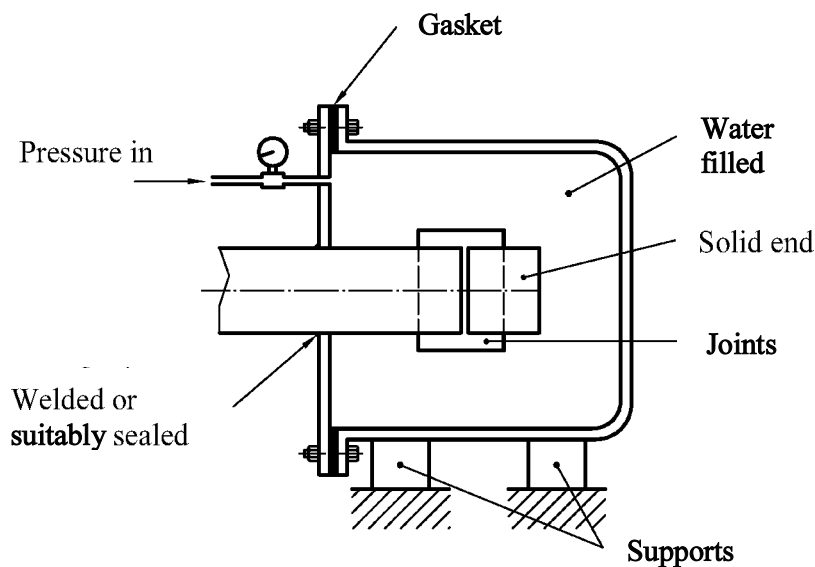


Figure 5

### 5.8.6 Air tightness

The joint assembly shall be subjected to an internal air pressure in stages of 1 mbar each lasting 1 min, up to the final pressure of 10 mbar.

Possible leakage shall be detected with the aid of a suitable foaming agent, e.g. soapy water.

### **5.8.7 Temperature cycling**

The temperature cycling test shall be carried out in accordance with the test conditions specified in 5.7.2.7.

Following this test the test assembly shall be subjected for 24 h to the passage of hot water at a temperature of  $(93 \pm 2)$  °C and at a constant flow rate of 30 l/min.

Finally the test assembly shall be filled with water at  $(15 \pm 5)$  °C and submitted for 15 min to a pressure of 0,5 bar at the lowest point and a minimum of 0,05 bar at the inlet point. No leakage shall occur during all these tests.

After these tests the joints shall be immediately dismantled and washed. The gaskets shall show no deterioration which may affect their performance.

## **5.9 Buried systems**

### **5.9.1 General**

The test methods defined in 5.1 to 5.8 shall apply except for 5.7.3 (see 5.9.2).

### **5.9.2 External coatings**

The uniformity of the coatings shall be checked by visual inspection. The zinc coating mass and the thickness of the finishing layer shall be measured in accordance with 6.5 and 6.6 respectively of EN 598: 1994.

## **5.10 Rainwater systems installed outside buildings**

The test methods defined in 5.1 to 5.8.2 shall apply.

### **5.11 Marking**

The marking shall be checked by visual inspection to ensure conformance with 4.10.

## **6 Evaluation of conformity**

For the purposes of regulatory marking Annex D shall apply. **A1**

**Annex A (informative)****Other dimensions for buried systems**

Table A.1 gives other dimensions used in different countries for grey cast iron products of buried systems at the time of establishment of this European Standard.

**Table A.1**

Dimensions in millimetres

DN	External diameter DE		Wall thickness	
	Nominal Value	Tolerance	Nominal value	Minimum value
50	63	+ 2 - 1	6	5
75	90	+ 2 - 1	7	6
100	117	+ 2 - 1	8	7
150	171	+ 2 - 2	9	8
225	253	+3 - 2	12	11
NOTE: The tensile strength of these products shall be at least 150 MPa and the ring crush strength at least 300 MPa				

**Annex B (informative)****Other dimensions for rainwater systems to be installed outside buildings**

Table B.1 gives dimensions frequently used in different countries for components of rainwater systems to be installed outside buildings at the time of establishment of this European Standard.

**Table B.1**

Dimensions in millimetres

DN	External diameter DE		Wall thickness	
	Nominal value	Tolerance	Nominal value	Minimum value
50	54	+ 2 - 1	3,5	3,0
60	65	+ 2 - 1		
75	80	+ 2 - 1		
100	104	+ 2 - 1		
150	157	+ 2 - 2		



## Annex C (informative)

### Field of use for buried pipes and fittings, characteristics of soils, load-bearing capacity

#### C.1 Field of use, characteristics of soils

Cast iron pipes and fittings provided with external coatings complying with 4.8.3 may be buried in contact with the majority of soils, except those:

- with a low resistivity, less than 1500  $\Omega$  cm above the water table or less than 2500  $\Omega$  cm below the water table;
- with a low pH, below 6;
- with contamination by certain wastes or organic or industrial effluents.

In such aggressive soils it is recommended that an additional protection is used e.g. polyethylene sleeving or other types of external coatings as appropriate (see notes to 4.8.3.2 and 4.8.3.3).

#### C.2 Load-bearing capacity

The load bearing capacity expressed by the load per unit length uniformly distributed on the top of the pipe may be evaluated by means of the formula below:

$$\boxed{A1} \quad f \geq \frac{\pi \cdot \sigma \cdot e_{\min}^2}{3(DE_{\max} - e_{\min})} \quad \boxed{A1}$$

where:  $f$  is the ultimate load per unit length on the top of the pipe, in newtons per millimetre,

$e_{\min}$  is the minimum wall thickness of the pipe, in millimetres,

$DE_{\max}$  is the maximum external diameter, in millimetres,

$\sigma$  is the ring crush strength in accordance with table 3, in megapascals.

