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**Ductile iron products for sewerage  
applications**

*Produits en fonte ductile pour l'assainissement*

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## 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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

ISO 7186 was prepared by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*, Subcommittee SC 2, *Cast iron pipes, fittings and their joints*.

This third edition cancels and replaces the second edition (ISO 7186:1996), which has been technically revised. A new classification system for pipes and fittings based on pressure is introduced with minimum wall thickness determined by allowable operating pressure.

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# Ductile iron products for sewerage 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 drains and sewers outside buildings:

- to convey surface water (e.g. rainwater), domestic waste water and/or certain types of industrial effluents, either in separate systems or in combined systems;
- operating without pressure (gravity sewers) or with positive or negative pressure;
- for installation below or above ground.

NOTE In this International Standard, all pressures are relative pressures expressed in bar<sup>1)</sup>.

This International Standard contains 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 is applicable to pipes, fittings and accessories cast by any type of foundry process or manufactured by fabrication of cast components, as well as corresponding joints, in the size range DN 80 to DN 2600 inclusive.

It is applicable to pipes, fittings and accessories which are

- manufactured with socketed, flanged or spigot ends (joint design and gasket shape are outside the scope of this International Standard), and
- normally delivered internally and externally coated.

## 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.

ISO 2531, *Ductile iron pipes, fittings, accessories and their joints for water applications*

ISO 4016, *Hexagon head bolts — Product grade C*

ISO 4034, *Hexagon nuts — Product grade C*

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

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

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1) 100 kPa = 1 bar = 0,1 MPa; 1 MPa = 1 N/mm<sup>2</sup>.

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

ISO 7091, *Plain washers — Normal series — Product grade C*

ISO 10804, *Restrained joint systems for ductile iron pipelines — Design rules and type testing*

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

### 3 Terms and definitions

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

#### 3.1 ductile iron

type of cast iron used for pipes, fittings and accessories in which graphite is present primarily in spheroidal form

[ISO 2531:2009, definition 3.8]

#### 3.2 pipe

casting of uniform bore, with straight axis, having either socket, spigot or flanged ends

NOTE This does not apply to flanged sockets, flanged spigots and collars, which are classified as fittings.

[ISO 2531:2009, definition 3.22]

#### 3.3 fitting

casting other than a pipe, which allows pipeline deviation, change of direction or bore

NOTE Flanged sockets, flanged spigots and collars are also classified as fittings.

[ISO 2531:2009, definition 3.9]

#### 3.4 accessory

any casting other than a pipe or fitting, which is used in a pipeline

EXAMPLE 1 Glands and bolts for mechanical flexible joints.

EXAMPLE 2 Glands, bolts and locking rings or segments for restrained joints.

[ISO 2531:2009, definition 3.1]

#### 3.5 inspection chamber

component of a discharge system, of a drain or of a sewer providing access from the ground surface for inspection and maintenance equipment

#### 3.6 manhole

component of a sewer of sufficient size to provide access from the ground surface for inspection and maintenance operations by personnel and equipment

**3.7****flange**

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, screwed-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 barrel axis before jointing.

[ISO 2531:2009, definition 3.10]

**3.8****spigot**

male end of a pipe or fitting

[ISO 2531:2009, definition 3.26]

**3.9****spigot end**

maximum insertion depth of the spigot,  $L_1$ , plus 50 mm

[ISO 2531:2009, definition 3.27]

See Figure 5.

**3.10****socket**

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

[ISO 2531:2009, definition 3.25]

**3.11****gasket**

sealing component of a joint

[ISO 2531:2009, definition 3.13]

**3.12****joint**

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

[ISO 2531:2009, definition 3.15]

**3.13****flexible joint**

joint providing significant angular deflection and movement parallel and/or perpendicular to the pipe axis

[ISO 2531:2009, definition 3.12]

**3.14****push-in flexible joint**

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

[ISO 2531:2009, definition 3.23]

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**3.15**

**mechanical flexible joint**

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

[ISO 2531:2009, definition 3.18]

**3.16**

**restrained joint**

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

[ISO 2531:2009, definition 3.24]

**3.17**

**flanged joint**

joint between two flanged ends

[ISO 2531:2009, definition 3.11]

**3.18**

**nominal size**

**DN**

alphanumeric designation of size for components of a pipework system, which is used for reference purposes

NOTE 1 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.

NOTE 2 Adapted from ISO 6708:1995, definition 2.1.

