
**Ductile iron pipes, fittings, accessories
and their joints for water or gas applications**

*Tuyaux, raccords et accessoires en fonte ductile et leurs assemblages pour
l'eau ou le gaz*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 2531:1998](https://standards.iteh.ai/catalog/standards/sist/4ca9dd5d-c8f4-4790-b086-e4a4c4b380bc/iso-2531-1998)

[https://standards.iteh.ai/catalog/standards/sist/4ca9dd5d-c8f4-4790-b086-
e4a4c4b380bc/iso-2531-1998](https://standards.iteh.ai/catalog/standards/sist/4ca9dd5d-c8f4-4790-b086-e4a4c4b380bc/iso-2531-1998)



Contents

Page

1	Scope	1
2	Normative references	1
3	Definitions	2
4	Technical requirements	4
4.1	General	4
4.1.1	Pipes and fittings	4
4.1.2	Surface condition and repairs	4
4.1.3	Types of joints and interconnection	4
4.1.4	Materials in contact with potable water	5
4.2	Dimensional requirements	5
4.2.1	Diameter	5
4.2.2	Wall thickness	6
4.2.3	Length	6
4.2.4	Straightness of pipes	8
4.3	Material characteristics	8
4.3.1	Tensile properties	8
4.3.2	Brinell hardness	9
4.4	Coating and linings for pipes	9
4.4.1	External coatings	9
4.4.2	Internal linings	10
4.5	Coatings and linings for fittings and accessories	10
4.5.1	External coatings	10
4.5.2	Internal linings	10
4.6	Marking	11

© ISO 1998

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

5	Leaktightness requirements	11
5.1	Pipes and fittings	11
5.2	Flexible Joints	11
5.2.1	General	11
5.2.2	Internal pressure	12
5.2.3	External pressure	12
6	Test methods	12
6.1	Dimensions	12
6.1.1	External diameter	12
6.1.2	Wall thickness	12
6.1.3	Length	13
6.2	Straightness of pipes	13
6.3	Tensile test	13
6.3.1	Sampling	13
6.3.2	Test bar	13
6.3.3	Equipment and test method	14
6.3.4	Test results	14
6.3.5	Test frequency	14
6.4	Brinell hardness	15
6.5	Works leaktightness test of pipes and fittings for water application	15
6.5.1	General	15
6.5.2	Centrifugally cast pipes	15
6.5.3	Pipes not centrifugally cast and fittings	15
6.6	Works leaktightness test of pipes and fittings for gas applications	16
7	Type tests	16
7.1	Leaktightness of joints to internal pressure	16
7.2	Leaktightness of joints to external pressure	17
8	Tables of dimensions	17
8.1	Socket and spigot pipes	17
8.2	Flanged pipes	19
8.2.1	Centrifugally cast pipes with welded-on flanges	19
8.2.2	Centrifugally cast pipes with screwed-on flanges	19
8.2.3	Pipes with integrally cast flanges	19
8.3	Fittings for socketed joints	19
8.3.1	Flanged sockets	19
8.3.2	Flanged spigots	21
8.3.3	Collars	21
8.3.4	Double socket 90° (1/4) bends	22
8.3.5	Double socket 45° (1/8) bends	22
8.3.6	Double socket 22° 30' (1/16) bends	23
8.3.7	Double socket 11° 15' (1/32) bends	23
8.3.8	All-socket tees	24

8.3.9	Double-socket tees with flanged branch, DN 40 to DN 250	26
8.3.10	Double-socket tees with flanged branch, DN 300 to DN 700	28
8.3.11	Double-socket tees with flanged branch, DN 800 to DN 2 600	29
8.3.12	Double-socket tapers	30
8.4	Fittings for flanged joints	32
8.4.1	Double-flanged 90° (1/4) bends	32
8.4.2	Double-flanged duckfoot 90° (1/4) bends	32
8.4.3	Double-flanged 45° (1/8) bends	33
8.4.4	All-flanged tees, DN 40 to DN 250	34
8.4.5	All-flanged tees, DN 300 to DN 700	36
8.4.6	All-flanged tees, DN 800 to DN 2 600	37
8.4.7	Double-flanged tapers	38
8.4.8	Blank flanges PN 10	39
8.4.9	Blank flanges PN 16	39
8.4.10	Blank flanges PN 25	40
8.4.11	Blank flanges PN 40	40
8.4.12	Reducing flanges PN 10	41
8.4.13	Reducing flanges PN 16	41
8.4.14	Reducing flanges PN 25	42
8.4.15	Reducing flanges PN 40	42
Annex A	(informative) Field of use, soil characteristics	43
Annex B	(informative) Field of use, characteristics of waters	44
Annex C	(informative) Pipe stiffness and diametral deflection	45

