BS EN 877:2021

BSI Standards Publication

Cast iron pipe systems and their components for the evacuation of water from works — characteristics and test methods

National foreword

This British Standard is the UK implementation of EN 877:2021. It supersedes BS EN 877:1999+A1:2006, which is withdrawn.

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 committee manager.

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Published by BSI Standards Limited 2021

ISBN 978 0 539 01002 2

ICS 23.040.05; 23.040.40; 23.040.01; 23.040.10

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2021.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 877

October 2021

ICS 23.040.01

Supersedes EN 877:1999

English Version

Cast iron pipe systems and their components for the evacuation of water from works - characteristics and test methods

Réseaux de canalisations en fonte et leurs composants pour l'évacuation des eaux des bâtiments - Caractéristiques et méthodes d'essai

Rohrsysteme aus Gusseisen und ihre Komponenten zur Entwässerung von Gebäuden - Merkmale und Prüfverfahren

This European Standard was approved by CEN on 16 August 2021.

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European foreword

This document (EN 877:2021) 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 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of an identical text or by endorsement, at the latest by April 2022, and conflicting national standards shall be withdrawn at the latest by April 2022.

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

This document has been prepared under a Mandate given to CEN by the European Commission and the European Free Trade Association.

This document supersedes EN 877:1999, EN 877:1999/A1:2006 and EN 877:1999/A1:2006/AC:2008.

This document includes the following significant technical changes with respect to the previous:

a) Product standard has been extended to kit and components standard.

b) Chapter 4 about characteristics has been restructured with all essential characteristics first.

c) Grip collars have been included as kit components.

d) Pressure tightness including Fittings with access as a kit component has been added.

e) Fire reaction classification has been amended with the agreement of WG 4 of TC 127.

f) Chapter 6 about Assessment and verification of constancy of performance – AVCP has been updated.

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

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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

1 Scope

This document specifies product characteristics, test/assessment methods and how to express test/assessment results. Cast iron pipelines kits are usually composed of cast iron pipes, fittings, joints and accessories.

This document covers the range of nominal diameter from DN 40 to DN 600 inclusive.

The cast iron includes grey cast iron and ductile cast iron.

The roof gullies used for siphonic systems are outside the scope of this document.

Sewerage applications are outside the scope of this document.

It is intended to be used for the construction of gravity or vacuum discharge pressurized or unpressurised networks installed inside and/or outside works, above and/or below ground and in construction works.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 598:2007+A1:2009, *Ductile iron pipes, fittings, accessories and their joints for sewerage applications - Requirements and test methods*

EN 681-1:1996, *Elastomeric seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 1: Vulcanized rubber*

EN 10088-1, *Stainless steels — Part 1: List of stainless steels*

EN 10204, *Metallic products — Types of inspection documents*

EN 13501-1:2018, *Fire classification of construction products and building elements — Part 1: Classification using 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 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread (ISO 898-1)*

EN ISO 898-2, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread (ISO 898-2)*

EN ISO 1514, *Paints and varnishes — Standard panels for testing (ISO 1514)*

EN ISO 1716, *Reaction to fire tests for products — Determination of the gross heat of combustion (calorific value) (ISO 1716)*

EN ISO 2409, *Paints and varnishes — Cross-cut test (ISO 2409)*

EN ISO 2808, *Paints and varnishes — Determination of film thickness (ISO 2808)*

EN ISO 2812-1, *Paints and varnishes — Determination of resistance to liquids — Part 1: Immersion in liquids other than water (ISO 2812-1)*

EN ISO 3506-1, *Fasteners — Mechanical properties of corrosion-resistant stainless steel fasteners — Part 1: Bolts, screws and studs with specified grades and property classes (ISO 3506-1)*

EN ISO 3506-2, *Fasteners — Mechanical properties of corrosion-resistant stainless steel fasteners — Part 2: Nuts with specified grades and property classes (ISO 3506-2)*

EN ISO 4628-2, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 2: Assessment of degree of blistering (ISO 4628-2)*

EN ISO 4628-3, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 3: Assessment of degree of rusting (ISO 4628-3)*

EN ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1)*

EN ISO 6892-1:2019, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2019)*

EN ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests (ISO 9227)*

EN ISO/CIE 11664-4, *Colorimetry — Part 4: CIE 1976 L*a*b* colour space (ISO/CIE 11664-4)*

EN ISO 11925-2, *Reaction to fire tests — Ignitability of products subjected to direct impingement of flame — Part 2: Single-flame source test (ISO 11925-2)*

ISO 185:2020, *Grey cast irons — Classification*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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 and this includes pipes between the building and the inspection chambers

Note 1 to entry: This applies to gravity or vacuum, inside and outside buildings, above and below ground.

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
kit
construction product placed on the market by a single manufacturer as a set of at least two separate components that need to be put together to be incorporated in the construction work

Note 1 to entry: The wording cast iron pipe systems is here in this document equivalent to cast iron pipe kits.

[SOURCE: CPR N° 305/2011 of 9 March 2011]

3.6
pipe
kit component casting of uniform bore, straight in axis, normally having plain ends but which can also be socketed

3.7
fitting
kit component in cast iron which allows a deviation, a change of direction or diameter, including access elements and traps

3.8
coupling
kit component, which is a jointing element for pipes and/or fittings subjected to internal or external pressure

3.9
gasket
kit component providing sealing function to joints

3.10
clamping
kit component, which is a securing element for pipes and/or fittings subjected to internal pressure, providing axial restraint to the end thrust arising from a change of direction, blank end etc., e.g. grip collars

3.11
grip collar
kit component that ensures axial restraint up to a defined pressure by mounting it over a joint

3.12
joint
connection between the ends of pipes and/or fittings, including the coupling or clamping component, with sealing effected by elastomeric gasket(s); as soon as it is an assembly of several kit components as coupling, clamping or gaskets, the joint is a kit

3.13
accessory
kit component, any element used in a network, e.g. for maintenance or inspection reasons

3.14
nominal size
DN
alphanumerical designation of size for components of a pipework system, to be used for reference purposes, which comprises the letters DN followed by a dimensionless which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections

Note 1 to entry: In this document, it is the bore.

[SOURCE: EN ISO 6708]

3.15
length
effective length of a pipe or fitting

Note 1 to entry: For double spigot 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 by the manufacturer.

3.16
range of products
design system 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

3.17
cast iron pipe system under vacuum
siphonic system for draining rainwater and vacuum system for waste waters

3.18
design system
collection of components from which a "kit" may be created for subsequent installation in the works

Note 1 to entry: A design system might, for example, be presented in a supplier's catalogue, from which the purchaser can make a choice. A design system can give rise to one or many different "kits", but the system itself cannot be bought.

3.19
assembled system
kit after it has been installed in the works

Note 1 to entry: An "assembled system" may be made up only of the "kit" or it may comprise the "kit" assembled with one or more other products which could themselves be construction products.

4 Characteristics for cast iron pipe systems and components

4.1 Crushing strength (only for grey cast iron)

Cast iron components as pipes, fittings and accessories shall have the minimal crushing strength given in Table 7. Test method is described in 5.6.

The assessment of each of those components insures the assessment of the kit.

4.2 Impact resistance for kits

The impact resistance assessment is given by the mechanical properties of pipes, fittings and accessories. They shall have the minimal tensile strength and maximum Brinell hardness as given in Table 7 in 4.10.2.

Test method for tensile strength is given in 5.4.

Test method for Brinell hardness measurement is given in 5.5

4.3 Tightness: gas and liquid

4.3.1 General

NOTE In this document, all pressures are relative pressures, expressed in bar (100 kPa = 1 bar).

The assessment of each component as described in this 4.3 insures the assessment of the kit.

4.3.2 Lengths of fittings and sealing zone

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

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

The length *T* (see Figure 1) of this sealing zone shall comply with the values given in Table 1.

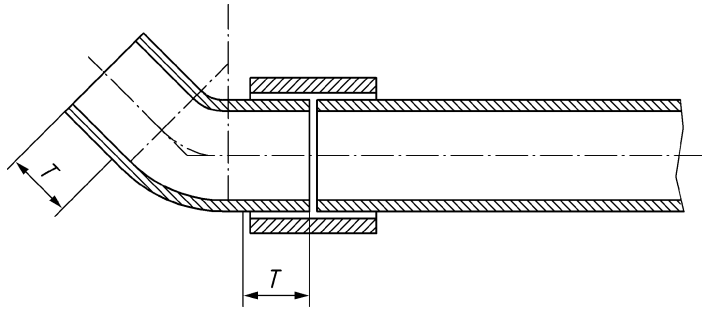


Figure 1 — Length of the sealing zone

4.3.3 Geometry of fittings and accessories

The geometry of fittings and accessories is not part of this document. Fittings and accessories of geometry used in various countries are in conformity with this document as long as they comply with all other technical requirements of this document.

Table 1 — Sealing zone of fittings

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

4.3.4 Water tightness

4.3.4.1 Water tightness of pipes and fittings

4.3.4.1.1 Water tightness of pipes

Water tightness of pipes can be demonstrated by the following calculation.

$$P = \frac{20 \times e \times R_{\mathrm{m}}}{D \times S_{\mathrm{F}}}$$

where

e is the minimum pipe wall thickness, in millimetres;

D is the mean pipe diameter ($DE - e$), in millimetres;

DE is the nominal pipe external diameter (see Table 6), in millimetres;

R_m is the minimum tensile strength of cast iron, in Megapascals;

(420 MPa for spheroidal graphite cast iron and 200 MPa for grey cast iron; see 4.10.2);

S_F is a safety factor of 3.

For a DN 100 pipe in grey cast iron, the internal pressure strength is more than 35 bars.

Expected results are given in Table 2.