**A1** Annex D (normative)

## Evaluation of conformity

### D.1 General

The manufacturer shall demonstrate compliance of his product with the relevant requirements of this European Standard and with the declared values or classes for the product properties by carrying out both of the following tasks:

- a) initial type testing of the product (see D.2);
- b) factory production control (see D.3), including product inspection.

NOTE This annex can be read in conjunction with Annex E for the purposes of assessment of conformity.

### D.2 Initial type testing

Initial type testing shall be performed to show conformity with this European Standard. Tests previously performed in accordance with the provisions of this European Standard (same product, same characteristic(s), test method, sampling procedure, system of attestation of conformity etc.) may be taken into account. For the purposes of testing (including FPC testing), cast iron pipes and fittings, their joints and accessories may be grouped into families where it is considered that the selected property is common to all products within that family.

Samples of prototypes (pipes, fittings, accessories and joints) for each range of DN (see **Table 7**) shall pass all the type tests listed in Tables 9 and 10 to demonstrate conformity with Clause 4, before production commences.

In case of significant changes in design of the product and/or in manufacturing process, which would change the properties of the finished product, the relevant type tests shall be repeated.

All characteristics in Clause 4 shall be subject to initial type testing.

NOTE In addition, the type tests in accordance with Annex D can be carried out by a competent laboratory accredited in accordance with EN ISO/CEI 17011 and in conformity with EN ISO/IEC 17025 in order to demonstrate compliance with the requirements of this European Standard, retaining full reports of these type tests by the manufacturer and, where applicable, to be made available for examination. **A1**

**A1** Table D.1 — Type tests for pipes, fittings and accessories

Items to be tested	Number of samples (minimum)	Test method in accordance with	Requirements in accordance with
Surface conditions	3 per DN	5.1	4.1.2
<b>External diameter and ovality</b>	3 per DN	5.2.1/5.2.4	4.2.2/4.2.5
<b>Wall thickness</b>	3 per DN	5.2.2	4.2.3
Internal diameter of pipes	3 per DN	5.2.3	4.2.4
Straightness of pipes	3 per DN	5.2.5	4.2.6
End faces	3 per DN	5.2.6	4.2.7
Length of pipes	3 per DN	5.2.7	4.2.8
Lengths of fittings and sealing zone	3 per DN	5.2.7	4.2.9
Angle of fittings	3 per DN	5.2.8	4.2.11
Masses	3 per DN	5.3	4.4
<b>Tensile strength</b>	3 per range of DN <sup>b</sup>	5.4	4.5.2
Brinell hardness	3 per range of DN <sup>b</sup>	5.5	4.5.2
<b>Ring crush strength of pipes</b>	3 per range of DN <sup>b</sup>	5.6	4.5.2
<b>Internal coatings</b>			
– Resistance to salt spray	3 test panels	5.7.2.1	4.6.2
– Resistance to waste water	3 test panels	5.7.2.2	4.6.2
– Chemical resistance	3 test panels	5.7.2.3	4.6.2
– Dry coating thickness	3 per DN	5.7.2.4	4.6.2
– Adhesion	3 per range of DN <sup>b</sup>	5.7.2.5	4.6.2
– Resistance to hot water	3 per range of DN <sup>b</sup>	5.7.2.6	4.6.2
– Resistance to temperature cycling	1 test set up	5.7.2.7	4.6.2
<b>External coatings</b>			
– Colour	3 test panels	5.7.3.1 (CS) <sup>a</sup>	4.6.3
– Compatibility with other paints	3 test panels	5.7.3.2 CS) <sup>a</sup>	4.6.3
– Ignitability	1 per coating	5.7.3.3 CS) <sup>a</sup>	4.6.3
or gross calorific potential	1 per coating	5.7.3.3 CS) <sup>a</sup>	4.6.3
– Dry coating thickness	3 per DN	5.7.3.4	4.6.3
– Adhesion	3 per range of DN <sup>b</sup>	5.7.3.5	4.6.3
– For buried systems	1 per range of DN <sup>b</sup>	5.9.2	4.8.3.2
Marking	3 per DN	5.11	4.10
<b>Reaction to fire</b>			
– <b>A1</b> Range <b>A1</b>	<b>A1</b> 1 per range <b>A1</b>	5.7.3.3/Annex H	4.1.3/4.6.3
<sup>a</sup> Certificate of the supplier. <sup>b</sup> Ranges of DN: see Table 7. NOTE Items in <b>bold</b> are used by the essential characteristics according to the mandate.			

**A1**

**Table 10 — Type tests for joints**

Items to be tested	Number of samples (minimum)	Test method in accordance with	Requirements in accordance with
Dimensions	3 per DN	5.8.1	4.7.2
Materials			
– Clamping components, couplings, bolts	3 per DN	Analysis or CS <sup>a</sup>	4.7.3
– Elastomeric gaskets	3 per range of DN <sup>b</sup>	5.8.2.1 CS <sup>a</sup>	4.7.3
Suitability for use	1 per DN	5.8.3	4.7.4
<b>Water tightness under different conditions</b>	1 per range of DN <sup>b</sup>	5.8.4 / 5.8.5	4.7.5
<b>Air tightness</b>	1 per DN	5.8.6	4.7.6
Temperature resistance	1 per range of DN	5.8.7	4.7.7
Marking	3 per DN	5.11	4.10
<sup>a</sup> Certificate of the supplier. <sup>b</sup> Ranges of DN: See Table 7. NOTE The item in <b>bold</b> is an essential characteristic according to the mandate.			