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

iTeh STANDARD PREVIEW

International Standard ISO 2531 was prepared by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*, Subcommittee SC 2, *Cast iron pipes, fittings and their joints*.

<https://standards.iteh.ai/catalog/standards/sist/45333333/iso-2531-1998>

This fifth edition cancels and replaces the fourth edition (ISO 2531:1991), of which it constitutes a technical revision. Its scope has been extended to include performance requirements and type testing of joints. Its style and presentation have been reviewed and improved.

Annexes A, B and C of this International Standard are for information only.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 2531:1998

<https://standards.iteh.ai/catalog/standards/sist/4ca9dd5d-c8f4-4790-b086-e4a4c4b380bc/iso-2531-1998>

Ductile iron pipes, fittings, accessories and their joints for water or gas applications

1 Scope

This International Standard specifies the requirements and test methods applicable to ductile iron pipes, fittings, accessories and their joints for the construction of pipelines

- to convey water (e.g. potable water) or gas;
- operated with or without pressure;
- installed below or above ground.

NOTE — In this International Standard, all pressures are relative pressures expressed in bars¹⁾.

This International Standard gives specifications for materials, dimensions and tolerances, mechanical properties and standard coatings of pipes, fittings and accessories. It also gives performance requirements for all components including joints.

This International 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, of a size range extending from DN 40 to DN 2 600 inclusive.

It is applicable 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 International Standard;
- normally delivered internally and externally coated.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of the publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on the International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4179:1985, *Ductile iron pipes for pressure and non-pressure pipelines — Centrifugal cement mortar lining — General requirements.*

ISO 4633:1996, *Rubber seals — Joint rings for water supply, drainage and sewerage pipelines — Specification for materials.*

1) 100 kPa = 1 bar

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

ISO 6506-1:—²⁾, *Metallic materials — Hardness testing — Brinell test — Part 1: Test method.*

ISO 6708:1995, *Pipeworks components — Definition and selection of DN (nominal size).*

ISO 7005-2:1988, *Metallic flanges — Part 2: Cast iron flanges.*

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

ISO 7268/Amd 1:1984, Amendment 1 to ISO 7268:1983.

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

ISO 8179-1:1995, *Ductile iron pipes — External coating — Part 1: Metallic zinc with finishing layer.*

ISO 8179-2:1995, *Ductile iron pipes — External coating — Part 2: Zinc rich paint with finishing layer.*

ISO 8180:1985, *Ductile iron pipes — Polyethylene sleeving.*

ISO 10804-1:1996, *Restrained joint systems for ductile iron pipelines — Part 1: Design rules and type testing.*

EN 1092-2:1997, *Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 2: Cast iron flanges.*

iTeh STANDARD PREVIEW (standards.iteh.ai)

3 Definitions

For the purposes of this International Standard, the following definitions apply:

[ISO 2531:1998](https://standards.iteh.ai/catalog/standards/sist/81-4714/03-e4a4c4b380bc/iso-2531-1998)

3.1 ductile iron: Type of iron used for pipes, fittings and accessories in which graphite is present primarily in spheroidal form.

3.2 pipe: Casting of uniform bore, with straight axis, having either socket, spigot or flanged ends, except for flanged sockets, flanged spigots 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 sockets, flanged spigots and collars are also classified as fittings.

3.4 accessory: Any casting other than a pipe or fitting, which is used in a pipeline, such as:

- glands and bolts for mechanical flexible joints (see 3.13);
- glands, bolts and locking rings or segments for restrained joints (see 3.14).

NOTE — Valves and hydrants 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, threaded-on or welded-on) or adjustable; an adjustable flange comprises a ring, in one or several parts bolted 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.

²⁾ To be published. (Revision of ISO 6506:1981 and ISO 410:1982)

- 3.7 spigot** : Male end of a pipe or fitting.
- 3.8 socket**: Female end of a pipe or fitting to make the joint with the spigot of an adjacent component.
- 3.9 gasket**: Sealing component of a joint.
- 3.10 joint**: Connection between the ends of pipes and/or fittings in which a gasket is used to effect a seal.
- 3.11 flexible joint**: Joint which provides significant angular deflection and movement parallel and/or perpendicular to the pipe axis.
- 3.12 push-in flexible joint**: Flexible joint assembled by pushing the spigot through the gasket into 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 joint**: 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 its Amendment 1).
- 3.18 allowable operating pressure (PFA)**: Internal pressure, excluding surge, that a component can safely withstand in permanent service.
- 3.19 allowable maximum operating pressure (PMA)**: Maximum internal pressure, including surge, that a component can safely withstand in service.
- 3.20 allowable test pressure (PEA)**: Maximum hydrostatic pressure that a newly installed component can withstand for a relatively short duration, when either fixed above ground level or laid and backfilled underground, in order to measure the integrity and tightness of the pipeline.
- 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 leaktightness.
- 3.21 diametral stiffness of a pipe**: Characteristic of a pipe which allows it to resist diametral deflection under loading.
- 3.22 batch**: Quantity of castings from which a sample may be taken for testing purposes during manufacture.
- 3.23 type 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 in the figures in clause 8.
- 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 indicated in the manufacturer's catalogues.
- 3.25 deviation**: Amount by which the design length may differ from the standardized length of a pipe or a fitting.

NOTE — Pipes and fittings are designed to a length selected in the range of standard length plus or minus the deviation (see table 4); they are manufactured to this length plus or minus the tolerance given in table 5.

3.26 ovality : Out of roundness of a pipe section, equal to

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

where

A_1 is the maximum axis, in millimetres, and

A_2 the minimum axis of the pipe cross-section, in millimetres.

4 Technical requirements

4.1 General

4.1.1 Pipes and fittings

Nominal sizes, thicknesses, lengths and coatings are specified in 4.1.1, 4.2.2, 4.2.3, 4.4 and 4.5, respectively. When, by agreement between manufacturer and purchaser, pipes and fittings with different lengths, thicknesses and/or coatings, and other types of fittings than those given in 8.3 and 8.4, are supplied according to this International Standard, they shall comply with all the other requirements of this International Standard.

The standard nominal sizes DN of pipes and fittings are the following:

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, 2 200, 2 400, 2 600.

The functional properties of ductile iron pipes are those given in annex C.

The pressures PFA, PMA and PEA (see 3.18, 3.19 and 3.20) are those indicated in the national standards or regulations.

NOTE — When installed and operated under the conditions for which they are designed (see annexes A and B), ductile iron pipes, fittings, accessories and their joints maintain all their functional characteristics over their operating life, due to 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 impair their compliance with the requirements of clauses 4 and 5.

When necessary, pipes and fittings may be repaired, for example by welding, to remove surface imperfections and localized defects which do not affect the entire wall thickness, provided that 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 beyond the scope of this International Standard.

Rubber gasket materials shall conform to the requirements of ISO 4633 for water applications and ISO 6447 for gas applications. When materials other than rubber are necessary (e.g. for flanged joints), they shall conform to the appropriate ISO standards.

4.1.3.2 Flanged joints

The dimensions and tolerances of the flanges of pipes and fittings shall comply with ISO 7005-2 or EN 1092-2 and flange gaskets with ISO 7483. This ensures interconnection between all flanged components (pipes, fittings, valves, etc.) of the same DN and PN and adequate joint performance.

Although it does not affect interconnection, the manufacturer shall indicate in his catalogue whether his products are normally delivered with fixed flanges or loose flanges.

4.1.3.3 Flexible joints

Pipes and fittings with flexible joints shall be in accordance with 4.2.1.1 for their spigot external diameters DE and their tolerances. This provides the possibility of interconnection between components equipped with different types of flexible joints. In addition, each type of flexible joint shall be designed to meet the performance requirements of 5.2.

NOTES

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 up to the highest pressures (e.g. measurement and selection of external diameter).

2 For interconnection with existing pipelines which can have external diameters not in accordance with 4.2.1.1, the manufacturer's guidance will be followed as to the appropriate means of interconnection (e.g. adaptors).

4.1.3.4 Restrained joints

Restrained joints for ductile iron pipelines shall be designed in accordance with ISO 10804-1. Their spigot external diameters DE and their tolerances shall comply with 4.2.1.1.

4.1.4 Materials in contact with potable water ISO 2531:1998

<https://standards.iteh.ai/catalog/standards/sist/4ca9dd5d-c8f4-4790-b086-4c9d4b40652d/iso-2531-1998>

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 have detrimental effects on the properties of that water for its intended use.

NOTE — When applicable, refer to national standards or regulations on the effects of materials on the quality of water.

4.2 Dimensional requirements

4.2.1 Diameter

4.2.1.1 Outer diameter

Table 11 in 8.1 specifies the values of the outer diameter DE of the spigot end of pipes and fittings, when measured circumferentially using a circumferential tape in accordance with 6.1.1. The positive tolerance is + 1 mm and applies to all thickness classes of pipes and also to flanged-spigot fittings.

The negative tolerance depends on the design of each type of joint and shall be as specified in national standards, or, when not so specified, in manufacturers' catalogues, for the type of joint and the nominal size considered.

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

- remain within the tolerances on DE for DN 40 to 200;
- not exceed 1 % of DE for DN 250 to DN 600 or 2 % for DN > DN 600.

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

4.2.1.2 Inner diameter

The nominal values of the inner diameters of centrifugally cast pipes, expressed in millimetres, are approximately equal to the numbers indicating their nominal sizes DN.

4.2.2 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 centrifugally cast pipes and 7 mm for pipes not centrifugally cast and 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 thickness class designation. It is selected from a series of whole numbers: 7, 8, 9, 10, 11, 12, ..

The standardized thickness classes of pipes are given in 8.1 and 8.2; other thicknesses are possible for pipes by agreement between manufacturer and purchaser.

For fittings, the thickness *e*, given in tables and in figures in 8.3 and 8.4, is the nominal thickness corresponding to the main part of the body. The actual thickness at any particular point shall be increased where necessary to meet localized high stresses depending on the size and shape of the casting (e.g. at inner radius of bends, at the branch-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 6.1.2.

Table 1

Dimensions in millimetres

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

1) A negative tolerance only is given so as to ensure sufficient resistance to internal pressure.

4.2.3 Length

4.2.3.1 Lengths of socket and spigot pipes

Pipes shall be supplied to the lengths given in table 2.

Table 2

Dimensions in metres

DN	Standardized lengths, $L_U^{1)}$
40 and 50	3
60 to 600	4 or 5 or 5,5 or 6 or 9
700 and 800	4 or 5,5 or 6 or 7 or 9
900 to 2 600	4 or 5 or 5,5 or 6 or 7 or 8,15 or 9
NOTE — Not all the standardized lengths are available in all countries.	
1) See 3.24.	

The manufacturers' design lengths L_U (see 3.24) shall be within a deviation (see 3.25) of ± 250 mm with respect to the lengths given in table 2 and shall be given in their catalogues. The actual length L_U shall be measured in accordance with 6.1.3 and shall not differ from the manufacturer's design length by more than the tolerance given in table 5. Of the total number of socket and spigot pipes to be supplied in each diameter, the percentage of shorter pipes shall not exceed 10 %.

NOTES

- 1 Pipes cut for test purposes may be excluded from the 10 % limitation and treated as full length pipes.
- 2 When pipes are ordered on a meterage basis, the manufacturer may determine the required quantity of pipes to be supplied by the summation of the measured individual pipe effective lengths.