4.3.4.1.2 Water tightness of fittings

4.3.4.1.2.1 Fittings without access or door

Expected results for water tightness of fittings without access or door are given in Table 2 and the demonstration done for pipe is valid for these fittings.

4.3.4.1.2.2 Fittings with access or door

When tested in accordance with 5.8, fittings with access or door shall exhibit no visible leakage from the access or door when subjected to the internal hydrostatic test pressure given in Table 2.

Table 2 — Water tightness of fittings with access or door - performance requirements

Internal test pressure in bar	
DN ≤ DN 200	DN > DN 200
0 to 5[a]	0 to 3[a]
[a] 0 to 0,5 bar water pressure for fittings which will only carry limited pressures because of their intended use and installation e.g. sanitary application.	

4.3.4.2 Water tightness of joints

4.3.4.2.1 General

When tested in accordance with 5.9.4 and 5.9.5, 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 3 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 3 — Water tightness of joints - performance requirements

Test condition	Hydrostatic test pressure in bar			
	DN ≤ DN 200		DN > DN 200	
	internal	external	internal	external
1) aligned	0 to 5 [a]	0 to 0,5 [b c]	0 to 3 [a]	0 to 0,5 [b c]
2) deflected	0 to 5 [a]	–	0 to 3 [a]	–
3) subject to shear force	0 to 1 [a b]	–	0 to 1 [a b]	–

[a] 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 and non-pressurized gravity flow.

[b] Applicable to socketed joints only when they are to be buried.

[c] Does not apply to nominal sizes less than DN 100 and does not apply to joints connecting to sanitary ware, e.g. WC, washbasin.

4.3.4.2.2 Water tightness for buried systems

For joints which are used exclusively for buried kits, the internal hydrostatic test pressure specified in Table 3 lines a) and b) may be limited to 1 bar. This may limit to 1 bar also the test pressure specified in Table 4 for buried grip collars.

4.3.4.2.3 Water tightness for rainwater systems installed outside buildings

Joints shall be watertight at least to non-pressurized gravity flow. See note a) in Table 3.

4.3.4.3 Resistance to end thrust with grip collars

When tested in accordance with 5.10.3, on test apparatus preventing any excessive axial displacement and subjected to the test conditions:

— joint with pipes aligned;

— internal hydrostatic pressures given in Table 4;

the grip collars shall limit the axial movement of pipes. During each stage in pressure, there shall be no axial movement of the pipes.

Table 4 — Resistance to end thrust of grip collars - performance requirements

Test condition	Internal test pressure in bar	
	DN ≤ DN 200	DN > DN 200
aligned	0 to 5	0 to 3

4.3.5 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 5.9.6.

4.4 Vacuum tightness (only for under vacuum evacuation of water from works)

4.4.1 General

The assessment of each component as described in this 4.4 insures the assessment of the kit.

4.4.2 Pipes resistance to vacuum

Expected results for pipes resistance to vacuum are given in Table 5, see 4.4.4.

4.4.3 Fittings – resistance to vacuum

4.4.3.1 Fittings without access or door

Expected results for resistance to vacuum of Fittings without access or door are given in Table 5. The demonstration done for pipe is valid for these fittings.

4.4.3.2 Fittings with access or door

When tested in accordance with 5.8, fittings with access or door shall withstand a negative pressure. An initial negative pressure of −0,8 bar is generated and after a waiting time of 1 h, the final pressure shall not reach the limiting values given in Table 5.

4.4.4 Joints – resistance to vacuum

In addition to the technical requirements of 4.3.4.2, 4.3.5 and 4.12 and when tested in accordance with 5.13, the joints shall withstand a negative pressure. An initial negative pressure of −0,8 bar is generated and after a waiting time of 1 h, the final pressure shall not reach the limiting values given in Table 5.

Table 5 — Resistance to vacuum - performance requirements

Test condition	Test pressure in bar	
	DN ≤ DN 200	DN > DN 200
aligned	−0,7	−0,4

4.5 Maximum load for admissible deformation (only for below ground)

Maximum load of kits and components can be assessed by the maximum load of the pipe.

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

$$f \geq \frac{\pi.\sigma.e_{\min}^2}{3\left(DE_{\max} - e_{\min}\right)}$$

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;

σ is the ring crush strength in accordance with Table 7, in megapascals.

4.6 Reaction to fire (only for above ground evacuation of water from works and under vacuum evacuation of water from works)

4.6.1 Reaction to fire of components

As written in the scope of EN 13501-1:2018, products are considered in relation to their end use application. Components are always assembled with other components into a system, therefore the assessment of single component is not considered as appropriate. Consequently, the assessment only applies to kit.

4.6.2 Reaction to fire of kits

The reaction to fire indicates the degree of contribution of the material to the behaviour of the construction product in the event of fire. When tested in accordance to the test methods given in 5.7.3.3, relevant for the claimed class, the test results are expressed as a class according to EN 13501-1.

Whether products covered by this document are made from one or more of the materials that have been considered, under established conditions, as belonging to the category “No contribution to fire” because of their low level of combustibility, the reaction to fire class A applies to these products without the need of carrying out reaction to fire tests.

The mounting and fixing conditions for the SBI test are given in Annex F.

Considering the products in their end-use conditions as an assembled system:

— internal coatings are not relevant as they are not exposed to fire (a very small volume of smoke can be created but this will exit the building via stacks vents);

— gaskets of joints are not relevant either as in the end-use conditions they are not exposed to fire (except for some designs a very small compressed edge) and as such represent a very low quantity of organic material.

In order to verify these assumptions, they shall be tested according to Annex F using the mounting adaptations given.

According to EN 13501-1, as the gross calorific potential (PCS) of the products considered as an assembled system including pipes, fittings and couplings, due to their densities and weight quantities, will always satisfy the requirement on PCS for the product as a whole (≤2,0 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 4.11.3 on ignitability or gross calorific potential, depending on the intended class of reaction to fire;

and

— a range of products (including coated pipes, coated fittings, couplings and possibly grip collars) shall be tested according to Annex F using the mounting adaptations given, and shall satisfy the requirements of classification criteria and additional classifications listed in EN 13501-1 for the intended class of reaction to fire. If a range of products includes grip collars, as these products are not always installed on the discharge system depending on the intended performance:

    — the test shall be done without them to evaluate the behaviour of the couplings without any protection to the flame;

    — and only if the grip collars include an organic material, the test shall be done again with the grip collars installed on top of the couplings (see Annex F).

In order for a manufacturer of only joints to obtain a classification, the joints shall be tested once according to Annex F using the mounting adaptations given, with pipes and fittings of a cast iron range of products which already has a reaction to fire classification issued by a certified test laboratory. It shall be demonstrated that the existing classification of the range of products is not made worse by the substitution of the joints.

NOTE See D.2.

4.7 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 document.

4.8 Dimensions

4.8.1 Nominal size (DN)

The nominal sizes shall be as given in column 1 of Table 6.

4.8.2 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 6, 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 4.3.4 and 4.3.5, in this case.

Table 6 — 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 −3,8	7,0	5,2
600	635	+2 −4	7,7	5,8

NOTE 1 In countries where the nominal sizes DN 60, DN 65 (DE 75) and DN 80 are still mentioned in application standards, these nominal sizes can still be used.

NOTE 2 Other dimensions are given in 4.14.2 for buried kits and in 4.15.3, 4.15.4 and 4.15.5 for rainwater kits installed outside buildings.

4.8.3 Wall thickness

Wall thicknesses of pipes and fittings shall comply with the values given in Table 6, when measured in accordance with 5.2.2.

Kit with minimum value of wall thickness up to −1 mm compared to Table 6 can be supplied with special identification by agreement between the manufacturer and the purchaser, all characteristics according

to this document shall be specifically assessed. Acoustic und fire resistance performances shall also be specifically and separately assessed.

4.8.4 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.

4.8.5 Ovality

When measured in accordance with 5.2.4 the ovality of the pipes and of the sealing zones of fittings (see 4.3.2) shall remain within the tolerances on DE shown in Table 6 for DN 40 to DN 300 and shall not exceed 1 % for DN 400 to DN 600 (see EN 598:2007+A1:2009, 3.36).

4.8.6 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.

4.8.7 End faces

The end faces of the products shall be free from faults which could 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.

4.8.8 Length of pipes

Pipes are usually produced with a length of 3 m. Other lengths are permitted and can be supplied with special identification by agreement between the manufacturer and the purchaser.

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

4.8.9 Angles of fittings

Fittings shall be designed to the angles specified below with a design tolerance of ± 2°:

— bends: 15°; 22°; 30°; 45°, 68°; 88°; 135°;

— single/double branches: 45°; 68°; 88°.

4.8.10 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.

4.9 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.

4.10 Material characteristics of pipes, fittings and accessories

4.10.1 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 598:2007+A1:2009; or

— any other type of cast iron in accordance with 4.10.2.

4.10.2 Mechanical properties

Pipes, fittings and accessories shall have the mechanical properties given in Table 7.

Table 7 — Mechanical properties of pipes, fittings and accessories

Type of casting and material [a] [b]	Minimum tensile strength **MPa**	Minimum ring crush strength **MPa**	Maximum Brinell hardness **HB**
Pipes			
— grey cast iron	200	350 [c]	260
— spheroidal graphite cast iron	420	–	230
Fittings and accessories			
— grey cast iron	150	–	260
— spheroidal graphite cast iron	420	–	250

[a] Other types of cast iron shall satisfy the criteria laid down for grey cast iron.

[b] Tensile and ring crush strength for other products see Annex A.

[c] 332 MPa for nominal sizes equal to or greater than DN 250.

The modulus of elasticity *E* shall be given by the manufacturer.

NOTE It is normally at least 110 GPa for grey cast iron and at least 170 GPa for spheroidal graphite cast iron.

4.11 Coatings for pipes, fittings and accessories

4.11.1 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 heated to 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 4.11.2 or 4.11.3 respectively.