### D.3 Factory production control system

#### D.3.1 Organization

The tasks, responsibilities and authority of the personnel involved in factory production control shall be documented, maintained and implemented, including procedures for, at least, the following activities:


- a) demonstration of conformity of the product at appropriate stages;
- b) identification and recording of any instance of non-conformity;
- c) handling of instances of non-conformity;
- d) establishment of causes of non-conformity and possible corrective action (design, materials or production procedures).

An organizational scheme should clarify where the involved personnel perform their activities.

#### D.3.2 Control system

The manufacturer shall establish, document, maintain and implement a *factory production control system* to ensure that the product put on the market meets the requirements of this European Standard and complies with the specified or declared values.

The factory production control system should consist of procedures, instructions, regular inspections, tests and the utilization of the results to control equipment, raw materials and the other incoming materials, the production process and the product.

Tests on products should be in accordance with D.3 and should at least cover all items in Tables 11 and 12. 

**A1) Table 11 — Production tests for pipes, fittings and accessories**

Items to be tested	Test method in accordance with	Requirements in accordance with
Surface condition	5.1	4.1.1
External diameter and ovality	5.2.1/5.2.4	4.2.2/4.2.5
Wall thickness	5.2.2	4.2.3
Straightness of pipes	5.2.5	4.2.6
End faces	5.2.6	4.2.7
Length of pipes	5.2.7	4.2.8
Type of cast iron	-	4.5.1
Tensile strength	5.4	4.5.2
Brinell hardness	5.5	4.5.2
Ring crush strength of pipes	5.6	4.5.2
Internal coating		
– Dry coating thickness	5.7.2.4	4.6.2
– Adhesion	5.7.2.5	4.6.2
– Resistance to hot water	5.7.2.6	4.6.2
External coatings:		
– dry coating thickness	5.7.3.4	4.6.3
– adhesion	5.7.3.5	4.6.3
– for buried systems	5.9.2	4.8.3.2
Marking	5.11	4.10

**Table 12 — Production tests for joints**

Items to be tested	Test method in accordance with	Requirements in accordance with
Dimensions	5.8.1	4.7.2
Elastomeric gasket	5.8.2.2 (CS) <sup>a</sup>	4.7.3
Marking	5.11	4.10
<sup>a</sup> Certificate of supplier.		

A manufacturer operating a quality system in accordance with EN ISO 9001 and taking into account the requirements of this European Standard shall be deemed to satisfy the factory production control requirements as described hereafter. **A1)**

### **Ⓐ<sub>1</sub> D.3.3 Document control**

Documents shall be controlled in such a way that only valid copies are available in the workplace. The documentation shall include all stages of production, from receipt of raw materials up to dispatch of finished products, describing all the elements which work towards control of the manufacturing process and the characteristics of the products, including the means of inspection. These documents are procedures, work instructions, standards, construction reports, drawings and the factory production control procedures.

The production drawings and documents shall provide the specifications and all data necessary for the manufacture of the product. They shall be dated and authorized by a person designated by the manufacturer, who will confirm that the production drawings are approved.

### **D.3.4 Process control**

The manufacturer shall identify the relevant features of the plant and of the production process. He shall define the criteria and plan the production processes which directly affect the conformity of the product.

### **D.3.5 Inspection and testing**

#### **D.3.5.1 General**

Inspection and testing shall be performed on equipment, raw materials and other incoming materials, the production process and the product. The subjects, criteria, methods and frequencies related to inspection and testing shall be laid down in inspection schemes. The frequency of checks and inspections and the methods, which are not specified in this European Standard, shall be defined in such a way as to achieve permanent conformity of the product.

The results of inspection which are expressed in numerical terms, all the inspection results requiring action and the test results shall be recorded and be available.

The tests shall be carried out in accordance with the methods mentioned in the relevant standard or by applying alternative test methods with a proven correlation or a safe relationship to the standard methods.

The results of testing shall meet the specified compliance criteria and be available.

#### **D.3.5.2 Equipment**

Testing – The weighing, measuring and testing equipment used in the factory shall be calibrated and inspected.

Manufacturing – All equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process. Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer's written procedures and the records retained for the period defined in the manufacturer's FPC procedures.

#### **D.3.5.3 Raw materials**

Raw materials and other incoming materials shall be inspected for compliance with the technical documentation according to D.3.3. Ⓐ<sub>1</sub>

**A1) D.3.6 Non-conforming products**

Procedures for dealing with non-conforming products shall be documented.

All non-conforming products shall be segregated and excluded from delivery, and instructions shall be given for further handling/administration (storage, marking).

If during the internal quality control carried out by the manufacturer non-conforming products are detected, the manufacturer shall be able to stop the production related to the failure(s).

Only after thorough investigation, due correction of the failure(s) and final inspection shall the manufacturer permit the recommencement of production. **A1)**

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## **Annex E (informative)**

### **Surveillance by an accredited third party (certification by third party)**

#### **E.1 General**

The purpose of a third party surveillance is to demonstrate the ability of the manufacturer to produce products which continuously meet the requirements of this standard and to give independent certification to these products.

#### **E.2 Factories certified to $\boxed{A_1}$ EN ISO 9001:2000 $\boxed{A_1}$**

The third party surveillance consists of:

- verifying the validity of the licence granted to the manufacturer for compliance of his quality assurance system with  $\boxed{A_1}$  EN ISO 9001:2000  $\boxed{A_1}$ ;
- verifying that the results of the production tests made by the manufacturer are in accordance with the requirements of this standard;
- independent random examination of finished products.

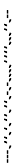
The third party surveillance is carried out at least twice a year, at regular intervals and may be undertaken without previous announcement.

#### **E.3 Factories not certified to $\boxed{A_1}$ EN ISO 9001:2000 $\boxed{A_1}$**

The third party surveillance is carried out at least four times a year at regular intervals and may be undertaken without previous announcement.

The third party surveillance consists of:

- verifying the adequacy of the staff and equipment for continuous and orderly manufacture;
- verifying that type testing has been satisfactorily carried out in accordance with the requirements of this standard;
- verifying that quality control is independent of production;
- verifying that the results of the production tests made by the manufacturer are in accordance with the requirements of this standard;
- independent random examination of finished products.





The frequency of third party surveillance may be reduced to three times a year provided the third party is satisfied that:

- the manufacturer's internal quality control system is suitable;
- the controls have been continuously carried out in a proper and effective way for three years;
- the results are in accordance with the requirements of this standard.

This reduced frequency may remain valid for as long as no defective products are detected during the surveillance visits.

#### E.4 Report by the third party

After the completion of the surveillance visit a report is drawn up by the third party inspector. The manufacturer signs this report. If no agreement can be reached between the inspector and the manufacturer on the content of the report, the manufacturer signs the report and states his reservations thereon.

The report contains at least the following items:

- name and/or mark of the manufacturer;
- name and location of the production plant;
- title and number of this standard;
- description and manufacturer's reference numbers of products examined;
- signature of the manufacturer's representative, place and date;
- the third party inspector's signature.

It also contains:

- a) for factories certified to **EN ISO 9001:2000**, a statement regarding:
  - the validity of the quality assurance certificate;
  - the conformity of the products.
- b) for factories not certified to **EN ISO 9001:2000**, a statement regarding the result of the surveillance visit in terms of:
  - staff;
  - production and testing facilities;
  - conformity of the products;
  - internal quality control;
  - document control;
  - control, handling and disposal of non-conforming products;
  - calibration and control of measuring equipment;
  - handling complaints concerning non-conformity of products.

### **E.5 Retesting**

If during the third party surveillance visit a sample fails, three more samples of the same type are tested. If any one of these three fails, the production related to the failure(s) is excluded from delivery pending the outcome of further investigation.

Within a period of four weeks or within a period to be agreed upon, the manufacturer is reassessed with respect to the rejected non-conforming product; six of these products are tested.

After satisfactory retesting of all these samples delivery may recommence.

## Annex F (informative)

### General information on some product characteristics

#### F.1 Mechanical resistance and stability

Cast iron products in accordance strong enough (see table 1) to withstand abnormal stresses expected in normal working conce with this European Standard possess very good mechanical properties (see table 3). They nditions, e.g. accidental impact and acts of vandalism. They are not affected by extremes of temperature and do not deteriorate with age.

#### F.2 Safety in case of fire

Cast iron products in accordance with this European Standard are non-flammable and non-combustible. When exposed to fire they will maintain their functional characteristics and integrity for several hours i.e. their walls will remain impervious to flames and gases and there will be no fracture, collapse or significant deformation. The integrity of connections through walls and ceilings is maintained.

**A1** The manufacturer can evaluate the fire resistance properties of his discharge systems using the standard EN 1366-3.

#### F.3 Hygiene, health and environment

The high leaktightness under all conditions of use (see Table 4) and the non-toxicity of cast iron and coating materials (see NOTE 1 and NOTE 2 of ZA.1) used for the products conforming to this European Standard ensure the hygiene and health of the installation and occupants of the premises. Moreover the products are entirely recyclable without residual waste.

#### F.4 Noise protection

Noise protection is not mandated under the CPD. Cast iron pipe systems due to their high mass per unit area of their pipe walls as well as the joint design characteristics provide considerable noise reduction benefits when evacuating waste water within buildings. The performances of installation could be evaluated using EN 14366. This test method measures airborne and structure borne noises emitted by installed discharge systems by means of common test assemblies. **A1**

## **A1** Annex G (informative)

**Method of calculation of gross calorific potential of external coatings for **AC1** the range, noted  $PCS_{\text{range ext. coating}}$**

$$PCS_{\text{range ext. coating}} = (0,8 \times PCS_{\text{pipes ext. coating}}) + (0,2 \times PCS_{\text{fittings ext. coating}}) \quad \text{AC1}$$

where

$PCS_{\text{pipes ext. coating}}$  is the gross calorific potential of pipes external coating;

$PCS_{\text{fittings ext. coating}}$  is the gross calorific potential of fittings external coating.

This equation covers all main known configurations in Europe.

If an external coating is obtained from adjacent layers, rules of EN 13501-1 apply. **A1**

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**A1) Annex H (normative)****AC1) Reaction to fire test (SBI adaptation for testing a products range) AC1)**

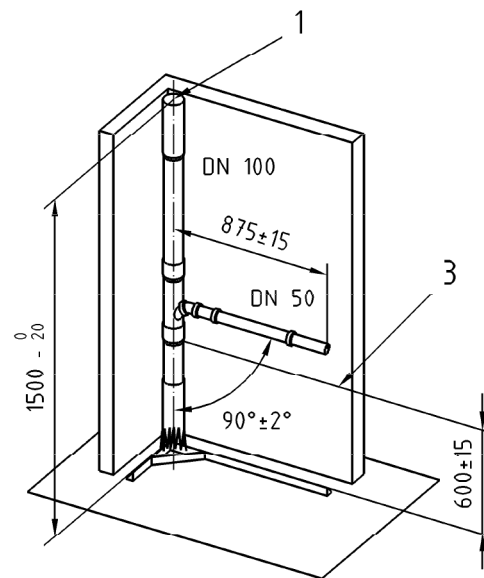
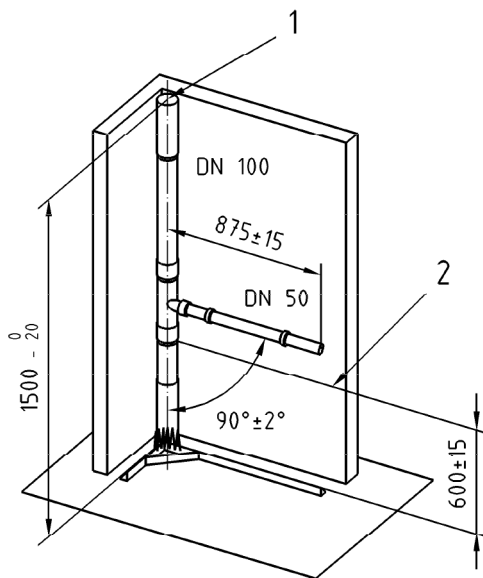
The test method shall conform to EN 13823 using the following mounting conditions, either for plain ends or socketed systems.

The SBI test is based on a frame supporting two silicate panels 1 500 mm × 1 000 mm and 1 500 mm × 500 mm forming a right-angle corner. Pieces of pipes and fittings shall be fixed on the framework of the SBI test using brackets fixed on the silicate panels. The products shall be DN 100 for vertical part of the network sample and DN 50 for horizontal part. If for the tested discharge system DN 50 does not exist, a higher diameter may be used. One or more fittings (branches and elbows) shall be used to make the connection at  $90^\circ \pm 2^\circ$  between horizontal and vertical parts (see Figure H.1).

Starting from the bottom of the vertical part, the first coupling (lower end) or socket (bottom) shall be placed at a height of 600 mm in order to ensure that the joints and the fitting(s) used for connecting DN 50 to DN 100 are all located in the area of observation of the test according to EN 13823 – 5.1.3, which means a height between 500 mm and 1 000 mm. Sockets shall be oriented to be representative of final use, the vertical part with the joint at the top. A1)

**A1**

Dimensions in millimetres



**AC1** Spigots and couplings range **AC1**

**AC1** Spigots and sockets range **AC1**

**Key**

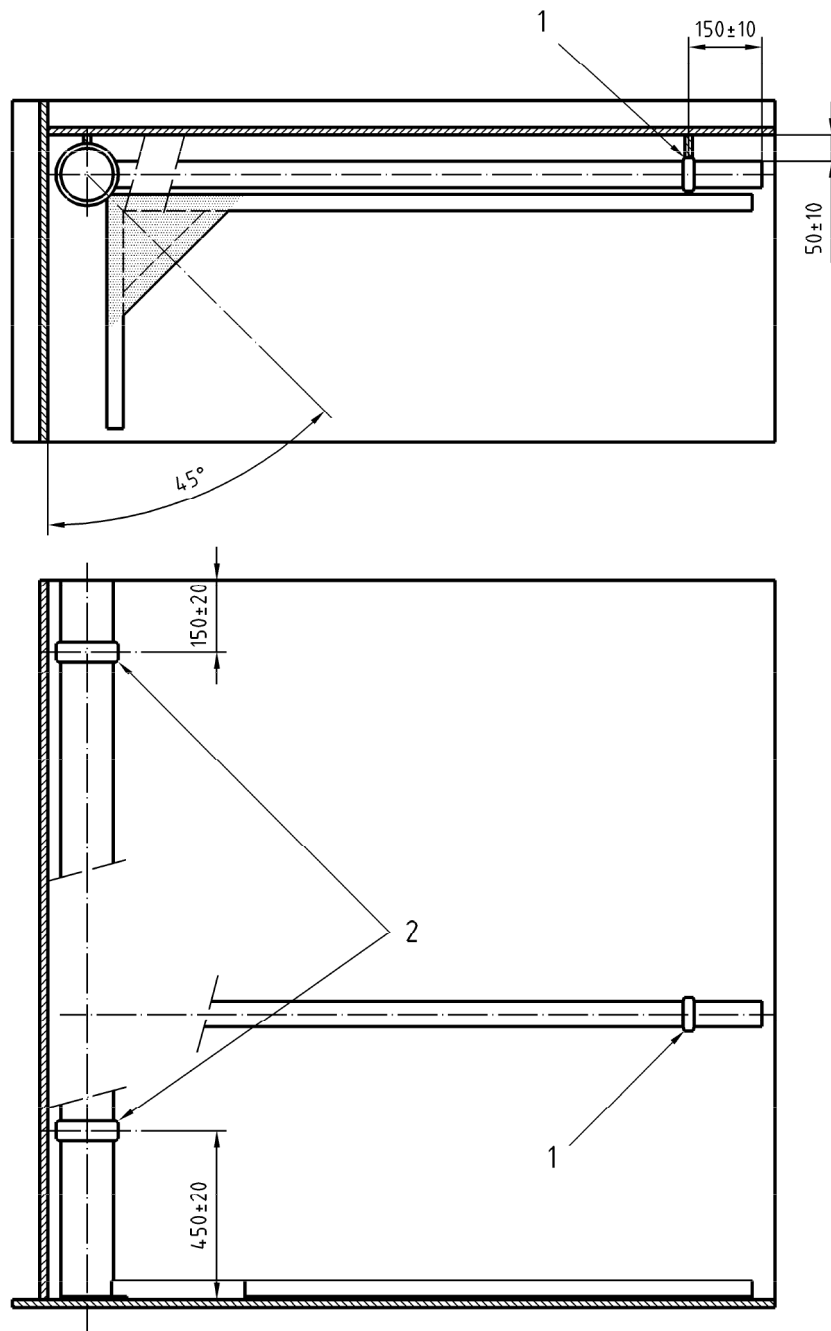
- 1 vertical part axis
- 2 lower end of coupling level
- 3 bottom of socket level

**Figure H.1 — Dimensions for mountings of cast iron **AC1** ranges **AC1****

Two brackets shall be placed on the vertical part and one on the horizontal part according to the dimensions given on Figure H.2. **A1**



Dimensions in millimetres



**Key**

- 1 bracket for horizontal part
- 2 brackets for vertical part

**Figure H.2 — Position of brackets on mountings of cast iron  $\boxed{AC_1}$  ranges  $\boxed{AC_1}$   $\boxed{A_1}$**

## **A1** Annex ZA (informative)

### **Clauses of the European Standard addressing essential requirements or other provisions of EU Directives**

#### **ZA.1 Scope and relevant characteristics**

This European Standard has been prepared under the mandate M/131 "Pipes, tanks and ancillaries not in contact with water intended for human consumption" given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard shown in this annex meet the requirement of the mandate given under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of cast iron pipes and fittings, their joints and accessories covered by this annex for the intended uses indicated herein and to be installed above and below ground. Reference should be made to the information accompanying the CE-marking.

