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Ductile iron pipes and accessories for non-pressure pipe-lines

Tuyaux et pièces accessoires en fonte ductile pour canalisations sans pression

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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 developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 7186 was developed by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*, and was circulated to the member bodies in September 1981.

It has been approved by the member bodies of the following countries:

Brazil	Hungary	Norway
China	India	Poland
Czechoslovakia	Israel	Romania
Egypt, Arab Rep. of	Italy	South Africa, Rep. of
Finland	Japan	Spain
France	Korea, Rep. of	Switzerland
Germany, F.R.	Netherlands	USSR

The member bodies of the following countries expressed disapproval of the document on technical grounds:

Austria
Belgium
Canada
United Kingdom
USA

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Ductile iron pipes and accessories for non-pressure pipe-lines

Section one: General specifications

0 Introduction

Ductile iron, also called nodular iron or spheroidal graphite iron, is characterized by the presence, in the corresponding castings, of spheroidal graphite.

It differs from lamellar graphite iron by an increased tensile strength, and significant proof stress and elongation after fracture.

The value adopted for the density of ductile iron is 7 050 kg/m³. It represents the mean of the values measured in various countries and provides good practical agreement between the calculated masses and actual masses.

1 Scope and field of application

This International Standard defines the dimensions of pipes used in the construction of non-pressure pipe-lines.

It comprises a general specification completed by specific requirements applicable to:

- a) ductile iron pipes manufactured by any one of the following four processes:
 - 1) centrifugal casting in lined or unlined metal moulds,
 - 2) centrifugal casting in sand¹⁾,
 - 3) casting in sand¹⁾ moulds,
 - 4) casting in metal moulds;
- b) ductile iron accessories manufactured by either of the following two processes:

1) welding,

2) casting in sand¹⁾ moulds or in metal moulds.

It is applicable to pipes and accessories for sewerage pipelines and drains.

The range of sizes extends from DN 100 to DN 2 600 inclusive.

NOTE — The nominal size (DN) is defined in ISO 6708.

2 References

ISO 2531, *Ductile iron pipes, fittings and accessories for pressure pipe-lines.*

ISO 6506, *Metallic materials — Hardness test — Brinell test.*

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

3 Types of joints

The pipes and accessories may be supplied with different types of joints.

The specification mainly concerns pipes with sockets for joints with elastomer gaskets. It may also be used for pipes and accessories having other types of joints, for example flanged joints, welded joints, saddle junctions.

NOTE — The standard external diameter of the spigot end of pipes and accessories is the same for all types of joint. Furthermore, this external diameter is the same as that specified in ISO 2531, which makes it possible to use the pipes of this International Standard with the fittings of ISO 2531.

1) By "sand" is understood sand or mineral-based materials used in the foundry trade irrespective of the type of bonding agent used.

4 Standard iron thickness of pipes and accessories

The standard thickness of pipes and accessories shall be calculated as a function of the nominal diameter by the formula:

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

where

e is the standard wall thickness in millimetres;

DN is the nominal size;

K is a coefficient selected from the series of integers ... 7, 8, 9, 10, 11, 12..., depending on service conditions and manufacturing processes:

$K = 7$ for the pipes in table 8,

$K = 7$ for accessories fabricated by welding,

$K > 7$ for cast accessories,

$K = 12$ or 14 for cast fittings as in ISO 2531.

If necessary, each specification shall give an additional formula applicable to small diameter castings.

The external diameter of the pipes, expressed in millimetres, is fixed as a function of the nominal diameter and independent of the thickness. Increases or decreases in the pipe wall thickness shall be obtained by modification of the actual internal diameter.

5 Marking

Each pipe or accessory shall bear at least the following marks:

- a) the manufacturer's mark;
- b) an indication that the casting is of ductile iron;
- c) the nominal size (DN).

Pipes with a nominal size greater than DN 300 shall also bear the year of manufacture. These marks may be made by casting, painting or cold stamping.

6 Quality of pipes and accessories for pipe-lines

After casting, iron pipes and accessories for pipe-lines may, if necessary, be subjected to a suitable heat treatment to endow them with the required mechanical properties.

Pipes and accessories shall not have any defects likely to be detrimental to their use.

Pipes and accessories showing small imperfections, unavoidable in the method of manufacture and in no way detrimental to use, shall not be rejected. The manufacturer may, on his own responsibility, decide the means to remedy slight surface imperfections in appearance. With the prior approval of the purchaser or the purchaser's representative, the repair of certain defects may be carried out using any well-tried method such as

welding for example. In this case, the purchaser may possibly require one of the tests given below to be carried out.