NOTE Specific requirements for coatings for buried kits and rainwater kits installed outside buildings are given in 4.15.3 and 4.15.2 respectively.

4.11.2 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 EN ISO 9227;
—	resistance to waste water:	at least 30 d at 23 °C ± 3°C;
—	chemical resistance from pH 2 to pH 12:	at least 30 d at 23 °C ± 3°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 4.11.1);
—	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.

4.11.3 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 EN ISO/CIE 11664-4 (approximately reddish-brown); other coating colors as long as all other technical requirement in §4.11.3 are fulfilled are permitted.
— compatibility with other paints:	paints normally used on metallic structures.

For a classification of the range of products within classes E to B (see EN 13501-1:2018, Table 1), 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 the range of products (see EN 13501-1:2018, Table 1), the gross calorific potential of the external coatings, noted $PCS_{\text{product range,}}$ shall conform to the requirements of EN 13501-1 on external components when tested and calculated in accordance with 5.7.3.3:

主要组分

次要组分

— gross calorific potential of external coatings, $PCS_{product\ range}$:

  — if external coatings are substantial components, $PCS_{product\ range} \leq 3$ MJ/kg;

  — if external coatings are non-substantial components, $PCS_{product\ range} \leq 4$ MJ/m2.

For the A1 classification of the range of products (see EN 13501-1:2018, Table 1), the gross calorific potential of the external coatings, noted $PCS_{product\ range}$, 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, $PCS_{product\ range}$:

  — if external coatings are substantial components, $PCS_{product\ range} \leq 2$ MJ/kg;

  — if external coatings are non-substantial components, $PCS_{product\ range} \leq 2$ MJ/m^2, provided that the range of products when tested according to EN 13823, using the mounting conditions of Annex F satisfies the following criteria: FIGRA < 20 W/s, and LFS < edge of specimen, and THR_{600s} < 4,0 MJ, and s1, and d0.

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 4.11.1);

— adhesion: in accordance with level 2 of EN ISO 2409.

4.12 Joints

4.12.1 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 document.

Taking into account the different applications of cast iron pipe systems and their components, various joint designs are permitted provided that they satisfy the requirements of this document. The joints shall incorporate one or more elastomeric gasket(s) to ensure leak tightness and prevent direct contact between the ends of pipework components. The manufacturer shall propose a design or a device when electrical conductivity of their joints is required.

4.12.2 Dimensions

The effective width of the sealing zone of joints shall not exceed the dimension 2 *T* as shown in Figure 1 and Table 1. The overall dimensions of the joints are also limited by the dimensions and angles of the fittings. They shall be measured according 5.9.1.

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

4.12.3 Material for couplings or clamping components except grip collars (for grip collars see 4.14)

It shall usually be made from:

a) cast iron according to Table 7 (for fittings and accessories);

b) the following stainless steels in accordance with EN 10088-1 as they ensure resistance to corrosion and a stabilization against the effects of intergranular corrosion:

— austenitic: all grades except X8CrNiS18–9 (1.4305);

— ferritic and martensitic: X3CrTi17 (1.4510), X3CrNb17 (1.4511) and X2CrTi17 (1.4520).

Cast iron couplings or clamping components shall be coated according to 4.11, at least on the surfaces not covered by the gaskets.

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 the assembled metallic components shall withstand a salt spray test of at least 350 h in accordance with EN ISO 9227. For all components the acceptable levels of blistering shall be dimension 3, class 3 in accordance with EN ISO 4628-2 and rusting Ri shall be not greater than 2 in accordance with EN 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 ISO 898-1 and EN ISO 898-2 respectively. If the bolts are made of stainless steel, according to EN ISO 3506-1, they shall be made of A2 or A4 or C1 and the minimum strength class shall be 70. If the nuts are made of stainless steel, according to EN ISO 3506-2, they shall be made of A2 or A4 or C1 and the minimum strength class shall be 70.

4.12.4 Material for gasket

It shall:

— conform to EN 681-1;

— satisfy the type test defined in 5.9.2.1, 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.

4.12.5 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 3 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.

4.12.6 Temperature resistance

When tested in accordance with 5.9.7 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 kits installed outside buildings or joints connecting to WC and urinals.

这些要求不适用于室外雨水组件的连接和卫生间和便池排水的连接

4.13 Grip collars

4.13.1 General

Grip collars can be components of the manufacturer's systems. They shall secure the joints of discharge systems submitted to internal pressure by providing axial restraint to the end thrust at changes in direction, blank ends etc.

Some joints can include components or devices which guarantee axial restraint. In such a case, they shall fulfil both requirements on joints and on grip collars.

4.13.2 Dimensions

The overall dimensions of the grip collars are limited by the dimensions of the couplings they are designed for, and the dimensions and the angles of the fittings. They shall be measured in accordance with 5.10.1.

The drawings of the grip collars provided by the manufacturer shall give their main dimensions and tolerances.

4.13.3 Materials

The grip collars shall usually be made from:

a) cast iron according to Table 7 (for fittings and accessories) and coated according to 4.11;

b) steels with corrosion protection;

c) all stainless steels in accordance with EN 10088-1.

The materials used shall meet the following requirements:

— the materials shall conform to the corresponding materials standards;

— the components shall have suitable corrosion resistance as the assembled grip collar. Two classes can be claimed. A class K1 grip collar shall withstand a salt spray test of at least 350 h in accordance with EN ISO 9227. For class K2 it shall withstand a salt spray test of 72 h: for all components the acceptable maximum levels of blistering shall be dimension 3, class 3 in accordance with EN ISO 4628-2 and rusting Ri shall be not greater than 2 in accordance with EN 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 ISO 898-1 and EN ISO 898-2 respectively. If the bolts are made of stainless steel, according to EN ISO 3506-1, they shall be made of A2 or A4 or C1 and the minimum strength class shall be 70. If the nuts are made of stainless steel, according to EN ISO 3506-2, they shall be made of A2 or A4 or C1 and the minimum strength class shall be 70.

The manufacturer shall specify the materials used for the different parts of the grip collars and shall be able to present inspection documents drawn up either by themselves or by their subcontractors (see EN 10204).

4.13.4 Suitability for use

All parts of the grip collars shall be free from defects likely to compromise their suitability for use. Sharp edges should be avoided except on the grip components.

Grip collars shall be designed so that they do not affect the performance of the joints they support and they shall withstand the end thrust resulting from the pressures given in Table 4 without any cracking or damage which could impair the performance of the product.

The manufacturer shall give all information concerning the compatibility of the grip collars with the couplings they offer.

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

4.14 Characteristics for buried systems

4.14.1 General

The requirements given in 4.1 and 4.2 and 4.8 to 4.12 shall apply, together with the modifications given in 4.14.2 to 4.14.4.

For marking see Annex G.

4.14.2 Dimensions

The dimensions are given in Table 6. Other dimensions as given in Annex A and B are permitted by agreement between the manufacturer and the purchaser.

4.14.3 External coatings

4.14.3.1 General

Coatings in accordance with 4.14.3.2 or 4.14.3.3 shall be used instead of those specified in 4.11.3. 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 kits is given in Annex C.

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

4.14.3.2 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 5.11.2:

— the mean mass of zinc per unit area shall be not less than 130 g/m^2, with a local minimum of 110 g/m^2;

— the mean dry film thickness of the finishing layer shall be not less than 70 µm, with a local minimum of 50 µm, when using a bituminous paint; with other paints, lower thicknesses may be applied on fine grained zinc (such as from flame spraying).

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.

4.14.3.3 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 4.14.3.2.

4.14.4 Joints

All parts of couplings or clamping components shall be made from cast iron (see 4.13.3), and coated in accordance with 4.14.3.3, or from austenitic stainless steel in accordance with EN 10088-1 with at least 16,5 % chrome and 8,5 % nickel or equivalent, or from material of comparable resistance.

4.15 Characteristics for rainwater systems installed outside buildings

4.15.1 General

The requirements given in 4.1 and 4.2, in 4.3.2 to 4.3.4.2.3 and in 4.8 to 4.12.6 shall apply together with the modifications in 4.15.2 to 4.15.5.

4.15.2 Coatings

The external coatings shall comply with 4.11.3 except for colour. The internal coatings may be identical to the external coatings.

4.15.3 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 6. The dimensions specified in Annex B are permitted by agreement between the manufacturer and the purchaser.

4.15.4 Nominal sizes

For components with circular cross-section see 3.14. 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.

4.15.5 Lengths of pipes

Pipes are usually produced with lengths of 1 m, 2 m or 3 m. Other lengths are permitted and can be supplied with special identification by agreement between the manufacturer and the purchaser.

4.16 Characteristics for systems under vacuum

The requirements given in 4.1 to 4.12 shall apply.

4.17 Interconnection

Products of the same DN in accordance with this document (see Table 6) can be connected with each other.

5 Testing, assessment and sampling methods

5.1 Surface condition

The surface condition (see 4.7) 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 6 and for ovality, in accordance with 4.8.5 For nominal sizes ≥ 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 1).

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

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 callipers. 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 6. In the case of coatings having a thickness greater than 400 µm the difference between the actual coating thickness and 400 µm shall be added to the minimum wall thickness as given in Table 6.

If necessary, additional measurements along the length of the pipes may be made, e.g. by means of ultrasonic 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 4.8.4 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 4.8.6.

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 4.8.7.

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 4.8.8 or 4.3.2.

5.2.8 Angle of fittings

The angle(s) of fittings shall be determined with a measurement uncertainty of 30’.