**WARNING** — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

NOTE 1 For dangerous substances, there may be requirements applicable to the products falling within the scope of this standard (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

NOTE 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (accessed through <http://europa.eu.int/comm/enterprise/construction/internal/dangsub/dangmain.htm>).

This annex has the same scope as Clause 1 of this standard. It establishes the conditions for the CE marking of cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings intended for the uses indicated in the relevant clauses applicable (see Table ZA.1). **A1**



**A1** Table ZA.1 – Relevant clauses for Cast iron pipes and fittings, their joints and Accessories for the evacuation of water from buildings

Essential Characteristics	Requirement clauses in this (or another) European Standard	Levels and/or classes	Notes
Reaction to fire NOTE 1	4.1.3 Reaction to fire - Cast iron  - System (assembled products)	Class A1  Class	Class A1 without the need for testing 5.7.3 External coatings And Annex H – System
Internal pressure strength NOTE 3	4.7.5 Water tightness		Pass/fail
Dimension tolerances (on external diameter DE for compatibility purposes)	4.2.2 External diameter 4.2.3 Wall thickness 4.2.5 Ovality		Pass/fail
Dimension tolerances (On external diameter DE for compatibility purposes)	4.2.2 External diameter 4.2.3 Wall thickness 4.2.5 Ovality		Pass/fail
Impact resistance NOTE 2	4.5.2 Mechanical properties		Pass/fail
Tightness: gas and liquid NOTE 4	4.7.5 Water tightness 4.7.6 Air tightness		Pass/fail
Durability aspects NOTE 5			
External coating for pipes, fittings and accessories	4.6.3 External coatings 4.8.3.2 Buried systems External coatings		Coating X – Pass/fail
Internal lining for pipes and fittings	4.6.2 Internal coatings		Coating Y – Pass/fail
<p>NOTE 1 In accordance with the Commission decision 96/603/EC of 4<sup>th</sup> of October 1996, the material is class A1 without the need for testing.</p> <p>NOTE 2 Measured through proxy characteristic.</p> <p>NOTE 3 Testing of the joint (weakest point) is sufficient for determining the internal pressure strength, moreover, pipes are used when testing the joints. The high level of performance of pipes and fittings on this matter can be demonstrated by the following calculation that will be included in the normative part of the standard in its next revision.</p> $P = \frac{20 \times e \times R_m}{D \times S_F}$ <p>where</p> <ul style="list-style-type: none"> <li><math>e</math> is the minimum pipe wall thickness, in millimetres;</li> <li><math>D</math> is the mean pipe diameter (<math>DE - e</math>), in millimetres;</li> <li><math>DE</math> is the nominal pipe external diameter (see Table 14), in millimetres;</li> <li><math>R_m</math> is the minimum tensile strength of cast iron, in megapascals. (<math>R_m = 420</math> MPa for spheroidal graphite cast iron and 200 MPA for grey cast Iron; see 4.5.2);</li> <li><math>S_F</math> is a safety factor of 3.</li> </ul> <p>For a DN 100 pipe, the internal pressure strength is more than 100 bars.</p> <p>NOTE 4 For the purpose of <u>tightness</u> the testing with air is more severe since the air molecules will be smaller than those of gasses normally encountered in drainage systems.</p> <p>NOTE 5 The durability of cast iron is determined by the performance of the coating used. Provided the coating is properly maintained the cast iron products will last indefinitely.</p>			

A1

**AC1** The requirement on a certain characteristic is not applicable in those Member States (MSs) where there are no regulatory requirements on that characteristic for the intended use of the product. In this case, manufacturers placing their products on the market of these MSs are not obliged to determine nor declare the performance of their products with regard to this characteristic and the option "No performance determined" (NPD) in the information accompanying the CE marking (see ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

## ZA.2 Procedure for attestation of conformity of cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings

### ZA.2.1 System of attestation of conformity

The system(s) of attestation of conformity of cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings indicated in Table ZA.1, as given in Annex III of the mandate M/131 for pipes, tanks and ancillaries not in contact with water intended for human consumption (see also Decision details 99/472/EC; dated 1999/07/17 **AC1**) and 2001/596/EC dated 2001/01/08 **AC1**), is shown in Table ZA.2 for the indicated intended use(s) and relevant level(s) or class(es):

**AC1** Table ZA.2 — System of attestation of conformity

Product(s)	Intended use(s)	Level(s) or class(es)	Attestation of conformity system(s)
Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings.	Discharge systems for buildings and drains outside buildings, for the conveyance of domestic wastewater and surface water (including rain water)	–	System 4
	in installations in areas subject to reaction to fire regulations, used for the transport/disposal/storage of water not intended for human consumption.	A1 <sup>(2)</sup> , A2 <sup>(2)</sup> , B <sup>(2)</sup> , C <sup>(2)</sup> , D, E (A1 to E) <sup>(3)</sup> , F	System 3 System 4
<p><sup>(1)</sup> Products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material). <b>Products covered by this standard do not fall into this class.</b></p> <p><sup>(2)</sup> Products/materials not covered by footnote 1</p> <p><sup>(3)</sup> Products/materials that do not require to be tested for reaction to fire (e.g. Products/materials of Classes A1 according to Commission Decision 96/603/EC).</p> <p>System 3: See CPD Annex III.2 (ii), Second possibility</p> <p>System 4: See CPD Annex III.2 (ii), Third possibility</p>			