**3.19**

**nominal pressure**

**PN**

numerical designation, which is a convenient rounded number, used for reference purposes

NOTE 1 All components of the same nominal size, DN, designated by the same PN number have compatible mating dimensions.

NOTE 2 Adapted from ISO 7268.

**3.20**

**leaktightness test pressure**

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

**3.21**

**allowable operating pressure**

**PFA**

maximum internal pressure, excluding surge, that a component can safely withstand in permanent service

[ISO 2531:2009, definition 3.2]

**3.22**

**allowable maximum operating pressure**

**PMA**

maximum internal pressure, including surge, which a component can safely withstand in service

NOTE Adapted from ISO 2531:2009, definition 3.17.



**3.23****allowable site 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 which is related to the design pressure of the pipeline.

[ISO 2531:2009, definition 3.3]

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

characteristic of a pipe allowing it to resist diametral deflection under loading

[ISO 2531:2009, definition 3.7]

**3.25****discharge system**

system of pipes, fittings, accessories and joints used to collect and drain waste water and rainwater from a building

NOTE It comprises discharge pipes, stack ventilation pipes and rainwater downpipes, installed within the limits of a building or attached to the building.

**3.26****drain**

system of pipes, fittings, accessories and joints installed outside the limits of a building in order to connect the discharge system of the building to a sewer or a septic tank

**3.27****sewer**

pipeline designed to collect waste water and rainwater from buildings and surface water and to convey them to the point of disposal or treatment

**3.28****gravity sewer**

sewer operating normally under free flowing conditions

**3.29****pumping sewer****pressure sewer**

sewer (or section of a sewer) operating under positive pressure

**3.30****vacuum sewer**

sewer operating under negative pressure

**3.31****combined sewer**

sewer collecting together rainwater, surface water and waste water

**3.32****separate sewer system**

sewerage system which collects waste water separately from surface water

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**3.33**

**batch**

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

[ISO 2531:2009, definition 3.4]

**3.34**

**type test**

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

[ISO 2531:2009, definition 3.29]

**3.35**

**laying length**

$L_e$   
length by which a pipeline progresses when an additional pipe is installed

NOTE 1 For socket and spigot pipes, it is equal to the total length of the pipe,  $L_{tot}$ , minus the maximum spigot insertion depth,  $L_i$ , as given by the manufacturer and as shown in Figure 5. For flanged pipes, it is equal to the total length of the pipe.

NOTE 2 It is expressed in metres.

NOTE 3 Adapted from ISO 2531:2009, definition 3.16.

**3.36**

**standardized length**

length of pipe barrel and fitting body or branch

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NOTE 1 For socket and spigot pipes, it is designated  $L_u$  ( $l_u$  for branches). For flanged pipes, and fittings, it is designated  $L$  ( $l$  for branches). See Figure 5 and ISO 2531:2009.

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NOTE 2 For flanged pipes and fittings, the standardized length  $L$  ( $l$  for branches) is equal to the total length. For socketed pipes and fittings, the standardized length  $L_u$  ( $l_u$  for branches) is equal to the total length minus the depth of socket, as indicated in the manufacturer's handbooks.

NOTE 3 Adapted from ISO 2531:2009, definition 3.28

**3.37**

**ovality**

out-of-roundness of a pipe section, equal to Equation (1):

$$100 \frac{(A_1 - A_2)}{(A_1 + A_2)} \tag{1}$$

where

$A_1$  is the maximum axis, in millimetres;

$A_2$  is the minimum axis, in millimetres.

[ISO 2531:2009, definition 3.21]

### 3.38 deviation

amount by which the design length may differ from the standardized length of a pipe or a fitting

NOTE 1 Pipes and fittings are designed to a length selected 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.

NOTE 2 Adapted from ISO 2531:2009, definition 3.6.

### 3.39 component

any product defined as an element of a pipeline, such as a pipe, fitting or accessory

[ISO 2531:2009, definition 3.5]

See 3.2, 3.3 and 3.4.

### 3.40 hoop stress

$\sigma$

stress in a pipe or fitting under pressure, acting tangentially to the perimeter of a transverse section

[ISO 2531:2009, definition 3.14]

## 4 Technical requirements

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### 4.1 General

#### 4.1.1 Pipes, fittings and accessories [ISO 7186:2011](https://standards.iteh.ai/catalog/standards/sist/a02aa9b3-68e7-4ec2-a3a8-13585651f051/iso-7186-2011)

Thicknesses, lengths and coatings are specified in 4.3.2, 4.3.3, and 4.5 and 4.6, respectively. Where, by agreement between the manufacturer and the purchaser, pipes and fittings with different lengths, thicknesses and/or coatings, and other types of fittings than those given in 8.2 and 8.3, are supplied in accordance with this International Standard, they shall comply with all the other requirements of this International Standard. This includes pipes and fittings manufactured to national standards and regulations.

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

80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1400, 1500, 1600, 1800, 2000, 2200, 2400, 2600.

The stiffness and allowable diametral deflection of ductile iron pipes are those given in Table 11.

The pressures PFA, PMA and PEA (see 3.21, 3.22 and 3.23) for pressure sewers are those indicated in Annex C.

NOTE Where designed, installed, operated and maintained with due regard to the factors described in Annexes A and B, ductile iron pipes, fittings, accessories and their joints maintain their functional characteristics over their service life, due to time-independent material properties and high factors of safety.

#### 4.1.2 Surface condition and repairs

Pipes, fittings and accessories shall be free from defects and surface imperfections which can impair their compliance with the requirements of Clauses 4 and 5.

Where necessary, pipes and fittings may be repaired by the manufacturer, for example by welding, to remove surface imperfections and localized defects, which do not affect the entire wall thickness, provided 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 sewerage applications. Where materials other than rubber are necessary (e.g. high-temperature flanged joints), they shall conform to the appropriate International Standards.

#### 4.1.3.2 Flanged joints

Flanged joints shall be designed such that they can be attached to flanges whose dimensions and tolerances comply with ISO 7005-2 or EN 1092-2. This ensures interconnection between all flanged components (pipes, fittings, valves, etc.) of the same DN and PN and adequate joint performance. Bolts and nuts shall comply, as a minimum, with the requirements of ISO 4016 and ISO 4034, property class 4.6. Where washers are required they shall comply with ISO 7091.

In addition, each type of flanged joint shall be designed to meet the performance requirements as specified in ISO 2531.

Although it does not affect interconnection, the manufacturer's handbook shall indicate whether products contained therein are normally delivered with fixed or loose flanges.

#### 4.1.3.3 Flexible joints

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Pipes and fittings with flexible joints shall be in accordance with 4.3.1.1 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 5.1.

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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).

For interconnection with existing pipelines, which can have external diameters not in accordance with 4.3.1.1, the manufacturer's guidance should 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. Their spigot external diameters, DE, and their tolerances shall comply with 4.3.1.1.

### 4.1.4 Colour identification

Pipes and fittings for sewers and drains shall be identified externally by a specific colour (see national standard). Identification is possible by various means, e.g. external paint, polyethylene sleeving or a warning tape.

NOTE This is to allow easy identification of installed sewers and drains and to avoid mistaking with pipelines for water and gas supply.

## 4.2 Pressure classification

### 4.2.1 General

Depending on the manner by which the surface water or sewerage is transported, the sewerage system can be classified as a pressure sewer or a gravity sewer and, accordingly, flexibly jointed pipeline systems can be classified as pressure pipes/fittings or gravity pipes/fittings.

The allowable pressures within a pipeline system shall be limited to the lowest pressure classification component within the system.

Components with flanged joints shall be classified by the PN number of the flange.

Pressure pipes can be used in gravity pipeline systems.

### 4.2.2 Gravity pipes

Gravity pipes are designed for gravity sewer applications. Their normal service, internal and external pressures are defined in Table 6.

### 4.2.3 Pressure pipes

Pressure pipes are designed for pressure sewer applications and are classified by the allowable operating pressure (PFA), prefixed by a letter C.

Allowable pipeline pressures relationships are as follows:

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- a) allowable operating pressure (PFA) = (C), in bar;
- b) maximum allowable operating pressure (PMA) =  $1,20 \times (PFA)$ , in bar;
- c) allowable site test pressure (PEA) =  $(1,20 \times PFA) + 5$ , in bar.

The pressure pipes shall be selected from the preferred pressure classes C25, C30 and C40 as defined in ISO 2531. Their normal service internal and external pressures are defined in Table 6.

Other pressure classes, specified in ISO 2531, may be used if applicable.

The allowable pressures within a pipeline system shall be limited to the lowest pressure classification component within the system.

## 4.3 Dimensional requirements

### 4.3.1 Diameter

#### 4.3.1.1 External diameter

Table 12 gives the values of the external 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 pressure classes of pipes and also to flanged spigot fittings.

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