5.3 Masses

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 4.10) the tensile strength shall be measured in accordance with EN 598:2007+A1:2009, 6.3. For products made of grey cast iron or any other type of cast iron (see 4.10) 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

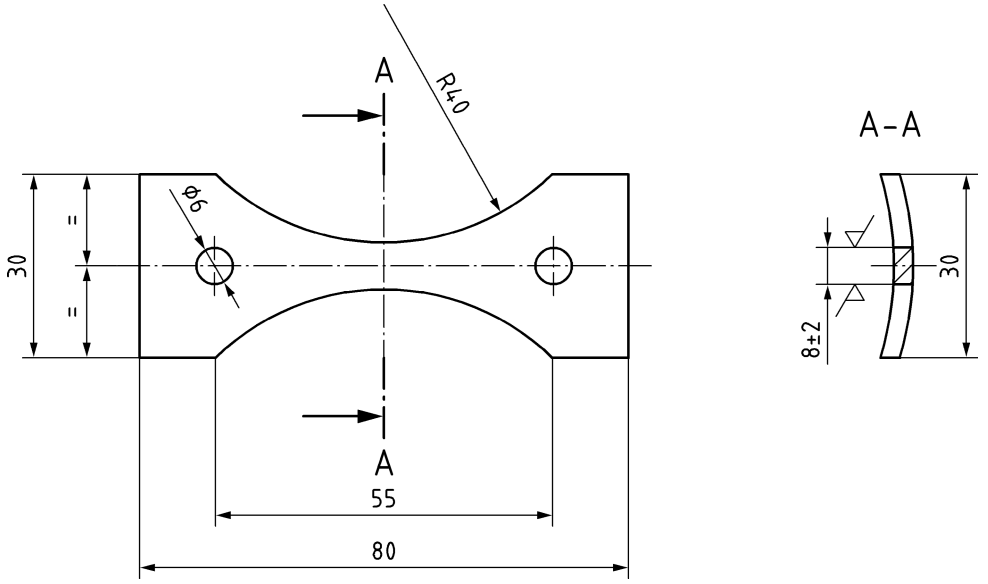
In order to obtain results which are as representative as possible of the finished products, the tensile tests shall be performed on samples:

— either taken from pipes or fittings. The sample shall then be cut parallel with the axis of the pipe or fitting;

— or, and only for fittings, from separately cast test pieces, cast at the same time as the fittings.

The test piece cut from the sample shall be in accordance with Figure 2, and if coming from separately cast test pieces, can be flat rather than curved.

Dimensions in millimetres



section A-A

~ not machined

Figure 2 — Sample for tensile test

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 EN ISO 6892-1:2019, Clause 9.

The speed of load application shall be as constant as possible in accordance with EN ISO 6892-1:2019, Clause 10.

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 EN ISO 6892-1:2019, Clause 9.

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 7. 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)

ISO 185:2020, Clauses 8, 9 and 10 shall apply.

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

EN 598:2007+A1:2009, 6.3 shall apply.

5.5 Brinell hardness

The Brinell hardness test shall be carried out in accordance with EN ISO 6506-1, 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 7.

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

σ 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 7 and only one value shall be allowed to be a maximum of 5 % below the value given in Table 7.

5.7 Coatings

5.7.1 General

If there is no specific requirement on the samples, the tests or measurements shall be made on samples either coming from finished products or on standard panels, after drying and/or polymerisation of the coatings (see 6.2 and 6.3). The standard panels shall be in accordance with EN ISO 1514.

5.7.2 Internal coatings

5.7.2.1 Resistance to salt spray

The tests shall be carried out in accordance with EN ISO 9227 and after the test period of at least 350 h (see 4.11.2) 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

The samples shall be immersed for 30 d in waste water at a temperature of (23 ± 3) °C with the composition given in Table 8.

Table 8 — 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 samples 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 ± 3) °C the samples 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. The 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 ± 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 EN 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 their material.

5.7.2.4 Coating thickness

The tests shall be carried out only on samples coming from finished products using test equipment in accordance with method 6 of EN ISO 2808 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.

The obtained value shall be not less than the minimum factory applied thickness specified by the manufacturer (see 4.11.1) and shall not exceed 400 µm except for specific coatings for special applications (see 4.11.2).

5.7.2.5 Adhesion

The adhesion of the coating shall be checked only on samples coming from finished products by a cross-cut test in accordance with EN ISO 2409, in the following way:

— test sample: section minimum100 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 4.11.2.

5.7.2.6 Resistance to hot water

The test shall be performed only on samples coming from finished products, minimum 100 mm long. 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 ± 2) °C. The internal coating shall then be examined immediately for degree of blistering which shall not exceed dimension 3, class 3 in accordance with EN ISO 4628-2.

5.7.2.7 Resistance to temperature cycling

The test shall be performed only on samples coming from finished products.

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

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

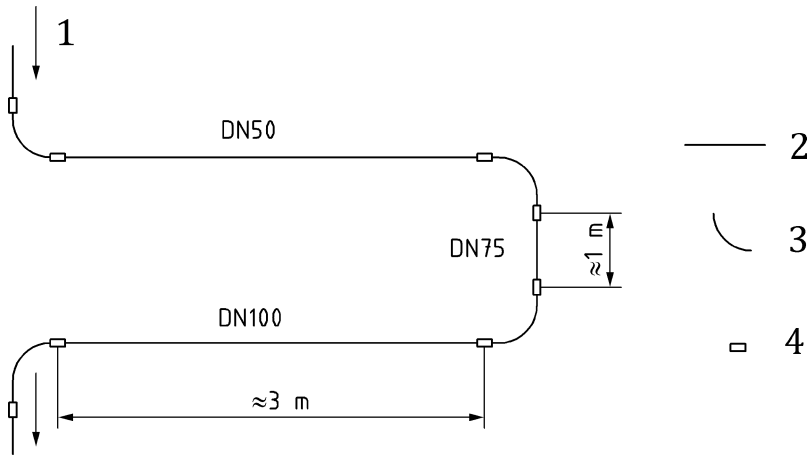
b) rest and drain period of 1 min;

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

d) rest and drain period of 1 min.

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

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



Key

1	Direction of flow
2	Pipe
3	Fitting
4	Joint in accordance with 4.13

Figure 3 — Example of a typical test set-up

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 EN ISO 4628-2;

— degree of rusting: Ri 2 according to EN ISO 4628-3.

5.7.3 External coatings

5.7.3.1 Colour

The values L, a, b and ΔE (see 4.11.3) shall be determined by a calibrated spectrocolorimeter or spectrophotometer preferably using CIE standard illuminant D65.

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 4.11.3). This shall be done by tests carried out on steel panels in accordance with EN ISO 1514 coated with the dry external coating defined in 4.11.3 Each of the following two types of finishing paints shall be applied by brush on the test panels with a dry thickness of (50 ± 10) µm, 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 4.11.3.

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 of a range of products for which the manufacturer is claiming a reaction to fire class A1 or A2, each external coating shall be tested according to EN ISO 1716 in order to obtain its gross calorific potential value (PCS).

To classify the range of products, the PCS of external coatings for the range of products, noted $PCS_{\text{product range,}}$ shall be calculated. The method of calculation is detailed in Annex E.

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 4.11.1).

5.7.3.5 Adhesion

The test procedure and criteria shall be in accordance with 5.7.2.5 and 4.11.3 respectively.

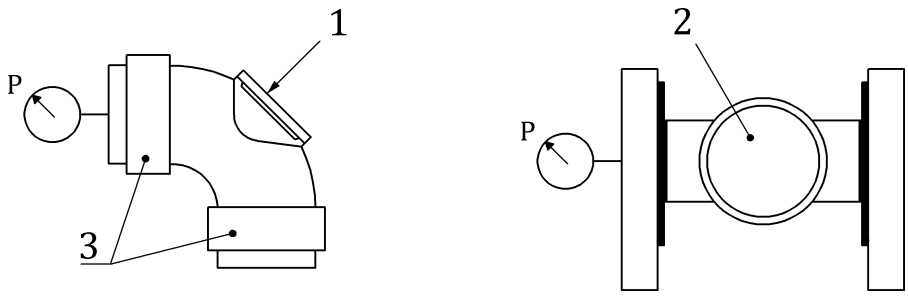
5.8 Water tightness test for fittings with access or door

This test shall be carried out at ambient temperature on coated products on at least one DN by type of fitting and by group of DN defined in Table 9.

Table 9 — Groups of DN

DN ≤ DN 200
DN > DN 200

The test assembly (see Figure 4 for examples) shall be capable of providing water tightness and lateral restraint on each end of the fitting for the required internal hydrostatic pressure. Sealing of the fittings ends can be with blank ends with couplings, plates with rubber seal, expansion plugs, etc. to ensure a leak tight seal and permit suitable end restraint.



Key

1 access
2 door
3 joints + grip collars

Figure 4 — Examples of equipment for water tightness test for fittings with access or door

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 11, until it reaches the test pressure given in Table 2.

Throughout the duration of the test, all necessary safety precautions have to be taken; the fitting shall show no leakage in the area of the access or the door.

5.9 Joints

5.9.1 Dimensions

The dimensions of the couplings and their components, including the elastomeric gaskets, shall be measured to an accuracy which is appropriate to the size of the various dimensions. They shall be in accordance with the drawings of the supplier of the coupling and with 4.12.2.

5.9.2 Elastomeric gaskets

5.9.2.1 Material type tests

Elastomeric gaskets shall be tested in accordance with EN 681-1:1996 (see 4.12.4). In addition they shall be tested by immersion in the emulsion specified in Table 10, combined with the determination of increase in volume and of ozone resistance.

Table 10 — Test liquid for elastomeric gaskets

Constituents
5 parts olive oil, cold-pressed, 1st pressing
2 parts emulsifier comprising, by mass, the following:
— 15 % non-ionic surface active agent;
— 5 % citric acid (free of water);
— 17 % Sodium-cumene-sulphonate solution
(45 % concentration);
— 63 % demineralized water
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 10 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 %.

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

The supplier of the couplings and/or gaskets shall demonstrate compliance with 5.9.2.1 for their material.

