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**Cevi, fittingi, pribor in spoji iz nodularne litine za vodovodno omrežje - Zahteve in preskusne metode**

Ductile iron pipes, fittings, accessories and their joints for water pipelines - Requirements and test methods

Rohre, Formstücke, Zubehörteile aus duktilem Gusseisen und ihre Verbindungen für Wasserleitungen - Anforderungen und Prüfverfahren

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## Ductile iron pipes, fittings, accessories and their joints for water pipelines - Requirements and test methods

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 203.

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## Foreword

This document (prEN 545:2008) 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 document is currently submitted to the CEN Enquiry.

This document will supersede EN 545:2006.

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

For relationship with EC Directive(s), see informative Annexes B, C, D, E, F, and G, which is an integral part of this document.

In this standard Annex A is normative.

This standard is in conformity with the general requirements already established by CEN/TC 164 in the field of water supply.

In respect of potential adverse effects on the quality of water intended for human consumption, caused by the product covered by this standard:

- this standard provides no information as to whether the product may be used without restriction in any of the member states of the EU or EFTA;
- it should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

## 1 Scope

This European Standard specifies the requirements and associated test methods applicable to ductile iron pipes, fittings, accessories and their joints for the construction of pipelines outside buildings:

- to convey water (e.g. water intended for human consumption, fire protection, snow guns, irrigation, hydro-electric, re-used water pipelines etc.);
- with or without pressure;
- to be installed below or above ground.

This standard is applicable to pipes, fittings and accessories which are

- manufactured with socketed, flanged or spigot ends;
- supplied externally and internally coated;
- suitable for fluid temperatures between 0 °C and 50 °C, excluding frost;
- not intended for use in areas subject to fire regulations.

NOTE 1 This does not preclude special arrangements for the products to be used at higher temperatures.

This standard covers pipes and fittings cast by any type of foundry process or manufactured by fabrication of cast components, as well as corresponding joints and accessories, in a size range extending from DN 40 to DN 2000, inclusive.

This standard specifies requirements for materials, dimensions and tolerances, mechanical properties and standard coatings of ductile iron pipes and fittings. It also gives performance requirements for all components including joints. Joint design and gasket shapes are outside the scope of this standard.

In addition reference is made to the performance requirements of couplings, flange adaptors and saddles manufactured for use with ductile iron pipes and fittings.

NOTE 2 In this standard, all pressures are relative pressures, expressed in bars (100 kPa = 1 bar).

## 2 Normative references

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

EN 196-1, *Methods of testing cement — Part 1: Determination of strength*.

EN 197-1, *Cement – Part 1: Composition, specifications and conformity criteria for common cements*.

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

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

EN 1092-2, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 2: Cast iron flanges*.

EN 10002-1, *Metallic materials – Tensile testing – Part 1: Method of test at ambient temperature*.

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EN ISO 4016, *Hexagon head bolts — Product grade C (ISO 4016:1999).*

EN ISO 4034, *Hexagon nuts — Product grade C (ISO 4034:1999).*

EN ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1:2005).*

EN ISO 7091, *Plain washers — Normal series — Product grade C (ISO 7091:2000).*

EN 14901, *Ductile iron pipes, fittings and accessories – Epoxy coating (heavy duty) of ductile iron fittings and accessories – Requirements and test methods*

### 3 Terms and definitions

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

**3.1**  
**ductile iron**  
cast iron used for pipes, fittings and accessories in which graphite is present substantially in spheroidal form

**3.2**  
**pipe**  
casting of uniform bore, straight in axis, having socket, spigot or flanged ends, except for flanged-socket pieces, flanged-spigot pieces and collars which are classified as fittings

**3.3**  
**fitting**  
casting other than a pipe which allows pipeline deviation, change of direction or bore. In addition flanged-socket pieces, flanged spigot pieces and collars are also classified as fittings

**3.4**  
**accessory**  
any casting/fabrication other than a pipe or fitting which is used in a pipeline, for example:

- glands and bolts for mechanical flexible joints (see 3.14);
- glands, bolts and locking rings for restrained flexible joints (see 3.15);
- pipe saddles for service valve connections;
- adjustable flanges and flanges to be welded or screwed;
- flange adaptors for use with ductile iron pipes and fittings (see 4.1.3.3);
- couplings for use with ductile iron pipes and fittings (see 4.1.3.3).

Valves of all types are not covered by the term accessory.

NOTE Wide tolerance flange adaptors and couplings are covered by EN 14525.