The pipes shall be such that they can be cut, drilled or machined; in case of dispute, they shall be considered as acceptable provided that the superficial hardness does not exceed 230 HB.

The superficial hardness of accessories shall not exceed 250 HB. However, if the pipes or accessories are to be fabricated from seamed elements, a higher local hardness at the location of the seams is permissible.

7 Tolerances on joints

In order to ensure interchangeability between supplies of different origins, the plus tolerance on the external diameters of the spigot ends of pipes and accessories, measured on the circumference at right angles to the joint, shall not be greater than 1 mm.

The tolerances on joints depend on the characteristics peculiar to each type of joint and shall be specified in national standards, or, where not so specified, in the manufacturer's catalogues for the type of joint and the nominal size considered.

NOTE — As a general rule, the tolerances on the sockets are more restricted than the tolerances on the barrel because of the greater thickness and greater rigidity of the sockets.

8 Tolerances on thickness

The tolerances on wall thickness are as given in table 1, where DN is the nominal size.

Table 1

Dimensions in millimetres

Type of casting	Tolerance
Centrifugally cast pipes	$-(1,3 + 0,001 \text{ DN})^{1)}$
Non-centrifugally cast pipes and accessories for pipe-lines	$-(2,3 + 0,001 \text{ DN})^{1)}$

1) No limit for the plus tolerances has been set. (See note to clause 11.)

9 Manufacturing length — Deviations and tolerances on length

The standard working lengths of socket pipes are shown in table 2.

Table 2

Nominal size DN	Standard working length m
DN < 500	4 — 5 — 5,5 — 6
600 < DN < 2 600	4 — 5 — 5,5 — 6 — 7 — 8 — 9

NOTE — Some countries do not manufacture every standard working length; it cannot therefore be stipulated.

Of the total number of socket pipes to be supplied in each diameter, the manufacturer may supply up to 10 % in lengths shorter than the standard working lengths specified, the maximum permissible reduction in length being given in table 3.

Table 3

Dimensions in metres

Specified length L	Maximum reduction in length
$L < 4$	1
$4 < L < 6$	2
$6 < L$	3

According to the manufacturing materials and type of joint in which they are used, pipes may have working manufacturing lengths showing slight differences or deviations in relation to the standard working lengths. The working manufacturing lengths shall be stated in the manufacturer's catalogues.

The deviations and tolerances on working manufacturing lengths are given in section two.

10 Tolerances on the straightness of centrifugally cast pipes

When the pipes are rolled along two gantries separated by approximately two-thirds of length L of the pipes, the maximum deviation f_m , in millimetres, shall not be greater than 1,25 times the length L , in metres, of this pipe, i.e.:

$$f_m < 1,25 L$$

11 Tolerances on masses

The values of the masses of the sockets appearing in table 8 are approximate.

The masses of pipes corresponding to each type of joint shall be specified in national standards or, when not so specified, in manufacturer's catalogues; these shall be calculated by taking the density of cast iron as 7 050 kg/m³.

The mass of the pipe for each working length shown in table 8 has been calculated taking into account in each case a socket mass fixed by a linear formula corresponding to average socket masses as manufactured in various countries.

The values indicated for the mass per metre of pipes and the masses of the sockets are rounded off to the nearest 0,1 kg.

The values indicated for the total masses of pipes are rounded off:

- to the nearest 0,5 kg for masses of less than 100 kg;
- to the nearest 1,0 kg for masses above 100 kg.

The tolerances on the standard masses are given in table 4.

Table 4

Type of casting	Tolerance on standard mass %
Centrifugally cast pipes:	
— < DN 200	± 8
— > DN 200	± 5
Non-centrifugally cast pipes	± 8
Welded accessories	± 12
Cast accessories	± 12

NOTE — Castings of a mass greater than the maximum shall be accepted provided that they comply in every other respect with the requirements of this International Standard.

12 Tensile tests — Test bars

12.1 Centrifugally cast pipes

The machined test bar for the tensile test shall be taken from the spigot end of the pipe, at approximately mid-thickness of the wall.

The choice of whether the test bar is taken parallel or at right angles to the pipe axis is left to the manufacturer. In case of dispute, sampling parallel to the pipe axis shall rule.

The test bar shall include a cylindrical part, the gauge length of which shall be at least five times its diameter; the latter shall be as given in table 5, according to the thickness of the pipe, e .