5.9.2.2 Production tests

For production testing, the immersion test in accordance with 5.9.2.1 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.

5.9.3 Suitability for use

Conformance with 4.12.5 shall be assessed for each type and each DN (see 5.9.4.2).

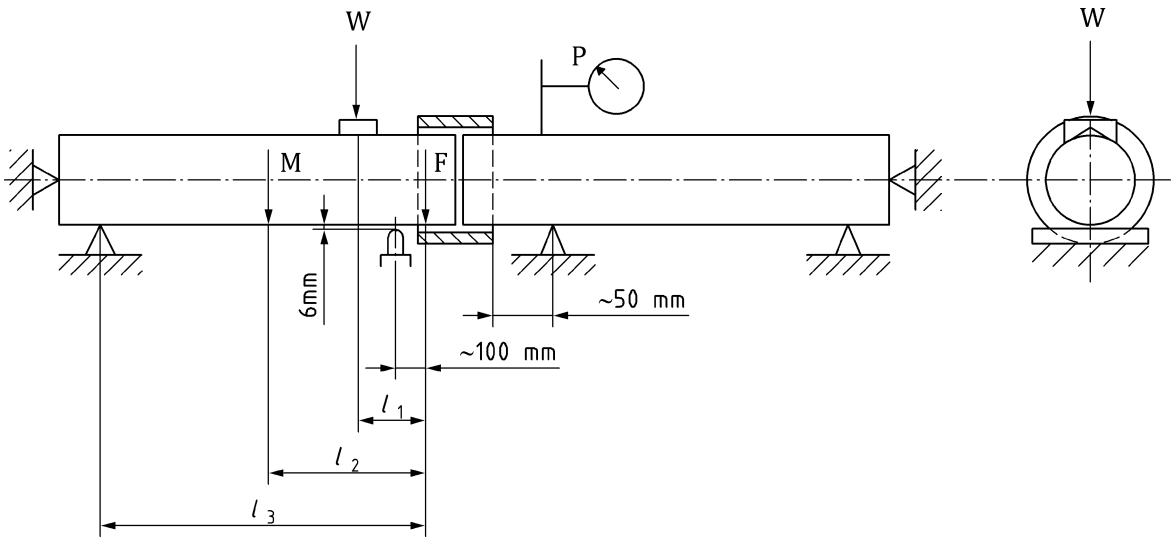
5.9.4 Water tightness of joints to positive internal pressure

5.9.4.1 General

The tests shall be carried out at ambient temperature on coated products on at least one DN by type of joint and by group of DN defined in Table 9.

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 5) 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.



Key

W Vertical load
M Mass of the pipe
P Manometer
F Shear force

Figure 5 — Test apparatus for water tightness of joints submitted to internal pressure

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 11 until it reaches the test pressure given in Table 3, depending on the test condition.

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

Table 11 — Rates and stages of increase in hydrostatic pressure

Test pressure	**Rate of increase in pressure**	**Level and duration of pressure stages**	
		Level	**Duration**
bar	bar/min	bar	min
> 0,5	≤ 10	0 0,5 test pressure (see Table 2 for fittings, Table 3 for joints and Table 4 for grip collars)	5 10 ≥ 15
≤ 0,5	≤ 0,1	0 0,05 test pressure (see Table 2 for fittings and Table 3 for joints)	5 10 ≥ 15

At each stage it is essential that the pressure is kept constant for the specified period.

5.9.4.2 Aligned position (see Table 3, test condition a)

Contrary to the requirements of 5.9.4.1, 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 5.9.3).

5.9.4.3 Angular deflection (see Table 3, 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 4.3.4.2.1 b).

5.9.4.4 Shear force (see Table 3, test condition c)

When tested under shear force the vertical load *W* (see Figure 5) shall be applied by means of a V-shaped block with an angle of 120°, 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 4.3.4.2.1 c), taking into account the mass *M* of the pipe and its contents and the geometry of the test assembly:

$$W = \frac{Fl_3 - M(l_3 - l_2)}{l_3 - l_1}$$

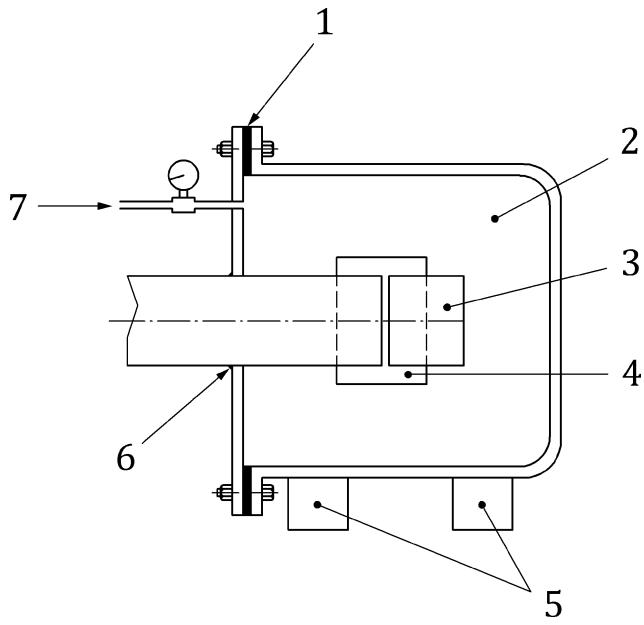
where

l_1, l_2 and l_3 are as shown in Figure 5.

5.9.5 Water tightness of joints to positive external pressure

This test shall be carried out in accordance with Table 3, test condition a).

The test procedure in accordance with 5.9.4.1 shall apply except that an appropriate test apparatus shall be used, e.g. as shown in Figure 6 and that the pipe sections may be shorter than 1 m.



Key

1 gasket
2 water filled
3 solid end
4 joint
5 supports
6 welded or suitably sealed
7 pressure in

Figure 6 — Test apparatus for water tightness of joints submitted to external pressure

5.9.6 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.

5.9.7 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 ± 2) °C and at a constant flow rate of 30 l/min.

Finally, the test assembly shall be filled with water at (15 ± 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 could affect their performance.

5.10 Grip collars

5.10.1 Dimensions

The dimensions of the grip collars and their components shall be measured to an accuracy which is appropriate to the size of the various dimensions. They shall be in accordance with the drawings of the supplier of the coupling and with 4.13.2.

5.10.2 Suitability for use

Conformance with 4.13.4 shall be assessed for each type and each DN (see 5.10.3).

5.10.3 Resistance to end thrust resulting from positive internal pressure

This test shall be carried out at ambient temperature on coated products, for each type of joint and each DN defined in Table 9 in order to demonstrate not only water tightness but suitability for use of the grip collars (see 5.10.2).

Each test shall be carried out with an assembled joint comprising:

— either a coupling equipped with a grip collar;

— or a special coupling which has intrinsic grips.

They shall joint 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 7) shall be capable of providing only suitable lateral restraint (to enable axial movement) with the joint in the aligned position. All of the pipe ends of the assembled joint shall bear on a flat support at approximately 50 mm from the joint. The movement of one pipe relative to the other can be limited for safety reasons (l_1 – Figure 7) at a value higher than 10 mm by means of an appropriate thrust block.

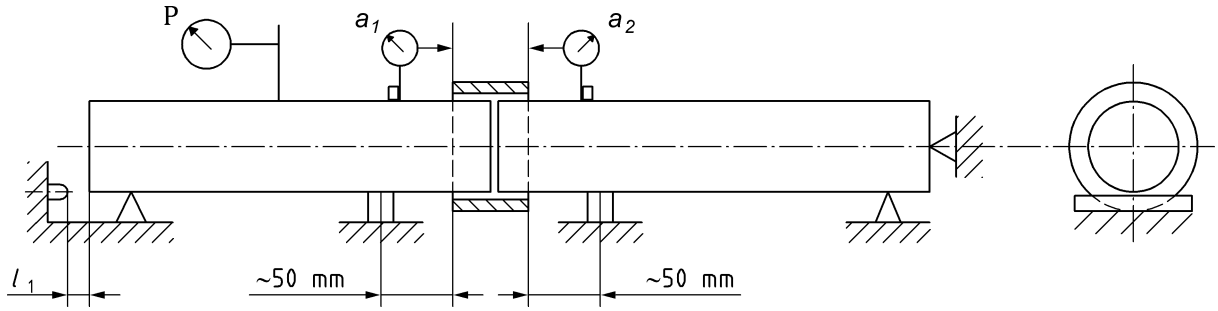


Figure 7 — Test apparatus for resistance to end thrust effect of grip collars

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 11 for test pressure > 0,5 bar, until it reaches the test pressure given in Table 4.

Throughout the duration of the test, all necessary safety precautions have to be taken; the joint shall show neither leakage nor changes which could impair its performance. An axial movement of each pipe compared to the grip collar or the special coupling with intrinsic grips is allowed during the pressure increases. Following the completion of all the pressure increases, its cumulative value ($a_1 + a_2$) shall not exceed 5 mm. During each stage in pressure, there shall be no axial movement of the pipes.

5.11 Buried kits

5.11.1 General

The test methods defined in 5.1 to 5.10 shall apply except for 5.7.3 (see 5.11.2).

5.11.2 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 EN 598:2007+A1:2009, 6.7 and 6.8 respectively.

5.12 Rainwater kits installed outside buildings

The test methods defined in 5.1 to 5.9.2 shall apply.

5.13 Kits under vacuum

This test shall be carried out at ambient temperature on coated products, for each type of joint and each DN defined in Table 9.

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 8) shall be capable of supporting the joint and the pipes in the aligned position. All of the pipe ends of the assembled joint shall bear on a flat support at approximately 50 mm from the joint.

