

INTERNATIONAL  
STANDARD

ISO  
7186

Second edition  
1996-12-15

---

---

**Ductile iron products for sewage  
applications**

*Produits en fonte ductile pour l'assainissement*

---



Reference number  
ISO 7186:1996(E)

## Contents

	Page
1 Scope .....	1
2 Normative references .....	1
3 Definitions .....	2
4 Technical requirements .....	4
4.1 General .....	4
4.2 Dimensional requirements .....	5
4.3 Material characteristics .....	7
4.4 Coatings and linings for pipes .....	7
4.5 Coatings for fittings and accessories .....	8
4.6 Marking .....	9
5 Leaktightness requirements .....	9
5.1 Systems design requirements .....	9
5.2 Leaktightness of pipeline components .....	10
5.3 Leaktightness of joints .....	10
6 Test methods and test frequencies .....	11
6.1 Dimensions .....	11
6.2 Straightness of pipes .....	11
6.3 Tensile test .....	11
6.4 Brinell hardness .....	13
6.5 Works leaktightness test of pipes and fittings for pressure applications .....	13
6.6 Works leaktightness test of pipes and fittings for vacuum applications .....	14
7 Type tests .....	14
7.1 Leaktightness of gravity pipeline components .....	14
7.2 Leaktightness of joints under internal pressure .....	14
7.3 Leaktightness of joints under external pressure .....	15
8 Dimensions .....	15
8.1 Socket and spigot pipes .....	15
8.2 Fittings for gravity applications .....	15
8.3 Fittings for pressure and vacuum applications .....	18

© ISO 1996

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

Printed in Switzerland

**Annexes**

<b>A</b>	Field of use: characteristics of soils .....	<b>19</b>
<b>B</b>	Field of use: characteristics of effluents .....	<b>20</b>
<b>C</b>	Pipe stiffness and diametral deflection .....	<b>21</b>
<b>D</b>	Bibliography .....	<b>22</b>

## 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.

International Standard 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 second edition cancels and replaces the first edition (ISO 7186:1983), which has been technically revised.

Annexes A to D of this International Standard are for information only.

# Ductile iron products for sewage 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 be operated by gravity or under positive or negative pressure;
- to be installed below or above ground;
- to convey surface water, domestic waste water and/or certain types of industrial effluents (see annex B), either in separate systems or in mixed systems.

This International Standard specifies products for gravity sewers and for sewer sections operated under pressures which do not normally exceed 6 bar. For higher pressure applications, special pipe thickness may be required by agreement between the manufacturer and the purchaser.

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

This International Standard contains specifications for materials, dimensions and tolerances, mechanical properties and standard surface protection of pipes, fittings and accessories. It also indicates 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 100 to DN 2 600 inclusive.

This International 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 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 publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this 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 2531:1991, *Ductile iron pipes, fittings and accessories for pressure pipelines*.

1) 1 bar = 0,1 MPa = 10<sup>5</sup> Pa

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.*

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

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

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

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

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

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

### 3 Definitions

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

**3.1 ductile iron:** Type of 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-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:** Casting other than a pipe or fitting which is used in a pipeline, except inspection chambers and manholes, for example:

- glands and bolts for mechanical flexible joints (see 3.15);
- glands, bolts and locking rings and segments for restrained flexible joints (see 3.16).

**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:** 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, screw-on or welded-on) or adjustable; a loose 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.