**AC1**

The attestation of conformity of the cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings in Table ZA.1 shall be based on the evaluation of conformity procedures indicated in Table(s) ZA.3 resulting from application of the clauses of this or other European Standard(s) indicated therein. **AC1**



**AC1** Table ZA.3.a — Assignment of evaluation of conformity tasks for cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings under system 3

Tasks		Content of the task	Evaluation of conformity clauses to apply
Tasks under the responsibility of the manufacturer	Factory production control (FPC)	Parameters related to all characteristics of Table ZA.1	D.3
	Initial type testing by a notified test laboratory	Reaction to fire classes A1 <sup>(2)</sup> , A2 <sup>(2)</sup> , B <sup>(2)</sup> , C <sup>(2)</sup> , D, E (A2 to E) <sup>(3)</sup>	4.1.3 D.2
	Initial type testing by the manufacturer	All characteristics of Table ZA.1 including declaration of Reaction to fire class A1 or class F	D.2

**Table ZA.3.b — Assignment of evaluation of conformity tasks for cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings under system 4**

Tasks		Content of the task	Evaluation of conformity clauses to apply
Tasks under the responsibility of the manufacturer	Factory production control (F.P.C)	Parameters related to all characteristics of Table ZA.1	Annex D, Evaluation of conformity
	Initial type testing	All characteristics of Table ZA.1 including declaration for reaction to fire class A.1 Reaction to fire class F	



## ZA.2.2 Declaration of conformity

When compliance with the conditions of this annex is achieved, the manufacturer or his agent established in the EEA (European Economic Area / Espace économique européen / Europäischer Wirtschaftsraum) shall prepare and retain a declaration of conformity (EC Declaration of conformity), which authorises the affixing of the CE marking. This declaration shall include:

- name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;
- description of the product (type, identification, use etc.), and a copy of the information accompanying the CE marking;
- provisions to which the product conforms (e.g. Annex ZA of this EN);

**A1**

— particular conditions applicable to the use of the product, (e.g. provisions for use under certain conditions etc.);

**AC1** — name and address of the notified laboratory(ies), if applicable; **AC1**

— name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or his authorised representative.

The above-mentioned declaration shall be presented in the official language or languages of the Member State in which the product is to be used.

### **ZA.3 CE marking and labelling**

For all cast iron pipes, fittings and accessories the producer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol shall be in accordance with Directive 93/68/EC and shall be shown on the cast iron pipes and fittings.

The following information shall appear legibly and indelibly on the product (see also 4.10):

— CE marking symbol.

The following information shall appear on the commercial documents:

— CE marking symbol;

— name or identifying mark and registered address of the producer or his authorised representative;

— last two digits of the year of affixing the CE marking;

— reference to this European Standard, i.e. EN 877;

**AC1** — description of the product: range to which it belongs, generic name, material, dimensions, intended use and place of installation; **AC1**

— characteristics covered by EN 877:

— reaction to fire;

— internal pressure strength;

— impact resistance;

— dimension tolerances (on external diameter DE for compatibility purposes);

— tightness;

— durability (according to the internal and external coatings);

— “No performance determined” for characteristics where this is relevant, (see ZA.1). **A1**

**AC1** The “No performance determined” (NPD) option may not be used where the characteristic is subject to threshold level. Otherwise, the NPD option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements in the Member State of destination. **AC1**

**A1** Figure ZA.1 gives an example of the information to be given on the product.




CE conformity marking consisting of the "CE"-symbol given in Directive 93/68/EEC.

**Figure Z1 — Example CE marking information for marking on the product**

Figure ZA.2 gives an example of the information to be given on the accompanying documents.

**AC1**

	CE conformity marking consisting of the "CE"-symbol given in Directive 93/68/EEC.																
<p>X Co Ltd, CEDEX, F-2351</p> <p>05</p> <p><b>EN 877:1999/A1:2006</b></p> <p><b>Cast fittings</b></p> <p><b>Drainage of water from buildings</b></p> <p><b>Range A - 45° Branch DN 100 x 50</b></p> <table border="0"> <tr> <td>- Reaction to fire (Range)</td> <td>A2 - s1, d0</td> </tr> <tr> <td>- Internal pressure strength</td> <td>Pass</td> </tr> <tr> <td>- Dimension tolerances</td> <td>Pass</td> </tr> <tr> <td>- Impact resistance</td> <td>Pass</td> </tr> <tr> <td>- Tightness</td> <td>Pass</td> </tr> <tr> <td>- Durability</td> <td></td> </tr> <tr> <td>- Internal coating</td> <td>epoxy, pass</td> </tr> <tr> <td>- External coating</td> <td>epoxy, pass</td> </tr> </table>	- Reaction to fire (Range)	A2 - s1, d0	- Internal pressure strength	Pass	- Dimension tolerances	Pass	- Impact resistance	Pass	- Tightness	Pass	- Durability		- Internal coating	epoxy, pass	- External coating	epoxy, pass	<p>Name, or identifying mark and registered address, of producer</p> <p>Last two digits of year in which marking was affixed</p> <p>N° of European Standard</p> <p>Description of product</p> <p>And information on regulated characteristics</p> <p>Where subject to a threshold values the manufacturer may declare actual values if they exceed the minimum requirements.</p>
- Reaction to fire (Range)	A2 - s1, d0																
- Internal pressure strength	Pass																
- Dimension tolerances	Pass																
- Impact resistance	Pass																
- Tightness	Pass																
- Durability																	
- Internal coating	epoxy, pass																
- External coating	epoxy, pass																