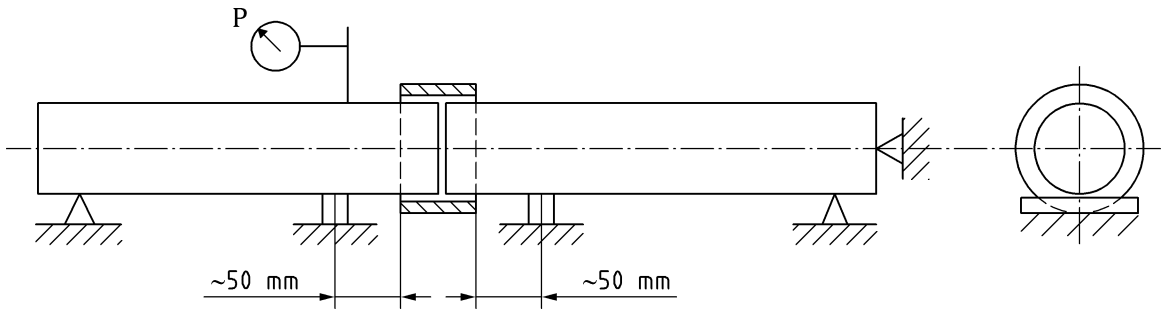


Figure 8 — Test apparatus for resistance to vacuum of couplings

The test assembly shall undergo an initial negative pressure generated by means of a vacuum pump or a Venturi device in order to reach the value of −0,8 bar. The limiting values of pressure after 1 h are given in 4.4.4, Table 5.

5.14 Marking

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

6 Assessment and verification of constancy of performance - AVCP

6.1 General

The technical details necessary for the implementation of the system of assessment and verification of constancy of performance of **cast iron pipes systems and their components for the evacuation of water from works** comprise provisions with regards to:

— the applicable factory production control; and

— the assessment of performances of the construction product, which may be carried out on the basis of testing (including sampling), calculation, tabulated values or descriptive documentation of the product".

The manufacturer shall always retain the overall control and shall have the necessary means to take responsibility for the assessment of the construction product and the performance(s) declared by the manufacturer in the DoP.

6.2 Assessment of performance

6.2.1 General

All performances related to characteristics included in this document shall be determined when the manufacturer intends to declare the respective performances unless the standard gives provisions for declaring them without performing tests. (e.g. use of previously existing data, Classification Without Further Testing and conventionally accepted performance).

Assessment previously performed in accordance with the provisions of this document, may be taken into account provided that they were made to the same or a more rigorous test method, under the same AVCP system on the same product or products of similar design, construction and functionality, such that the results are applicable to the product in question.

NOTE Same AVCP system means testing by an independent third party [only for products covered by system 1+, 1 and 3], under the responsibility of a notified product certification body [only for products covered by system 1+ and 1].

— For the purposes of assessment, the manufacturer's products may be grouped into families, where it is considered that the results for one or more characteristics from any one product within the family are representative for those same characteristics for all products within that same family.

Products may be grouped in different families for different characteristics.

Reference to the assessment method standards should be made to allow the selection of a suitable representative sample.

In addition, the determination of the product type shall be performed for all characteristics included in the standard for which the manufacturer declares the performance:

— at the beginning of the production of a new or modified **Cast iron pipes systems and their components for the evacuation of water from Works** (unless a member of the same product range); or

— at the beginning of a new or modified method of production (where this could affect the stated properties); or

they shall be repeated for the appropriate characteristic(s), whenever a change occurs in the design of **Cast iron pipes systems and their components for the evacuation of water from Works**, in the raw material or in the supplier of the components, or in the method of production (subject to the definition of a family), which would affect significantly one or more of the characteristics.

Where components are used whose characteristics have already been determined, by the component manufacturer, on the basis of assessment methods of other product standards, these characteristics need not be re-assessed. The specifications of these components shall be documented.

Products bearing regulatory marking in accordance with appropriate harmonized European specifications may be presumed to have the performances declared in the DoP, although this does not replace the responsibility on the manufacturer of **Cast iron pipes systems and their components for the evacuation of water from Works** to ensure that the **Cast iron pipes systems and their components for the evacuation of water from Works** as a whole is correctly manufactured and its component products have the declared performance values.

6.2.2 Test samples, testing and compliance criteria

The number of samples of **Cast iron pipes systems and their components for the evacuation of water from Works** to be tested/assessed shall be in accordance with Tables 13 to 15.

Table 13 — 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	4.8
External diameter and ovality	3 per DN	5.2.1/ 5.2.4	4.8.2/ 4.8.5
Wall thickness	3 per DN	5.2.2	4.8.3
Internal diameter of pipes	3 per DN	5.2.3	4.8.4
Straightness of pipes	3 per DN	5.2.5	4.8.6
End faces	3 per DN	5.2.6	4.8.7
Length of pipes	3 per DN	5.2.7	4.8.8
Lengths of fittings and sealing zone	3 per DN	5.2.7	4.3.2
Angle of fittings	3 per DN	5.2.8	4.8.9
Masses	3 per DN	5.3	4.9
Tensile strength	3 per group of DN [b]	5.4	4.10.2
Brinell hardness	3 per group of DN [b]	5.5	4.10.2
Impact resistance test for pipes	3 per group of DN [b]	5.4 + 5.5	4.2
Ring crush strength of pipes	3 per group of DN [b]	5.6	4.10.2
Internal coatings			
— Resistance to salt spray	3 samples	5.7.2.1	4.11.2
— Resistance to waste water	3 samples	5.7.2.2	4.11.2
— Chemical resistance	3 samples	5.7.2.3	4.11.2
— Dry coating thickness	3 per DN	5.7.2.4	4.11.2
— Adhesion	3 per group of DN [b]	5.7.2.5	4.11.2

Items to be tested	**Number of samples** (minimum)	**Test method in accordance with**	**Requirements in accordance with**
— Resistance to hot water	3 per group of DN [b]	5.7.2.6	4.11.2
— Resistance to temperature cycling	1 test set up	5.7.2.7	4.11.2
External coatings			
— Colour	3 samples	5.7.3.1 (CS) [a]	4.11.3
— Compatibility with other paints	3 samples	5.7.3.2 (CS) [a]	4.11.3
— Ignitability or gross calorific potential	1 per coating 1 per coating	5.7.3.3 (CS) [a] 5.7.3.3 (CS) [a]	4.11.3 4.11.3
— Dry coating thickness	3 per DN	5.7.3.4	4.11.3
— Adhesion	3 per group of DN [b]	5.7.3.5	4.11.3
— For buried kits	1 per group of DN [b]	5.11.2	4.14.3.2
Water tightness of fittings with access or door	1 per group of DN [b]	5.8	4.3.4.1.2.2
Marking	3 per DN	5.14	Annex G
Reaction to fire			
— Range	1 per range of products	5.7.3.3/ Annex F	4.6/ 4.11.3
NOTE Items **in bold** are used by the essential characteristics according to the Mandate.			
[a] Certificate of the supplier. [b] Groups of DN: see Table 9.			

Table 14 — 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	5.9.1	4.12.2
Materials — Clamping components, couplings, bolts — Elastomeric gaskets	 3 per DN 3 per group of DN [b]	 Analysis or CS [a] 5.9.2.1 CS [a]	 4.12.3 4.12.4
Suitability for use	1 per DN	5.9.3	4.12.5
Water tightness under different conditions	1 per group of DN [b]	5.9.4 / 5.9.5	4.3.4.2
Air tightness	1 per DN	5.9.6	4.3.5
Temperature resistance	1 per group of DN [b]	5.9.7	4.12.6
For kits under vacuum	1 per group of DN [b]	5.13	4.4.4
Marking	3 per DN	5.14	Annex G
Reaction to fire [c] — Couplings	 1 per range of products	 Annex F	 4.6
NOTE The item **in bold** is an essential characteristic according to the Mandate.			
[a] Certificate of the supplier. [b] Groups of DN: See Table 9. [c] For manufacturer of only joints – see 4.6.			

Table 15 — Type tests for grip collars

Items to be tested	Number of samples (minimum)	Test method in accordance with	Requirements in accordance with
Dimensions	3 per DN	5.10.1	4.13.2
Materials — Frames, grips (or teeth), bolts	 3 per DN	 Analysis or CS [a]	 4.13.3
Suitability for use	1 per DN	5.10.2	4.13.4
Resistance to end thrust	1 per DN	5.10.3	4.3.4.3
Marking	3 per DN	5.14	Annex G
Reaction to fire if organic material [b] — Grip collars	 1 per range of products	 Annex F	 4.6
[a] Certificate of the supplier. [b] For manufacturer of only joints. Joints includes grip collars – see 3.10 and 4.6.			

6.2.3 Test reports

The results of the product type tests shall be documented in test reports. These test reports shall be retained by the manufacturer for at least 10 years after the last date of production of the **Cast iron pipes systems and their components for the evacuation of water from Works** to which they relate.

6.3 Factory production control (FPC)

6.3.1 General

The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market comply with the declared performance of the essential characteristics.

The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product.

All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures.

This factory production control system documentation shall ensure a common understanding of the evaluation of the constancy of performance and enable the achievement of the required product performances and the effective operation of the production control system to be checked. Factory production control therefore brings together operational techniques and all measures allowing maintenance and control of the compliance of the product with the declared performances of the essential characteristics.

6.3.2 Requirements

6.3.2.1 General

An effective implementation of the FPC system shall be established in line with the content of this product standard. Tasks and responsibilities in the production control organization shall be documented and this documentation shall be kept up-to-date.

The responsibility, authority and the relationship between personnel that manages, performs or verifies work affecting product constancy, shall be defined. This applies in particular to personnel that need to initiate actions preventing product non-constancies from occurring, actions in case of non-constancies and to identify and register product constancy problems.

Personnel performing work affecting the constancy of performance of the product shall be competent on the basis of appropriate education, training, skills and experience for which records shall be maintained.