**3.8 collar; coupling:** Connecting piece used to join together the spigots of mating pipes or fittings.

**3.9 spigot:** Male end of a pipe or fitting.

**3.10 socket:** Female end of a pipe or fitting to make the joint with the spigot of the next component.

- 3.11 gasket:** Sealing component of a joint.
- 3.12 joint:** Connection between the ends of pipes and/or fittings in which a gasket is used to effect a seal.
- 3.13 flexible joint:** Joint which provides angular deflection and movement parallel and/or perpendicular to the pipe axis.
- 3.14 push-in flexible joint:** Flexible joint assembled by pushing the spigot through the gasket in the socket of the mating component.
- 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.
- 3.16 restrained joint:** Joint wherein a means is provided to prevent separation of the assembled joint.
- 3.17 flanged joint:** Joint between two flanged ends.
- 3.18 DN (nominal size):** Alphanumeric designation of size for components of a pipework system, which is used for reference purposes. It comprises the letters DN followed by a dimensionless whole number which is in directly related to the physical size, in millimetres, of the bore or outside diameter of the end connections. [ISO 6708]
- 3.19 nominal pressure PN:** Numerical designation which is a convenient rounded number for reference purposes. All components of the same nominal size DN designated by the same PN number have compatible mating dimensions. [ISO 7268/Amd.1]
- 3.20 diametral stiffness of a pipe:** Characteristic of a pipe which allows it to resist ovalization under loading when installed.
- 3.21 discharge system:** Piping system used to collect and drain waste water and rainwater from a building; it comprises discharge pipes, stack-ventilation pipes and rainwater downpipes, installed within the limits of a building or attached to the building.
- 3.22 drain:** Piping system installed outside the limits of a building in order to connect the discharge system of this building to the closest sewer or to the septic tank.
- 3.23 sewer:** Pipeline system designed to collect waste water and/or rainwater from buildings and/or surface water, and to convey them to the point of disposal.
- 3.24 gravity sewer:** Sewer operating normally under free flowing conditions.
- 3.25 pumping sewer; pressure sewer:** Sewer (or section of a sewer) operating under positive pressure.
- 3.26 vacuum sewer:** Sewer operating under negative pressure.
- 3.27 combined sewer:** Sewer collecting rainwater, surface water and waste water.
- 3.28 separate sewers:** Sewers collecting separately
- rainwater and surface water on one side,
  - waste water on the other side.
- 3.29 batch:** Quantity of castings from which a certain number of samples may be taken for testing purposes during manufacture.
- 3.30 type test:** Proof-of-design test which is done once, and must be repeated only after change of design.
- 3.31 length:** Effective length of a pipe or fitting.

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

**3.32 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 of the pipe cross-section, in millimetres;

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

## 4 Technical requirements

### 4.1 General

#### 4.1.1 Pipes, fittings and accessories

Nominal sizes, lengths, thicknesses and standard coatings are specified in 4.1.1, 4.2.2, 4.2.3, 4.4 and 4.5. When, by agreement between the manufacturer and the purchaser, pipes and fittings with different thicknesses, lengths, and/or coatings are supplied with reference 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: DN 100, DN 125, DN 150, DN 200, DN 250, DN 300, DN 350, DN 400, DN 450, DN 500, DN 600, DN 700, DN 800, DN 900, DN 1 000, DN 1 100, DN 1 200, DN 1 400, DN 1 500, DN 1 600, DN 1 800, DN 2 000, DN 2 200, DN 2 400, DN 2 600.

#### 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 the requirements of 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 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 International Standard.

Rubber gasket materials shall comply with the requirements of ISO 4633. When materials other than rubber are necessary (e.g. for flanged joints), they shall comply with 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, and flange gaskets shall comply 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 state in his catalogue 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 4.2.1.1 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 fulfill the performance requirements of 5.3.

#### NOTES

- 1 For interconnection with certain types of joints operating within a smaller tolerance 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 may have external diameters not in compliance with 4.2.1.1, the manufacturer's guidance should be followed as to the appropriate means of interconnection (e.g. adaptors).

### 4.1.4 Colour identification

Pipes and fittings for sewers and drains shall be identified externally by a specific colour (depending on each country). Identification is possible by various means, for example by the external paint, by the polyethylene sleeving or by a warning tape.

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

## 4.2 Dimensional requirements

### 4.2.1 Diameter

#### 4.2.1.1 External diameter

Table 6 specifies the values of the external diameter DE of the spigot end of spigot and socket pipes when measured circumferentially using a diameter tape (see 6.1.1). The tolerance is + 1 mm and applies to all DN and to all thicknesses of pipes, and also to flange-spigot fittings.

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

In addition, the ovality (see 3.32) of the spigot end of pipes and fittings shall

- remain with the tolerances on DE for DN 100 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 rounding prior to jointing.

#### 4.2.1.2 Internal diameter

The nominal values of the internal diameters of lined centrifugally cast pipes, expressed in millimetres are equal to the figures indicating their DN.

### 4.2.2 Wall thickness

The minimum iron wall thickness of centrifugally cast pipes shall be in conformity with those given in table 6 (see 6.1.2).

NOTE — Annex C gives values of diametral stiffness which corresponds to pipes having locally minimum wall thickness.

The minimum thickness of fittings shall be equal to or higher than those of pipes of the same DN.

### 4.2.3 Length

The standard lengths of socket and spigot pipes shall be as given in table 1.

**Table 1**

DN	Standard length $L_u^{1)}$ m
DN 100 to DN 600	4; 5; 5,5; 6
DN 700 and DN 800	4; 5,5; 6; 7; 9
DN 900 to DN 2 600	4; 5,5; 6; 7; 8,15; 9
1) See 3.31.	

The deviation on standard lengths shall be  $\pm 250$  mm.

Of the total number of socket and spigot pipes to be supplied in each diameter, the percentage of shorter pipes shall not exceed 10 %, unless a larger percentage is agreed upon between the manufacturer and the purchaser; the length shall be reduced

- by 0,15 m for the pipes from which samples have been cut for testing (see 4.3);
- or by 0,5 m increments (0,25 m increments for  $DN \geq 700$ ), the maximum allowed reduction being half the standard length.

When measured in accordance with 6.1.3, the length of pipes shall be within a manufacturing tolerance of  $\pm 30$  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 normally carried out by visual inspection, but in case of doubt or in dispute, the deviation shall be measured in accordance with 6.2.

### 4.2.5 Fittings

The standard types of fittings shall be those listed in clause 8; for lengths, see the manufacturer's catalogue.

Other types of fittings than those listed in clause 8 may be supplied as long as they meet the relevant requirements of this International Standard.

### 4.2.6 Inspection chambers

Inspection chambers shall be manufactured either as an integral item or by site assembly of a bottom part and a vertical part.

Normal access sizes shall be as follows: 250 mm, 300 mm, 400 mm, 600 mm.

The leaktightness of inspection chambers shall be in accordance with 5.2.

### 4.2.7 Manholes

Manholes are composed of a vertical part of  $DN \geq 800$ , a bottom plate, as top plate capable of receiving a frame and a manhole cover, and two or more inlets/outlets fixed to the vertical part.

The number and location of the inlets/outlets shall be determined by an agreement between the manufacturer and the purchaser and shall preserve the hydraulic continuity inside the manhole.

The leaktightness of manholes shall be in accordance with 5.2.

## 4.2.8 Flanged pipes and flanged fittings

The dimensions and tolerances of flanged pipes and flanged fittings shall comply with ISO 2531.

## 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 2.

During the manufacturing process the manufacturer shall carry out suitable tests in order to verify these tensile properties; such 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 testing) where a positive correlation can be demonstrated with the tensile properties specified in table 3. Testing verification procedures shall be based on the use of reference samples having known and verifiable properties. This system of testing shall be supported by tensile testing in accordance with 6.3.

**Table 2**

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

NOTE — By agreement between the manufacturer and the purchaser, the 0,2 % proof stress may be measured. It shall not be less than

- 270 MPa when  $A \geq 12$  % for DN 100 to DN 1 000 or  $A \geq 10$  % for DN > 1 000;
- 300 MPa in other cases.

### 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 in accordance with 6.4. The Brinell hardness shall not exceed 230 HB for centrifugally cast pipes and 250 HB for fittings and accessories. For components manufactured by welding, a higher Brinell hardness is allowed in the vicinity of the heat affected zone of the weld.

## 4.4 Coatings and linings for pipes

Pipes shall be normally delivered internally and externally coated.

### 4.4.1 External coatings

By agreement between the manufacturer and the purchaser, the following coatings may be supplied, depending on the external conditions of use (see annex A):

- metallic zinc and finishing layer, in accordance with ISO 8179-1;
- zinc rich paint and finishing layer in accordance with ISO 8179-2;