**Figure ZA.2 — Example of information to be given on the accompanying documents** **AC1**

**NOTE 1** In addition to any specific information relating to dangerous substances shown above, the product should also be accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

**NOTE 2** European legislation without national derogations need not be mentioned. **A1**

**Ⓐ Bibliography**

- [1] EN 1366-3, *Fire resistance tests for service installations — Part 3: Penetration seals*
- [2] EN 14366, *Laboratory measurement of noise from waste water installations*
- [3] EN ISO/IEC 17011, *Conformity assessment – General requirements for accreditation bodies accrediting conformity assessment bodies (ISO/IEC 17011:2004)*
- [4] EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005)* Ⓐ

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## National Annex NA (informative)

### National annex

#### NA1 General

This British Standard has been developed by CEN and replaces BS 416:2 1990 and BS 6087:1990 both of which are withdrawn. The other provisions and requirements detailed in BS 437, and BS 416:1 not covered by the requirements and provisions of BSEN 877 eg lead caulked joints will be revised and published in a separate standard. BS 460 is not subject to standstill and is being revised.

This annex has been written to identify some of the most significant changes from the above British Standards which have been adopted in BS EN 877 and it is not intended to contradict nor replace any of the clauses or provisions in BS EN 877.

The main advantages of this new BS EN 877 are that it:

- Provides a single standard containing most of the requirements
- Includes additional requirements for coating performance, production and type testing and quality assurance

It also gives guidance in relation to the European Directive on Construction Products.

#### NA2 Leakage

The Standard contains requirements for the leaktightness of joints (see 4.7.5). Whilst not specifically stated, leaktightness of pipes and fittings at their specified operating pressures is clearly implied and should be considered as a requirement of this Standard.

#### NA3 Coatings

The interpretation that coatings should only be spray applied is not intended (see 4.8.3.2) as the use of the term 'usually' indicates that alternative methods of application are acceptable e.g. brush, roller etc.

Additionally the Note to the sub-clause implies that alternative materials can be used, for example: zinc-rich paint.

Clause 4.6.3 states that the colour shall conform to certain trichromatic co-ordinates and then goes on to state approximately reddish-brown. The actual colours currently being used by all manufacturers are not likely to conform to the trichromatic co-ordinates but are totally accepted by the end users. For this reason if the colour is reddish-brown then it is deemed to comply with the standard.

**NA4 Verification of DE**

The method of verification of DE (as specified in 5.2.1) by measurement of pipe axes, is normally applicable to type testing only.

For production testing, the normal method of testing is by pass-fail gauges with or without the additional use of circumferential tape measurement, the latter normally being required on DN 400 and greater.

**NA5 Joint leaktightness type test**

To obtain consistency in the test method and its results, the application of the load W to the test pipes (see 5.8.4.1 fig.4) should follow the principles defined in BS 6087 ie

- a) The block for the application of the shear load should be 300 mm wide and be positioned abutting the coupling
- b) The unloaded pipe may need to be restrained to prevent any resultant upward movement when the shear load is applied
- c) If necessary, at the end of the test pressure stage (see Table 8), adjust the shear load to the original value.

**NA6 Test method- coating adhesion**

Cutting of a test sample is acceptable (see 5.7.2.5) for type testing but for production testing, it is permissible to test a pipe or fitting intact not as a test sample.

**NA7 Ovality**

It is an omission that ovality is not defined. It is intended that the definition as given in BSEN 598 should be used, i.e.:

$$\text{Ovality} = 100 \times \frac{(A_1 - A_2)}{(A_1 + A_2)}$$

Where  $A_1$  is the maximum axis in millimetres  
 $A_2$  is the minimum axis in millimetres

This formula applies to sizes DN400 to DN 600 only ( see 4.2.5 of this standard)

**NA8 Electrical continuity**

The Standard does not accommodate Electrical requirements, for such requirements BS 6087 amendment 2 should be referenced. The text of BS 6087 amendment 2 is reproduced below:

*'If provision is made for electrical continuity, the electrical resistance of the coupling shall not exceed 0.3 ohms, when tested in accordance with the following procedure:*



*Apply a steadily increasing voltage not exceeding 50V ac, 50Hz., across the junction until a steady current of  $25 \pm 1$  A flows through the coupling. Allow the current to flow for 30 s, maintaining it as necessary by adjusting the voltage. Calculate the resistance of the coupling by dividing the observed voltage by the current.'*

#### **NA9 Socketed joints**

The Standard does not illustrate socketed pipes/ fittings in its figures but it is its intention to cover such pipes ( see 3.5 and Table 4 note 2 ).

#### **NA10 Fittings angles**

The requirements for fittings angles and how to mark them are not very clear and could cause some confusion; the following clarification applies:

Clause 4.2.11 specifies a series of standard fittings angles with a tolerance of plus/ minus 2 applying to each angle, thus, for example, the standard angle of  $68^\circ$  means that a manufacturer can select his own design angle within the range of  $66^\circ$  to  $70^\circ$ . This tolerance is necessary to accommodate the various different fittings angles currently manufactured in Europe e.g.  $67.5^\circ$ ,  $69^\circ$  etc.

This permits manufacturers to continue to supply fittings with a design angle of  $67.5^\circ$  and continue to mark them as  $67.5^\circ$  as specified in clause 4.10.1.

The standard does not specify any manufacturing tolerance which might be applicable to the manufacturer's design angle.

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