In each factory the manufacturer may delegate the action to a person having the necessary authority to:

— identify procedures to demonstrate constancy of performance of the product at appropriate stages;

— identify and record any instance of non-constancy;

— identify procedures to correct instances of non-constancy.

The manufacturer shall draw up and keep up-to-date documents defining the factory production control. The manufacturer's documentation and procedures should be appropriate to the product and manufacturing process. The FPC system should achieve an appropriate level of confidence in the constancy of performance of the product. This involves:

a) the preparation of documented procedures and instructions relating to factory production control operations, in accordance with the requirements of the technical specification to which reference is made;

b) the effective implementation of these procedures and instructions;

c) the recording of these operations and their results;

d) the use of these results to correct any deviations, repair the effects of such deviations, treat any resulting instances of non-conformity and, if necessary, revise the FPC to rectify the cause of non-constancy of performance.

Where subcontracting takes place, the manufacturer shall retain the overall control of the product and ensure that they receive all the information that is necessary to fulfill their responsibilities according to this document.

If the manufacturer has part of the product designed, manufactured, assembled, packed, processed and/or labelled by subcontracting, the FPC of the subcontractor may be taken into account, where appropriate for the product in question.

The manufacturer who subcontracts all of their activities may in no circumstances pass the above responsibilities on to a subcontractor.

NOTE Manufacturers having an FPC system, which complies with EN ISO 9001 and which addresses the provisions of the present document are considered as satisfying the FPC requirements of the Regulation (EU) No 305/2011.

6.3.2.2 Equipment

6.3.2.2.1 Testing

All weighing, measuring and testing equipment shall be calibrated and regularly inspected according to documented procedures, frequencies and criteria.

6.3.2.2.2 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.

6.3.2.3 Raw materials and components

The specifications of all incoming raw materials and components shall be documented, as shall the inspection scheme for ensuring their compliance. In case supplied kit components are used, the constancy of performance system of the component shall be that given in the appropriate harmonized technical specification for that component.

6.3.2.4 Traceability and marking

Individual component of **Cast iron pipes systems and their components for the evacuation of water from Works** shall be identifiable and traceable with regard to their production origin. The manufacturer shall have written procedures ensuring that processes related to affixing traceability codes and/or markings are inspected regularly.

6.3.2.5 Controls during manufacturing process

The manufacturer shall plan and carry out production under controlled conditions.

6.3.2.6 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the stated values of the characteristics they declare are maintained. The characteristics, and the means of control, are described in Tables 16 to 18.

Table 16 — Production tests for pipes, fittings and accessories

Characteristic / Items to be tested	Test method in accordance with	Requirements in accordance with
Surface condition	5.1	4.7
External diameter and ovality	5.2.1/ 5.2.4	4.8.2/ 4.8.5
Wall thickness	5.2.2	4.8.3
Straightness of pipes	5.2.5	4.8.6
End faces	5.2.6	4.8.7
Length of pipes	5.2.7	4.8.8
Type of cast iron	-	4.10.1
Tensile strength	5.4	4.10.2
Brinell hardness	5.5	4.10.2
Ring crush strength of pipes	5.6	4.10.2
Internal coating — Dry coating thickness — Adhesion — Resistance to hot water	 5.7.2.4 5.7.2.5 5.7.2.6	 4.11.2 4.11.2 4.11.2
External coatings: — Dry coating thickness — Adhesion — For buried kits	 5.7.3.4 5.7.3.5 5.11.2	 4.11.3 4.11.3 4.14.3.2
Marking of pipes Marking of fittings and accessories	5.14 5.14	Annex G Annex G

Table 17 — Production tests for joints

Items to be tested	Test method in accordance with	Requirements in accordance with
Dimensions	5.9.1	4.12.2
Elastomeric gasket	5.9.2.2 (CS) [a]	4.12.4
Marking	5.14	Annex G
[a] Certificate of supplier.		

Table 18 — Production tests for grip collars

Items to be tested	Test method in accordance with	Requirements in accordance with
Dimensions	5.10.1	4.13.2
Marking	5.14	Annex G

6.3.2.7 Non-complying products

The manufacturer shall have written procedures which specify how non-complying products shall be dealt with. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the manufacturer's written procedures.

Where the product fails to satisfy the acceptance criteria, the provisions for non-complying products shall apply, the necessary corrective action(s) shall immediately be taken and the products or batches not complying shall be isolated and properly identified.

Once the fault has been corrected, the test or verification in question shall be repeated.

The results of controls and tests shall be properly recorded. The product description, date of manufacture, test method adopted, test results and acceptance criteria shall be entered in the records under the signature of the person responsible for the control/test.

With regard to any control result not meeting the requirements of this document, the corrective measures taken to rectify the situation (e.g. a further test carried out, modification of manufacturing process, throwing away or putting right of product) shall be indicated in the records.

6.3.2.8 Corrective action

The manufacturer shall have documented procedures that instigate action to eliminate the cause of non-conformities in order to prevent recurrence.

6.3.2.9 Handling, storage and packaging

The manufacturer shall have procedures providing methods of product handling and shall provide suitable storage areas preventing damage or deterioration.

6.3.3 Product specific requirements

The FPC system shall address this document and ensure that the products placed on the market comply with the declaration of performance.

The FPC system shall include a product specific FPC, which identifies procedures to demonstrate compliance of the product at appropriate stages, i.e.:

a) the controls and tests to be carried out prior to and/or during manufacture according to a frequency laid down in the FPC test plan,

and/or

b) the verifications and tests to be carried out on finished products according to a frequency laid down in the FPC test plan.

If the manufacturer uses only finished products, the operations under b) shall lead to an equivalent level of compliance of the product as if FPC had been carried out during the production.

If the manufacturer carries out parts of the production himself, the operations under b) may be reduced and partly replaced by operations under a). Generally, the more parts of the production that are carried out by the manufacturer, the more operations under b) may be replaced by operations under a).

In any case the operation shall lead to an equivalent level of compliance of the product as if FPC had been carried out during the production.

NOTE Depending on the specific case, it can be necessary to carry out the operations referred to under a) and b), only the operations under a) or only those under b).

The operations under a) refer to the intermediate states of the product as on manufacturing machines and their adjustment, and measuring equipment etc. These controls and tests and their frequency shall

be chosen based on product type and composition, the manufacturing process and its complexity, the sensitivity of product features to variations in manufacturing parameters etc.

The manufacturer shall establish and maintain records that provide evidence that the production has been sampled and tested. These records shall show clearly whether the production has satisfied the defined acceptance criteria and shall be available for at least three years.

6.3.4 Initial inspection of factory and of FPC

Initial inspection of factory and of FPC (only for products covered by AVCP 1+, 1 and 2+) shall be carried out when the production process has been finalized and in operation. The factory and FPC documentation shall be assessed to verify that the requirements of 6.3.2 and 6.3.3 are fulfilled.

During the inspection it shall be verified:

a) that all resources necessary for the achievement of the product characteristics included in this document are in place and correctly implemented;

b) that the FPC-procedures in accordance with the FPC documentation are followed in practice;

c) that the product complies with the product type samples, for which compliance of the product performance to the DoP has been verified.

All locations where final assembly or at least final testing of the relevant product is performed shall be assessed to verify that the above conditions a) to c) are in place and implemented. If the FPC system covers more than one product, production line or production process, and it is verified that the general requirements are fulfilled when assessing one product, production line or production process, then the assessment of the general requirements does not need to be repeated when assessing the FPC for another product, production line or production process.

All assessments and their results shall be documented in the initial inspection report.

6.3.5 Continuous surveillance of FPC (only for products covered by AVCP system 1+, 1 and 2+)

Surveillance of the FPC shall be undertaken once a year. The surveillance of the FPC shall include a review of the FPC test plan(s) and production processes(s) for each product to determine if any changes have been made since the last assessment or surveillance. The significance of any changes shall be assessed.

Checks shall be made to ensure that the test plans are still correctly implemented and that the production equipment is still correctly maintained and calibrated at appropriate time intervals.

The records of tests and measurement made during the production process and to finished products shall be reviewed to ensure that the values obtained still correspond with those values for the samples submitted to the determination of the product type and that the correct actions have been taken for non-compliant products.

6.3.6 Procedure for modifications

If modifications are made to the product, production process or FPC system that could affect any of the product characteristics declared according to this document, then all the characteristics for which the manufacturer declares performance, which could be affected by the modification, shall be subject to the determination of the product type, as described in 6.2.1.

Where relevant, a re-assessment of the factory and of the FPC system shall be performed for those aspects, which could be affected by the modification.

All assessments and their results shall be documented in a report.

Annex A
(informative)

Other dimensions of pipes, fittings and accessories for buried kits

This informative annex gives information to manufacturer about the state of the art to allow them to produce products compatible with the existing one.

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

Table A.1 — Other dimensions of pipes, fittings and accessories for buried kits

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 It is essential that the tensile strength of these products is at least 150 MPa and the ring crush strength at least 300 MPa.				

Annex B
(informative)

Other dimensions of pipes, fittings and accessories for rainwater kits to be installed outside buildings

This informative annex gives information to manufacturer about the state of the art to allow them to produce products compatible with the existing one.

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

Table B.1 — Other dimensions of pipes, fittings and accessories for rainwater kits to be installed outside buildings

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

Cast iron pipes and fittings provided with external coatings complying with 4.14.3 may be buried in contact with the majority of soils.

In 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 4.14.3.2 and 4.14.3.3) especially when soils characteristics are:

— with a low resistivity, less than 1 500 Ω cm above the water table or less than 2 500 Ω cm below the water table;

— with a low pH, below 6;

— with contamination by certain wastes or organic or industrial effluents.

Annex D
(informative)

General information on some product properties

D.1 Mechanical resistance and stability

Cast iron products in accordance with this document possess very good mechanical properties (see Table 7). They are strong enough to withstand abnormal stresses expected in normal working conditions, e.g. accidental impact and acts of vandalism. They are not affected by extremes of temperature and do not deteriorate with age.

