



SLOVENSKI STANDARD

SIST EN 545:2002

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SIST EN 545:1998

Cevi, fittingi in dodatki iz duktilne železove litine za vodovod - Zahteve in postopki preskušanja

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

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

Tuyaux, raccords et accessoires en fonte ductile et leurs assemblages pour canalisations d'eau - Prescriptions et méthodes d'essai

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

Tuyaux, raccords et accessoires en fonte ductile et leurs assemblages pour canalisations d'eau - Prescriptions et méthodes d'essai

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This European Standard was approved by CEN on 10 May 2002.

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

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 545:2002) 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 supersedes EN 545:1994.

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of an identical text or by endorsement, at the latest by December 2002, and conflicting national standards shall be withdrawn at the latest by December 2002.

In this standard the Annex A is normative and the Annexes B, C, D, E, F and G are informative.

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

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EN 545:2002 (E)**Introduction**

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.

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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 :

- to convey water (e. g. potable water) ;
- 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;
- normally delivered externally and internally coated ;
- suitable for fluid temperatures between 0 °C and 50 °C, excluding frost.

This standard covers pipes, fittings and accessories cast by any type of foundry process or manufactured by fabrication of cast components, as well as corresponding joints, in a size range extending from DN 40 to DN 2 000, 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.

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

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2 Normative references

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

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.*

EN ISO 4016:2000, *Hexagon head bolts — Product grade C (ISO 4016:1999).*

EN ISO 4034:2000, *Hexagon nuts — Product grade C (ISO 4034:1999).*

EN ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1:1999).*

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

EN 545:2002 (E)**3 Terms and definitions**

For the purposes of this European Standard, 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 other than a pipe or fitting which is used in a pipeline ; for example :

- glands and bolts for mechanical flexible joints (see 3.13) ;
- glands, bolts and locking rings for restrained flexible joints (see 3.14) ;
- pipe saddles for service cock connections ;
- adjustable flanges and flanges to be welded or screwed.

NOTE Valves of all types are not covered by the term accessory. [SIST EN 545:2002](https://standards.iteh.ai/SIST/EN/545/2002)
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3.5 flange
flat circular end of a pipe or fitting 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.

3.6 spigot
male end of a pipe or fitting

3.7 spigot end
maximum insertion depth of the spigot plus 50 mm

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

3.9 gasket
sealing component of a joint

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

3.11**flexible joint**

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

3.12**push-in flexible joint**

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

3.13**mechanical flexible joint**

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

3.14**restrained flexible joint**

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

3.15**flanged joint**

joint between two flanged ends

3.16**nominal size (DN)**

alphanumerical 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, 2.1]

3.17**nominal pressure (PN)**

alphanumerical 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 1333:1996, 2]

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

3.18**leak tightness test pressure**

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

3.19**allowable operating pressure (PFA)**

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

[EN 805:2000, 3.1.2]

3.20**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, 3.1.1]

3.21**allowable site-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

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[EN 805:2000, 3.1.3]

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 ; see also A.1.

3.22 diametral stiffness of a pipe

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

3.23 performance test

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

3.24 length

effective length of a pipe or fitting, as shown on Figure 4 for pipes and on Figures 5 to 21 for fittings

NOTE For flanged pipes and fittings, the effective length L (l for branches) is equal to the overall length. For socketed pipes and fittings, the effective length L_U (l_u for branches), is equal to the overall length minus the maximum spigot insertion depth as given in the manufacturer's catalogues.

3.25 deviation

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

3.26 ovality

out of roundness of a pipe section ; it is equal to :

$$100 \left(\frac{A_1 - A_2}{A_1 + A_2} \right)$$

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where

A_1 is the maximum axis, in millimetres ;

A_2 is the minimum axis, in millimetres.

4 Technical requirements

4.1 General

4.1.1 Ductile iron pipes and fittings

Nominal sizes, thickness classes, lengths and coatings are specified in 4.1.1, 4.2.1, 4.2.3, 4.4 and 4.5 respectively. When, by agreement between manufacturer and purchaser, pipes and fittings with different wall thickness 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 Other types of fittings include angle branches, tees and tapers with other combinations DN x dn, draining tees, ...

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, 1 000, 1 100, 1 200, 1 400, 1 500, 1 600, 1 800, 2 000.

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

NOTE 2 Annexes B and C give respectively the longitudinal bending resistance and the diametral stiffness of ductile iron pipes.

NOTE 3 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 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 clause 4 and clause 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 clause 4 and clause 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 flanged joints), they shall comply with the appropriate European Standard or, where no European Standard exists, the appropriate International Standard.

4.1.3.2 Flanged joints

Flanges shall be constructed in such a way 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,...) of the same PN and DN and adequate joint performance.

Bolts and nuts shall comply as a minimum with the requirements of EN ISO 4016:2000 and EN ISO 4034:2000, grade 4.6. When applicable, washers shall comply with EN ISO 7091.

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

NOTE Flange gaskets can be one of those given in EN 1514.

4.1.3.3 Flexible joints

Pipes and fittings with flexible joints shall comply with 4.2.2.1 for their spigot external diameter DE and their tolerances. This offers the possibility of interconnection between components equipped with different types of flexible joints. In addition, each type of flexible joint shall be designed to fulfil the performance requirements of clause 5.

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 4.2.2.1, the manufacturer's guidance should be followed as to the appropriate means of interconnection (e.g. adaptors).