**3.5****component**

any product defined in 3.2 to 3.4

**3.6****flange**

end of a pipe fitting or accessory extending perpendicular to its axis, with bolt holes equally spaced on a circle

NOTE A flange can be fixed (e.g. integrally cast or welded) or adjustable; an adjustable flange comprises a ring, in one or several parts assembled together, which bears on an end joint hub and can be freely rotated around the pipe axis before jointing.

**3.7****spigot**

male end of a pipe or fitting

**3.8****spigot end**

maximum insertion depth of the spigot plus 50 mm

**3.9****socket**

female end of a pipe or fitting to make the connection with the spigot of the next component

**3.10****gasket**

sealing component of a joint

**3.11****joint**

connection between the ends of two pipes and/or fittings in which a gasket is used to effect a seal

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**3.12****flexible joint**

joint which permits significant angular deflection both during and after installation and which can accept a slight offset of the centreline

**3.13****push-in flexible joint**

flexible joint assembled by pushing the spigot through the gasket in the socket of the mating component

**3.14****mechanical flexible joint**

flexible joint in which sealing is obtained by applying pressure to the gasket by mechanical means, e.g. a gland

**3.15****restrained flexible joint**

flexible joint in which a means is provided to prevent separation of the assembled joint

**3.16****flanged joint**

joint between two flanged ends

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**prEN 545:2008 (E)****3.17****nominal size (DN)**

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

[EN ISO 6708:1995]

**3.18****nominal pressure (PN)**

alphanumeric designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system. It comprises the letters PN followed by a dimensionless number

[EN 1333:2006]

**NOTE** All equipment of the same nominal size DN designated by the same PN number have compatible mating dimensions.

**3.19****leak tightness test pressure**

pressure applied to a component during manufacture in order to ensure its leak tightness

**3.20****allowable operating pressure (PFA)**

maximum hydrostatic pressure that a component is capable of withstanding continuously in service

[EN 805:2000]

**3.21****pressure class**

PFA of a family of components including their joint, as verified by all the performance tests described in this standard

**3.22****allowable maximum operating pressure (PMA)**

maximum pressure occurring from time to time, including surge, that a component is capable of withstanding in service

[EN 805:2000]

**3.23****allowable test pressure (PEA)**

maximum hydrostatic pressure that a newly installed component is capable of withstanding for a relatively short duration, in order to insure the integrity and tightness of the pipeline

[EN 805:2000]

**NOTE** This test pressure is different from the system test pressure (STP), which is related to the design pressure of the pipeline and is intended to ensure its integrity and leak tightness.

**3.24****diametral stiffness of a pipe**

characteristic of a pipe which allows it to resist ovalization under loading when installed

**3.25****performance test**

proof of design test which is done once and is repeated only after change of design

**3.26****laying length of a socket and spigot pipe**

laying length  $L_e$  is equal to the overall length of the pipe (OL) minus the maximum spigot insertion depth (X) as given by the manufacturer as shown in Figure 5.

**3.27****standardized length**

standardized length of socketed pipes and fitting ( $L_u$  or  $l_u$  for branches), as shown on Figure 5 for pipes and on Figures 6 to 15 for fittings

NOTE For socketed pipes, the standardized length  $L_u$ , is equal to the overall length (OL) minus the depth of the socket (DOS) as given by the manufacturer. For flanged pipes and fittings (see Figures 16 to 22), the standardized length ( $L$  or  $l$  for branches) is equal to the overall length.

**3.28****deviation**

design length allowance with respect to the standardized length of a pipe or a fitting

**3.29****ovality**

out of roundness of a pipe section; it is equal to:  $100 \left( \frac{A_1 - A_2}{A_1 + A_2} \right)$

where

$A_1$  is the maximum axis, in millimetres;

$A_2$  is the minimum axis, in millimetres.

**3.30****pipe minimum thickness**

minimum thickness at any point (see Tables 16 and 17) used in the calculation of the pressure class

**3.31****thickness for pipe stiffness calculation**

pipe thickness based on the pipe minimum thickness and the DN used in the calculation of the pipe diametral stiffness

**4 Technical requirements****4.1 General****4.1.1 Ductile iron pipes and fittings**

Nominal sizes, pressure classes, thicknesses, lengths and coatings are specified in 4.1.1, 4.2, 4.3.1, 4.3.3, 4.5 and 4.6 respectively. When pipes and fittings with different pressure classes, lengths and/or coatings and other types of fittings than those given in 8.3 and 8.4, are supplied with reference to this standard, they shall comply with all the other requirements of this standard.

NOTE 1 Annex F, Table F1 gives the correspondence by DN between the former K classes and the current pressure classes.

NOTE 2 Other types of fittings include angle branches, tees and tapers with other combinations DN x dn, draining tees, etc.