4.2.3.2 Lengths of flanged pipes

The lengths of flanged pipes shall be as given in table 3. Other lengths are available by agreement between manufacturer and purchaser.

Table 3

Dimensions in metres

Type of pipe	DN	Standardized lengths, $L^{1)}$
With cast-on flanges	40 to 2 600	0,5 or 1 or 2 or 3
With screwed-on or welded-on 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 2 600	4 or 5 or 6 or 7
1) See 3.24.		

4.2.3.3 Lengths of fittings

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

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

The permissible deviations (see 3.25) on the lengths of series A fittings shall be as given in table 4.

Table 4

Dimensions in millimetres

Type of fitting	DN	Deviation
Flanged sockets	40 to 1 200	± 25
Flanged spigots	1 400 to 2 600	± 35
Collars, tapers		
Tees	40 to 1 200	+ 50 - 25
	1 400 to 2 600	+ 75 - 35
Bends 90° (1/4)	40 to 2 600	± (15 + 0,03 DN)
Bends 45° (1/8)	40 to 2 600	± (10 + 0,025 DN)
Bends 22° 30' (1/16) and 11° 15' (1/32)	40 to 1 200	± (10 + 0,02 DN)
	1 400 to 2 600	± (10 + 0,025 DN)

4.2.3.4 Tolerances on lengths

The tolerances on lengths shall be as given in table 5.

Table 5

Dimensions in millimetres

Type of casting	Tolerance
Socket and spigot pipes (full length or shortened)	± 30
Fittings for socketed joints	± 20
Pipes and fittings for flanged joints	± 10 ¹⁾
1) By agreement between manufacturer and purchaser, smaller tolerances are possible, but not less than ± 3 mm for DN ≤ 600 and ± 4 mm for DN > 600.	

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 normally 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 made of ductile iron shall have the tensile properties given in table 6.

During the manufacturing process the manufacturer shall carry out suitable tests 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 casting concerned. Test bars shall be machined from these samples and tensile tested in accordance with 6.3; or
- b) a system of process control testing (e.g. non-destructive) where a positive correlation can be demonstrated with the tensile properties specified in table 6. Testing verification procedures shall be based on the use of comparator samples having known and verifiable properties. This system of testing shall be supported by tensile testing in accordance with 6.3.

Table 6

Type of casting	Minimum tensile strength, R_m MPa	Minimum elongation percent after fracture, A	
	DN 40 to DN 2 600	DN 40 to DN 1 000	DN 1 100 to DN 2 600
Pipes centrifugally cast	420	10	7
Pipes not centrifugally cast, fittings and accessories	420	5	5

NOTES

1 By agreement between manufacturer and purchaser, the 0,2 % proof stress ($R_{p0,2}$) may be measured. It shall be not less than:
270 MPa when $A \geq 12$ % for DN 40 to 1 000 or $A \geq 10$ % for DN > 1 000;
300 MPa in other cases.

2 For centrifugally cast pipes of DN 40 to DN 1 000, the minimum elongation after fracture shall be 7 % for thickness classes greater than K12.

4.3.2 Brinell hardness

The hardness of the various components shall be such that they can be cut, tapped, drilled and/or machined with standard tools. In case of dispute, the hardness shall be measured according to 6.4.

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

ISO 2531:1998

4.4 Coating and linings for pipes

<https://standards.iteh.ai/catalog/standards/sist/4ca9dd5d-c8f4-4790-b086-e4a4c4b380bc/iso-2531-1998>

Pipes shall normally be delivered internally and externally coated.

4.4.1 External coatings

Depending on the external conditions of use (see annex A) and taking into account existing national standards, the following coatings may be supplied:

- metallic zinc with finishing layer, in accordance with ISO 8179-1;
- zinc rich paint with finishing layer, in accordance with ISO 8179-2;
- thicker metallic zinc with finishing layer;
- polyethylene sleeving, in accordance with ISO 8180;
- polyurethane;
- polyethylene;
- fibre cement mortar;
- adhesive tapes;
- bituminous paint;
- epoxy.

When ISO standards do not exist, these coatings shall comply with national standards, or with an agreed technical specification.