4.1.4 Materials in contact with water intended for human consumption

Ductile iron pipes, fittings and their joints 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.

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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.

NOTE A European Acceptance Scheme (EAS) is in course of development in relation to the Construction Products Directive and to the Drinking Water Directive ; its requirements will be introduced in this standard when completed.

4.2 Dimensional requirements**4.2.1 Wall thickness****4.2.1.1 General**

The thickness shall be calculated either by the K class formula for pipes and fittings (see 4.2.1.2) or defined according to 4.2.1.3 for Class 40 pipes of DN 40 to DN 400.

For pipes, the standardized thickness classes are given in clause 8.1. Other thicknesses are possible for pipes by agreement between manufacturer and purchaser.

For fittings, the 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,...).

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

4.2.1.2 K classes for pipes and fittings

The nominal iron wall thickness of pipes and fittings is given as a function of the nominal size, DN, by the following formula, with a minimum of 6 mm for pipes and 7 mm for fittings:

$$e = K(0,5 + 0,001 DN)$$

where

e is the nominal wall thickness, in millimetres ;

DN is the nominal size ;

K is a coefficient used for the determination of the thickness. It is selected from a series of whole numbers :.... 8, 9, 10, 11, 12.....

4.2.1.3 Class 40 for pipes

The nominal iron wall thickness of pipes DN 40 to DN 400 is given as a function of the nominal size, DN, in Table 15.

4.2.1.4 Tolerance

The tolerance on the nominal wall thickness of pipes 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

Dimensions in millimetres

Type of casting	Nominal iron wall thickness e	Limit deviation on the nominal wall thickness ^a
Pipes centrifugally cast Class 40	$\leq 5,0$	- 1,3
	$> 5,0$	- (1,3 + 0,001 DN)
Pipes centrifugally cast K class	$\leq 6,0$	- 1,3
	$> 6,0$	- (1,3 + 0,001 DN)
Pipes not centrifugally cast and fittings	$\leq 7,0$	- 2,3
	$> 7,0$	- (2,3 + 0,001 DN)

^aThe lower limit only is given, so as to ensure sufficient resistance to internal pressure.

4.2.2 Diameter

4.2.2.1 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 tolerances, when measured using a circumferential tape in accordance with 6.1.2. These tolerances apply to the spigot ends of all thickness 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 a percentage of the pipes, defined by agreement between manufacturer and purchaser. Such pipes shall be marked.

In addition, the ovality (see 3.26) of the spigot end of pipes and fittings shall :

- remain within the tolerance on DE (see Table 15) 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.

4.2.2.2 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 tolerances shall be as given in Table 2 which applies to lined pipes.

These tolerances apply to pipe thickness classes up to K10 and to cement mortar lining thicknesses as given in Table 8. Where greater iron and/or cement mortar lining thicknesses are agreed between manufacturer and purchaser, 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.

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Table 2

DN	Limit deviation ^a mm
40 to 1 000	- 10
1 100 to 2 000	- 0,01 DN

^aThe lower limit only is given.

4.2.3 Length

4.2.3.1 Standardized lengths of socket and spigot pipes

Pipes shall be supplied to the standardized lengths given in Table 3.

Table 3

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 1 400	6 or 7 or 8,15
1 500 to 2 000	8,15

^a See 3.24.

The permissible deviations (see 3.25) on the standardized length L_u of pipes shall be as follows :

- for standardized length 8,15 m : ± 150 mm ;
- for all other standardized lengths : ± 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 deviation given in Table 6.

The manufacturer shall show his design lengths in his catalogues.

The length shall be measured according to 6.1.4 and shall be within the limit deviations given in Table 6.

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 4.3) ;
- 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 ≥ 700 .

4.2.3.2 Standardized lengths of flanged pipes

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

Table 4

Type of pipe	DN	Standardized lengths L^a m
With cast flanges	40 to 2 000	0,5 or 1 or 2 or 3
With screwed or welded flanges	40 to 600	2 or 3 or 4 or 5
	700 to 1 000	2 or 3 or 4 or 5 or 6
	1 100 to 2 000	4 or 5 or 6 or 7

^a See 3.24. Other lengths are available by agreement between manufacturer and purchaser.

4.2.3.3 Standardized lengths of fittings

Fittings shall be supplied to the standardized lengths as given in 8.3 and 8.4.

NOTE Two series of dimensions are shown, the series A corresponding to ISO 2531 and the series B, generally limited up to DN 450.

The permissible deviations (see 3.25) on the standardized length of series A fittings shall be as given in Table 5. No deviation is permitted for the fittings of series B. Fittings 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 6.

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Table 5

Type of fitting	DN	Deviation mm
Flanged sockets	40 to 1 200	± 25
Flanged spigots	1 400 to 2 000	± 35
Collars, tapers		
Tees	40 to 1 200	+ 50/- 25
	1 400 to 2 000	+ 75/- 35
Bends 90° (1/4)	40 to 2 000	$\pm (15 + 0,03 \text{ DN})$
Bends 45° (1/8)	40 to 2 000	$\pm (10 + 0,025 \text{ DN})$
Bends 22° 30' and 11° 15' (1/6 and 1/32)	40 to 1 200	$\pm (10 + 0,02 \text{ DN})$
	1 400 to 2 000	$\pm (10 + 0,025 \text{ DN})$

4.2.3.4 Tolerances on lengths

The limit deviations on lengths shall be as given in Table 6.