The standardized nominal sizes DN of pipes and fittings are as follows: 40, 50, 60, 65, 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1400, 1500, 1600, 1800, 2000.

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The allowable pressures of ductile iron pipes and fittings shall be as given in Annex A.

NOTE 3 Annexes B and C give respectively the longitudinal bending resistance and the diametral stiffness of ductile iron pipes.

NOTE 4 When installed and operated under the conditions for which they are designed (see annexes D, E and G), ductile iron pipes, fittings, accessories and their joints maintain all their functional characteristics over their reasonable economic operating life, due to the constant material properties, to the stability of their cross section and to their design with high safety factors.

**4.1.2 Surface condition and repair**

Pipes, fittings and accessories shall be free from defects and surface imperfections which can lead to non-compliance with Clauses 4 and 5.

When necessary, pipes and fittings may be repaired, for example by welding, in order to remove surface imperfections and localized defects which do not extend through the entire wall thickness, provided that:

- the repairs are carried out according to the manufacturer's written procedure;
- the repaired pipes and fittings comply with all the requirements of Clauses 4 and 5.

**4.1.3 Types of joints and interconnection****4.1.3.1 General**

Rubber gasket materials shall comply with the requirements of EN 681-1, type WA. When materials other than rubber are necessary (e.g. for high temperature flanged joints), they shall comply with the appropriate European Technical Specification or where no European Technical Specification exists, the appropriate International Standard.

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**4.1.3.2 Flanged joints**

Flanges shall be designed such that they can be attached to flanges whose dimensions and tolerances comply with EN 1092-2. This ensures interconnection between all flanged components (pipes, fittings, valves etc.) of the same PN and DN and adequate joint performance.

Bolts and nuts shall comply as a minimum with the requirements of EN ISO 4016 and EN ISO 4034, grade 4.6. Where washers are required they shall comply with EN ISO 7091.

Although it does not affect interconnection, the manufacturer shall state whether his products are normally delivered with fixed flanges or adjustable flanges.

Flange gaskets may be one of any type given in EN 1514.

**4.1.3.3 Flexible joints**

Components with flexible joints shall comply with 4.3.2.1 for their spigot external diameter DE and their limit deviations. This offers the possibility of interconnection between components equipped with different types of flexible joints.

The design of the sockets and the gaskets for use with the above spigots shall throughout all possible tolerance combinations:

- ensure leak tightness at minimum compression under shear and/or angular deflection;
- ensure both leak tightness and satisfactory anchorage (restrained joint) under shear and/or angular deflection.

In addition each type of flexible joint shall be designed to fulfil the performance requirements of Clause 5.

Couplings and flange adaptors manufactured for use with ductile iron pipes and fittings shall meet the performance requirements of flexible joints as detailed in Clauses 5 and 7

NOTE 1 For interconnection with certain types of joints operating within a different tolerance range on DE, the manufacturer's guidance should be followed as to the means of ensuring adequate joint performance at high pressures (e.g. measurement and selection of external diameter).

NOTE 2 For interconnection with existing pipelines which can have external diameters not in compliance with 4.3.2.1, the manufacturer's guidance should be followed as to the appropriate means of interconnection (e.g. adaptors).

NOTE 3 If components of different suppliers are used care should be taken to ensure that the requirements of the performance tests are met.

#### 4.1.3.4 Pipe saddles

Pipe saddles for service connections manufactured for use with ductile iron pipes shall meet the performance requirements as detailed in Clauses 5 and 7.

#### 4.1.4 Materials in contact with water intended for human consumption

Components of a pipe system include several materials given in this standard. When used under the conditions for which they are designed, in permanent or in temporary contact with water intended for human consumption, ductile iron pipes, fittings and their joints shall not change the quality of that water to such an extent that it fails to comply with the requirements of national regulations.

For this purpose, reference shall be made to the relevant national regulations and standards, transposing EN standards when available, dealing with the influence of materials on water quality and to the requirements for external systems and components as given in EN 805.

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#### 4.2 Pressure class

The pressure class of a component is defined by the combination of:

- The performance of the joint
- The structural performance of the component

See Annex A.

#### 4.3 Dimensional requirements

##### 4.3.1 Pipe and fittings thickness

The minimum iron wall thickness of pipes DN 40 to DN 2000 is given as a function of the nominal size (DN) and pressure class (PFA) in Tables 16 and 17.

For fittings, the nominal thickness  $e$  given in tables and on figures of 8.3 and 8.4 is the nominal thickness corresponding to the main part of the body. The actual thickness at any particular point may be increased to meet localized high stresses depending on the shape of the casting (e.g. at internal radius of bends, at the branch-body junction of tees etc.).

Annex A gives the maximum values of PFA, PMA and PEA.

#### 4.3.1.1 Limit deviations

The limit deviations on the nominal wall thickness of pipes not centrifugally cast and fittings shall be as given in Table 1. The measurement of the wall thickness shall be in accordance with 6.1.1.

**Table 1 – Limit deviations on thickness of pipes not centrifugally cast and fittings**

Type of casting	Nominal iron wall thickness $e$ mm	Limit deviations on the nominal wall thickness <sup>a</sup> mm
Pipes not centrifugally cast and fittings	$\leq 7,0$	- 2,3
	$> 7,0$	- (2,3 + 0,001 DN)
<sup>a</sup> The lower limit only is given, so as to ensure sufficient resistance to internal pressure.		

#### 4.3.2 Diameter

##### 4.3.2.1 External diameter

8.1 specifies the values of the external diameter DE of the coated spigot ends of pipes and fittings and their maximum allowable limit deviations, when measured using a circumferential tape in accordance with 6.1.2. These limit deviations apply to the spigot ends of all pressure classes of pipes and fittings.

NOTE 1 Certain types of flexible joints operate within a different range of tolerance (see 4.1.3.3).

For  $DN \leq 300$ , the external diameter of the pipe barrel measured with a circumferential tape shall be such as to allow the assembly of the joint over at least two thirds of the pipe length from the spigot end when the pipe needs to be cut on site.

For  $DN > 300$ , the same applies to 5 % of the pipes.

In addition, the ovality (see 3.29) of the spigot end of pipes and fittings shall:

- remain within the tolerance on DE (see Tables 16 and 17) for DN 40 to DN 200;
- not exceed 1 % for DN 250 to DN 600 or 2 % for DN > 600.

NOTE 2 The manufacturer's guidance should be followed as to the necessity and means of ovality correction; certain types of flexible joints can accept the maximum ovality without a need for spigot re-rounding prior to jointing.

##### 4.3.2.2 Internal diameter

The nominal values of the internal diameter of centrifugally cast pipes, expressed in millimetres, are equal to the numbers indicating their nominal size, DN, and the limit deviations shall be as given in Table 2 which applies to lined pipes.

These limit deviations apply to pipe up to the maximum DN, as defined for each pressure class in Table 3 and to cement mortar lining thicknesses as given in Table 9. For greater iron and/or cement mortar lining thicknesses these tolerances do not apply.

NOTE Due to the manufacturing process of ductile iron pipes and their internal linings, internal diameters with the lower limit deviation will only appear locally along the pipe length.

Compliance shall be demonstrated according to 6.1.3 or by calculation from the measurements taken for pipe external diameter, iron wall thickness and lining thickness.

**Table 2 – Limit deviation on internal diameter**

DN	Limit deviation a mm
40 to 1000	- 10
1100 to 2000	- 0,01 DN
<sup>a</sup> The lower limit only is given.	

**Table 3 – Maximum DN for limit deviations on internal diameter for pressure classes**

	Class 25	Class 30	Class 40	Class 50	Class 64	Class 100
Maximum DN	2000	2000	600	250	250	250

### 4.3.3 Length

#### 4.3.3.1 Standardized lengths of socket and spigot pipes

Pipes shall be supplied to the standardized lengths given in Table 4.

**Table 4 – Standardized lengths of socket and spigot pipes**

DN	Standardized lengths, $L_u^a$ m
40 and 50	3
60 to 600	5 or 5,5 or 6
700 and 800	5,5 or 6 or 7
900 to 1400	6 or 7 or 8,15
1500 to 2000	8,15
<sup>a</sup> See 3.27.	

The permissible deviations (see 3.28) on the standardized length  $L_u$  of pipes shall be as follows:

- for standardized length 8,15 m  $\pm$  150 mm;
- for all other standardized lengths  $\pm$  100 mm.

Pipes shall be designed to a length taken in the range: standardized length plus or minus the permissible deviation; they shall be manufactured to this design length plus or minus the limit deviations given in Table 7.

The manufacturer shall make the information available as to his design lengths.

The standardized length shall be measured according to 6.1.4 and shall be within the limit deviations given in Table 7.

Of the total number of socket and spigot pipes to be supplied in each diameter, the percentage of shorter pipes shall not exceed 10 %, in which case the length reduction shall be:

- up to 0,15 m for the pipes in which samples have been cut for testing (see 4.4);
- up to 2 m by increments of 0,5 m for DN < 700;
- up to 3 m by increments of 0,1 m for DN  $\geq$  700.