D.2 Safety in case of fire

Cast iron products in accordance with this document are non-flammable and non-combustible. When exposed to fire they will maintain their functional properties 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.

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

D.3 Hygiene, health and environment

The high leak tightness under all conditions of use (see Table 2) and the non-toxicity of cast iron and coating materials (see 4.6) used for the products conforming to this document ensure the hygiene and health of the installation and occupants of the premises. Moreover the products are almost entirely recyclable without residual waste.

D.4 Noise protection

Noise protection is one of the basic requirements for construction works in the CPR. Cast iron pipe systems due to their high mass per unit area of their pipe walls as well as the joint design 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.

Annex E
(normative)

Method of calculation of gross calorific potential of external coatings for the range of products

This annex gives rules for calculating the gross calorific potential of external coatings for the range of products, noted $PCS_{\text{product range}}$ according to EN ISO 1716 rules.

The values 0,8 and 0,2 are respectively representative of the external surface ratio of pipes and fttings for assembled systems. Therefore, they are used for the assessment of a range of products. Other values are permitted for specific range of products dedicated to specific fields of application.

$$PCS_{\text{product range}} = (0{,}8 \times PCS_1) + (0{,}2 \times PCS_2)$$

where

PCS_1 is the gross calorific potential of pipes external coating in MJ/m^2;

PCS_2 is the gross calorific potential of fittings external coating in MJ/m^2.

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

Annex F
(normative)

Mounting and fixing conditions for Single Burning Item test

The following mounting and fixing conditions for Single Burning Item test for Cast iron pipes systems for the evacuation of water from works have been agreed by reaction to fire experts from TC127WG4.

The test method shall conform to EN 13823 using the following mounting conditions, either for plain ends or socketed cast iron pipe 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° ± 2° between horizontal and vertical parts (see Figure F.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, 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.

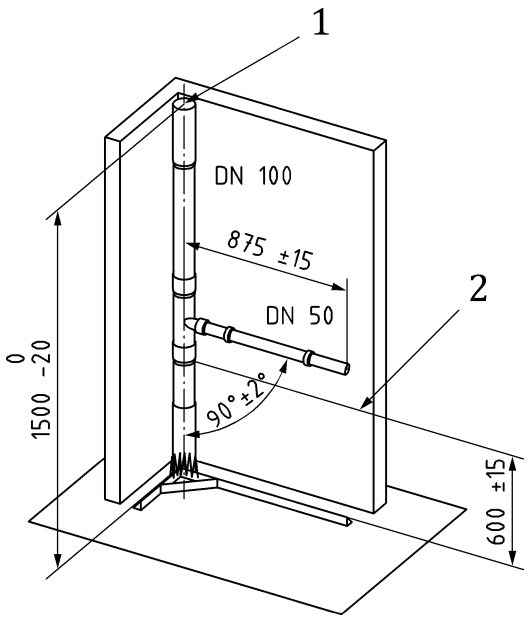
If a range of products includes grip collars, testing shall be done as follows:

— as these products are not always installed on the discharge system (depending of the expected performance):

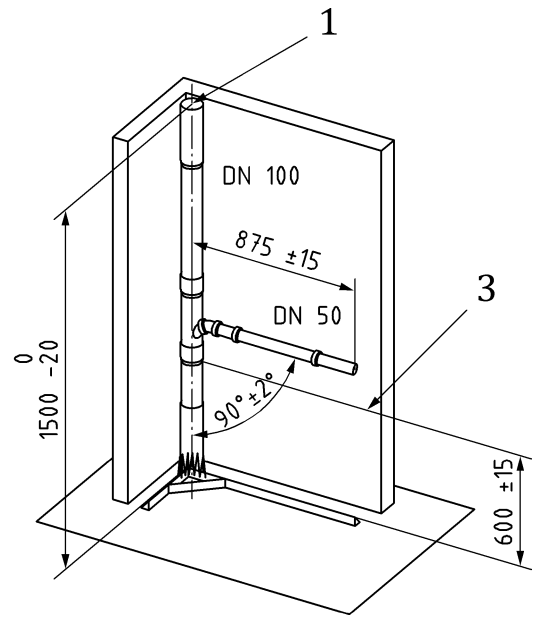
  — the test shall be done without them to evaluate the behaviour of the couplings without any protection from the flame;

  — and only if the grip collars include an organic material, the test shall be done again with the grip collars installed on top of the couplings.

Dimensions in millimetres



Spigots and couplings range of products



Spigots and sockets range of products

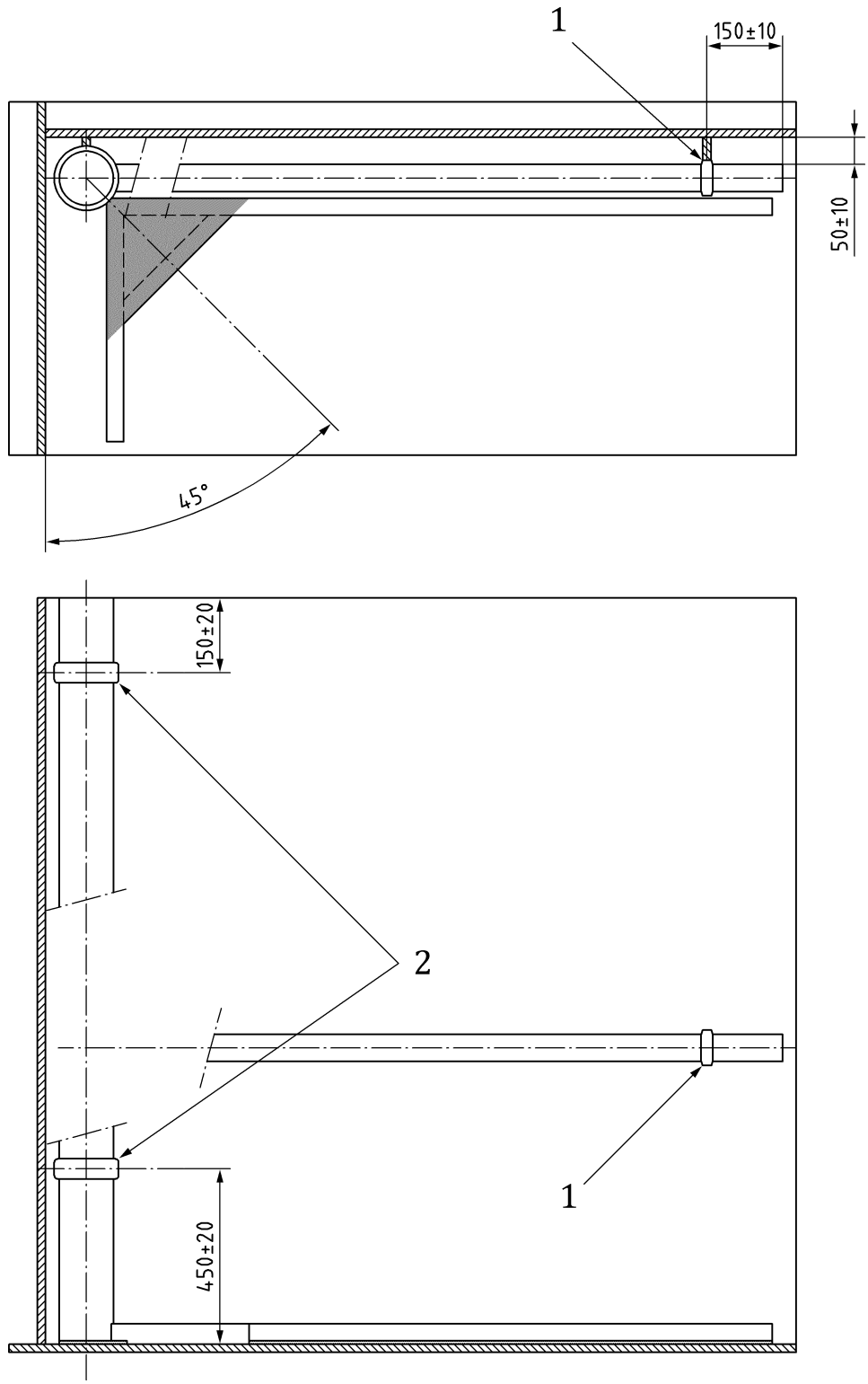
Key

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

Figure F.1 — Dimensions for mountings of a range of products

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

Dimensions in millimetres



Key

1 bracket for horizontal part
2 brackets for vertical part

Figure F.2 — Position of brackets on mountings of a range of products

Annex G
(informative)

Marking

G.1 General

Pipes, fittings and accessories as well as the couplings or clamping components and the gaskets should be legibly and indelibly marked and should bear at least the following information:

— the manufacturer's name or mark;

— the identification of the production site;

— the period of manufacture, coded or not;

— the reference to this document;

— 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 should be applied at least once per metre length.

When the marking on fittings is cast-on, it should be located outside the sealing zone *T* (see Table 1).

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

G.2 Components for buried systems

In addition to the requirements of G.1 pipes for buried systems shall be identified by specific colour or additional marking.

G.3 Components for 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.

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[1] EN 476, *General requirements for components used in drains and sewers*

[2] EN 1366-3, *Fire resistance tests for service installations — Part 3: Penetration seals*

[3] EN 14366, *Laboratory measurement of noise from waste water installations*

[4] EN ISO 6708, *Pipework components — Definition and selection of DN (nominal size) (ISO 6708)*

[5] EN ISO/IEC 17011, *Conformity assessment — Requirements for accreditation bodies accrediting conformity assessment bodies (ISO/IEC 17011)*

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[7] EN ISO 9001, *Quality management systems — Requirements (ISO 9001)*

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BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK