

Specification for

Ductile iron pipes, fittings, accessories and their joints for gas pipelines — Requirements and test methods

The European Standard EN 969:1995, with the incorporation of amendment A1:1998, has the status of a British Standard

ICS 23.040.10

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PSE/10, Iron pipes and fittings, upon which the following bodies were represented:

- Adhesive Tape Manufacturers' Association
- British Foundry Association
- Ductile Iron Pipe Committee
- Institute of British Foundrymen
- Institution of Mechanical Engineers
- Institution of Water and Environmental Management
- Pipeline Protection Association
- Society of British Water Industries
- Water Companies Association
- Water Research Centre
- Water Services Association of England and Wales

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National foreword

This British Standard has been prepared by Technical Committee PSE/10. It is the English language version of EN 969:1995 *Ductile iron pipes, fittings, accessories and their joints for gas pipelines — Requirements and test methods*, including amendment A1:1998, published by the European Committee for Standardization (CEN).

In conjunction with BS EN 545 and BS EN 598 it supersedes BS 4772, which is withdrawn.

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Summary of pages

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English version

Ductile iron pipes, fittings, accessories and their joints for gas pipelines — Requirements and test methods

(includes amendment A1:1998)

Tuyaux, raccords et accessoires en fonte ductile et leurs assemblages pour canalisations de gaz —
Prescriptions et méthodes d'essai
(inclut l'amendement A1:1998)

Rohre, Formstücke, Zubehörteile aus duktilem Gußeisen und ihre Verbindungen für Gasleitungen —
Anforderungen und Prüfverfahren
(enthält Änderung A1:1998)

This European Standard was approved by CEN on 1995-07-13. Amendment A1 was approved by CEN on 1998-11-05. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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Foreword

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

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

It deals with the subjects covered by the International Standards ISO 2531 and ISO 8179. The major differences are the presentation in one single standard and the addition of product performance specifications.

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 February 1996, and conflicting national standards shall be withdrawn at the latest by February 1996.

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

Foreword to amendment A1

This amendment EN 969:1995 A1:1998 to EN 969:1995 has been prepared by Technical Committee CEN/TC 203, Cast iron pipes, fittings and their joints, the Secretariat of which is held by AFNOR.

This amendment to the European Standard EN 969:1995 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 1999, and conflicting national standards shall be withdrawn at the latest by June 1999.

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

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Introduction

In preparing this standard it was recognized that there may exist various national regulations in the individual member states of Europe which may influence some of the requirements. This standard makes allowance for this by referring to national regulations at relevant places.

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 air or combustible gases (e.g. natural gas or town gas) at pressures up to 16 bar;
- to be installed below or above ground.

NOTE 1 A combustible gas is a gas or any fuel that is in gaseous state at a temperature of 15 °C at a pressure of 1 bar.

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

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.

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 600 inclusive.

This standard applies to pipes, fittings and accessories which are:

- manufactured with socketed, flanged or spigot ends for jointing by means of various types of gaskets which are not within the scope of this standard;
- normally delivered externally and internally coated;
- suitable for gas temperatures between – 15 °C and 50 °C.

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.

EN 545:1994, *Ductile iron pipes, fittings, accessories and their joints for water pipelines — Requirements and test methods*.

EN 10002-1:1990, *Metallic materials — Tensile testing — Part 1: Method of test at ambient temperature*.

EN 29002:1987, *Quality systems — Model for quality assurance in production and installation*.

EN 45012:1989, *General criteria for certification bodies operating quality system certification*.

EN 1092-2:1997, *Flanges and their joints — Part 2: Cast iron flanges — PN designated*.

ISO 2531:1991, *Ductile iron pipes, fittings and accessories for pressure pipelines*.

ISO 6447:1983, *Rubber seals — Joint rings used for gas supply pipes and fittings — Specification for material*.

ISO 6506:1981, *Metallic materials — Hardness tests — Brinell test*.

ISO 6708:1980, *Pipe components — Definition of nominal size*.

ISO 7268:1983, *Pipe components — Definition of nominal pressure*.

ISO 7268/A1:1984, *Pipe components — Definition of nominal pressure*.

ISO 7483:1991, *Dimensions of gaskets for use with flanges to ISO 7005*.

3 Definitions

For the purposes of this standard, the following 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 either 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, e.g.:

- 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 cocks connection;
- adjustable flanges and flanges to be welded or screwed-on.

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

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 may be fixed (e.g. integrally cast or welded-on) 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

collar; coupling

connecting piece used to join together the spigots of mating pipes or fittings

3.7

spigot

male end of a pipe or fitting

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

numerical designation of size which is common to all components in a piping system. It is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions (see ISO 6708)

3.17

nominal pressure

PN Numerical designation expressed by a number which is used for reference purposes. All components of the same nominal size DN designated by the same PN number have compatible mating dimensions (see ISO 7268 and ISO 7268/A1)

3.18

leaktightness test pressure

pressure applied to a component during manufacture in order to ensure its leaktightness

3.19

allowable operating pressure (PFA)

maximum pressure that a component can withstand continuously in service

3.20

diametral stiffness of a pipe

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

3.21 batch

quantity of castings from which a sample is taken for testing purposes during manufacture

3.22 type test

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

3.23 length

effective length of a pipe or fitting, as shown on the figures of clause 9

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 spigot insertion depth as given in the manufacturer's catalogues.

3.24 deviation

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

NOTE Pipes and fittings are designed to a length taken in the range of standard length plus or minus the deviation (see Table 3); they are manufactured to this length plus or minus the tolerance given in Table 4.

3.25 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.

4 Technical requirements

4.1 General

4.1.1 Ductile iron pipes and fittings

Unless otherwise agreed between the manufacturer and the purchaser, all pipes shall be delivered with an external coating of zinc with finishing layer in accordance with 4.4.2 and an internal coating of paint in accordance with 4.5.2, or, when pipes have to be capable of carrying either gas or water, an internal cement mortar lining in conformity with 4.4.3 of EN 545:1994. The field of use of these pipes is given in Annex C.

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 9.3 and 9.4, 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 $DN \times dn$, 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.

The functional properties of ductile iron pipes and fittings shall be as given in Annex A and Annex B dealing respectively with longitudinal bending resistance and diametral stiffness.

NOTE 2 When installed and operated under the conditions for which they are designed (see Annex C and Annex D), 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 repairs

Pipes, fittings and accessories shall be free from defects and surface imperfections which could 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 affect the entire wall thickness, provided that:

- the repairs are carried out according to a written procedure included in the manufacturer's quality assurance system;
- 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

Joint design and gasket shapes are outside the scope of this standard.

Rubber gasket materials shall comply with the requirements of ISO 6447. When materials other than rubber are necessary (e.g. for flanged joints), they shall comply with the appropriate EN standard or, where no EN standard exists, the appropriate ISO standard.

4.1.3.2 Flanged joints

The dimensions and tolerances of the flanges of pipes and fittings shall comply with EN 1092-2 and flange gaskets with ISO 7483. This ensures interconnection between all flanged components (pipes, fittings, valves, etc) of the same PN and DN and adequate joint performance.

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.

4.1.3.3 Flexible joints

Pipes and fittings with flexible joints shall comply with 4.2.2 for their spigot external diameters 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 tighter 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 may have external diameters not in compliance with 4.2.2, the manufacturer's guidance should be followed as to the appropriate means of interconnection (e.g. adaptors).

4.2 Dimensional requirements

4.2.1 Wall thickness

The nominal iron wall thickness of pipes and fittings shall be calculated 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:

$$e = K(0,5 + 0,001 \text{ DN})$$

where:

e is the nominal wall thickness, in millimetres;

DN is the nominal size;

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

The standardized thickness classes are given in the tables of clause 9; other thicknesses are possible for pipes by agreement between manufacturer and purchaser.

For the fittings, the thickness e given in tables and on figures of 9.3 and 9.4 is the nominal thickness corresponding to the main part of the body. The actual thickness at any particular point requires to 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).

The tolerances on nominal wall thickness of pipes and fittings shall be as given in Table 1. The measurement of wall thickness shall be in accordance with 6.1.1.

Table 1

Dimensions in millimetres

Type of casting	e	Tolerance ^a
Pipes centrifugally cast	6,0	-1,3
	>6,0	-(1,3 + 0,001 DN)
Pipes not centrifugally cast and fittings	7,0	-2,3
	>7,0	-(2,3 + 0,001 DN)

^a A negative tolerance only is given, so as to ensure sufficient resistance to internal pressure.

4.2.2 External diameter

Subclause 9.1 specifies the values of the external diameter DE of the 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 tighter range of tolerance (see 4.1.3.3).

For $\text{DN} \leq 300$, 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. For $\text{DN} > 300$, the same applies to a percentage of the pipes, when they need to be cut on site, after agreement between manufacturer and purchaser.

In addition, the ovality (see 3.25) of the spigot and of pipes and fittings shall:

- remain within the tolerances on DE (see Table 11) for DN 40 to DN 200;
- not exceed 1 % for DN 250 to 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.

4.2.3 Length

4.2.3.1 Standardized lengths of socket and spigot pipes

Pipes shall be supplied in standardized lengths of 3 m, 5 m, 5,5 m and 6 m.

The permissible deviations on the standardized length L_u of pipes shall be ± 100 mm:

The manufacturer shall show his design lengths (see 3.24) in his catalogues.

The length shall be measured according to 6.1.3 and shall be within the tolerance given in Table 4.

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.

4.2.3.2 Standardized lengths of flanged pipes

Pipes shall be supplied to the standardized lengths given in Table 2.

Table 2

Type of pipe	Standard lengths L^a m
With cast-on flanges	0,5 or 1 or 2 or 3
With screwed-on or welded-on flanges	2 or 3 or 4 or 5
^a See 3.23. 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 9.3 and 9.4.

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

The permissible deviations on the standardized length of series A fittings shall be as specified in Table 3.

Table 3

Type of fitting	Deviation mm
Flanged sockets Flanged spigots Collars, tapers	±25
Tees	+50/ – 25
Bends 90° (1/4)	±(15 + 0,03 DN)
Bends 45° (1/8)	±(10 + 0,025 DN)
Bends 22° 30' and 11° 15' (1/16 and 1/32)	±(10 + 0,02 DN)

4.2.3.4 Tolerances of lengths

The tolerances on lengths shall be as given in Table 4.

Table 4

Type of casting	Tolerance mm
Socket and spigot pipes (full length or shortened)	±30
Fittings for socketed joints	±20
Pipes and fittings for flanged joints	±10 ^a
^a By agreement between manufacturer and purchaser, smaller tolerances are possible, but not less than ±3 mm.	

4.2.4 Straightness of pipes

Pipes shall be straight, with a maximum deviation of 0,125 % of their length.

The verification of this requirement is usually carried out by visual inspection, but in case of doubt or in dispute the deviation shall be measured in accordance with 6.2.

4.3 Material characteristics

4.3.1 Tensile properties

Pipes fittings and accessories of ductile iron shall have the tensile properties given in Table 5.

Table 5

Type of casting	Minimum tensile strength R_m , MPa	Minimum elongation after fracture, A %
Pipes centrifugally cast	420	10
Pipes not centrifugally cast, fittings and accessories	420	5
NOTE 1 By agreement between manufacturer and purchaser, the 0,2 % proof stress ($R_p 0,2$) may be measured. It shall be not less than: — 270 MPa when $A \geq 12$ %; — 300 MPa in other cases. NOTE 2 For centrifugally cast pipes the minimum elongation after fracture shall be 7 % for thickness classes over K 12.		

During the manufacturing process the manufacturer shall carry out suitable tests in order to verify these tensile properties; these tests may be:

- a) either a batch sampling system whereby samples are obtained from the pipe spigot or, for fittings, from samples cast separately or integrally with the castings concerned. Test bars shall be machined from these samples and tensile tested in accordance with 6.3; or
- b) a system of process control (e.g. by non-destructive testing) where a positive correlation can be demonstrated with the tensile properties specified in Table 5. Testing verification procedures shall be based on the use of comparator samples having known and verifiable properties. This system shall be supported by tensile testing in accordance with 6.3.

4.3.2 Hardness

The hardness of the various components shall be such that they can be cut, drilled, tapped and/or machined with normal tools. In case of dispute, the hardness shall be measured by the Brinell hardness test in accordance with 6.4.

The Brinell hardness shall not exceed 230 HB for pipes and 250 HB for fittings and accessories. For components manufactured by welding, a higher Brinell hardness is allowed in the heat affected zone of the weld.

4.4 Coatings and linings for pipes

4.4.1 General

Unless otherwise agreed between the manufacturer and the purchaser, all pipes shall be delivered with an external coating of zinc with finishing layer in accordance with 4.4.2 and an internal coating of paint in conformity with 4.5.2. The field of use of these pipes is given in Annex C.

NOTE Pipes with cast-on flanges may be coated as fittings (see 4.5).

Pipe ends are generally coated as follows:

- external surface of spigots: zinc coating with finishing layer;
- flanges and sockets (face and internal surface): bituminous paint or synthetic resin paint, alone or as a supplement to a primer or zinc coating.

By agreement between manufacturer and purchaser, the following coatings may also be supplied, depending on the external and internal conditions of use, which may be different to those given in Annex C.

- a) External coatings:
 - zinc rich paint coating with finishing layer;

- thicker metallic zinc coating with finishing layer;
- polyethylene sleeving (as a supplement to the zinc coating with finishing layer);
- extruded polyethylene;
- extruded polypropylene;
- polyurethane;
- fibre cement mortar;
- adhesive tapes.

- b) Internal coatings (linings):

- polyurethane.

- c) End coating:

- epoxy.

These external and internal coatings shall comply with the corresponding EN standards or, where no EN standard exists, they shall comply with ISO standards or with national standards, or with an agreed technical specification.

4.4.2 External coating of zinc with finishing layer

4.4.2.1 General

The external coating of centrifugally cast ductile iron pipes shall comprise a layer of metallic zinc, covered by a finishing layer of bituminous product of synthetic resin compatible with zinc. Both layers shall be works-applied by spraying with suitable spray-guns, the design of which is outside the scope of this standard.

The zinc is normally applied on oxide-surfaced pipes after heat treatment; at the manufacturer's option, it may also be applied on blast-cleaned pipes. Prior to application of the zinc, the pipe surface shall be dry and free from rust or non-adhering particles or foreign matter such as oil or grease.

4.4.2.2 Coating characteristics

The metallic zinc coating shall cover the external surface of the pipe and provide a dense, continuous, uniform layer. It shall be free from such defects as bare patches or lack of adhesion.

The uniformity of the coating shall be checked by visual inspection.

When measured in accordance with 6.6, the mean mass of zinc per unit area shall be not less than 130 g/m², with a local minimum of 110 g/m².

4.4.2.3 Repairs

Damage to coatings where the area of total removal of metallic zinc has a width exceeding 5 mm and areas left uncoated (e.g. under test token, see 6.6) shall be repaired.

Repairs shall be carried out either by:

- a) metallic zinc spray complying with 4.4.2; or