Table 5

Dimensions in millimetres

Thickness of pipe, e	Diameter of test bar
$e < 6$	2,5
$6 < e < 8$	3,5
$8 < e < 12$	5,0
$12 < e$	6,0

12.2 Pipes not centrifugally cast and accessories for pipe-lines

The machined bar for the tensile test shall be taken, at the choice of the manufacturer, either from a sample attached to the casting or cast separately. In the latter case, it shall be cast from the same iron and, if necessary, shall be subjected to the same heat treatment as the castings. The choice of the method used for casting the sample shall be left to the manufacturer with a view to obtaining sound test bars. The thickness of the sample and the diameter of the bar are given in table 6, dependent on the mean thickness of the casting.

Table 6

Dimensions in millimetres

Mean thickness of casting	Thickness of sample	Diameter of test bar
< 12	12,5	6
> 12	25	12

The gauge length of the machined bar shall be at least five times its diameter.

In all cases the ends of the test bars shall be such that they will fit the testing machine.

13 Tensile test – Method and results

The manufacturer’s mechanical test shall be carried out during manufacture.

The mechanical acceptance test shall be carried out on castings grouped in batches as follows:

a) Centrifugally cast pipes

Each batch shall be made up of pipes cast successively as follows:

- 200 pipes for DN 100 to 300 inclusive;
- 100 pipes for DN 350 to 600 inclusive;
- 50 pipes for DN 700 to 1 000 inclusive;
- 25 pipes for DN 1 200 to 2 600 inclusive.

b) Pipes and accessories not centrifugally cast

Castings made from iron of substantially the same composition and, if necessary, having been subjected to the same heat treatment, shall be considered as one batch. The size of such batches shall be limited to 4 t of crude castings, excluding the mass of the risers.

The manufacturer shall take from one pipe [see a)] or from one sample of each batch [see b)] a test bar which shall satisfy the requirements of table 7. A single casting is considered as one batch if the mass is 4 t or more.

If the results of this test are below the specified minimum values, two other test bars shall be taken from the same pipe, or from the same sample in the case of accessories, and these shall satisfy the same specified requirements.

Pipes from which test bars have been selected shall be part of the supply just as pipes that were not selected.

NOTE — The provisions made for the composition of batches and the heat treatment of the castings, the choice of a test bar diameter according to the thickness and the type of casting all contribute to the precision of this test.

14 Brinell hardness test

The Brinell hardness, HB, specified in clause 6, shall be checked by means of a test carried out on the outer surface of the castings after slight grinding.

The Brinell hardness test shall be carried out in accordance with ISO 6506, with a steel ball of 10,5 or 2,5 mm diameter.

15 Leak-tightness test

15.1 Spigot and socket pipes

Pipes shall be subjected to a works hydrostatic leak-tightness test for a duration of at least 10 s using water at one bar pressure*, without leaking.

15.2 Accessories

Accessories shall be subjected to the same leak-tightness test with water as the pipes or to an equivalent test using air, without leaking.

16 Coatings

16.1 Internal linings

Pipes shall be lined with a layer of cement mortar suitable for transportation of normal sewerage effluent.

16.2 External coatings

Pipes shall be coated with the usual bitumen coating layer, reinforced, at the manufacturer’s option, with a sub-layer of zinc or with a polyethylene liner according to the soil nature.

Table 7

Type of casting	Minimum tensile strength	Minimum 0,2 % proof stress ¹⁾	Minimum elongation after fracture	
	R_m	$R_{p0,2}$	A	
	N/mm ²	N/mm ²	%	
	DN 100 to 2 600	DN 100 to 2 600	DN 100 to 1 000	DN 1 200 to 2 600
Centrifugally cast pipes	420	300	10	7
Non-centrifugally cast pipes, and accessories	400	300	5	5

1) The proof stress shall be measured only where there is a special agreement between the manufacturer and the purchaser and under conditions which shall be specified on the order.

* 1 bar = 0,1 MPa

16.3 Coatings for pipes of diameter over 600 mm

For pipes with a diameter greater than 600 mm, the reinforcement shall be applied for incursive soils only.

NOTE — In case of exceptional incursivity of soils or effluents, special coatings may be applied by agreement between the manufacturer and the customer.

17 Inspection by the customer

Should the customer wish to inspect pipes and accessories for sewers and drains, this inspection shall be carried out at the manufacturer's works.

The manufacturer shall supply the test equipment, appliances, inspection gauge and the necessary personnel.

The receiving agent appointed by the purchaser and recognized by the manufacturer shall be notified in advance of the time at which acceptance operations are normally carried out.

The receiving agent may be present at the operations of sampling, preparation and testing of the test bars, at the dimensional inspection and weighing and at the hydraulic tests.

The acceptance and weighing of the pipes and accessories for sewers and drains may be carried out after coating.

If the purchaser, or his representative, is not present to observe these operations at a convenient time, the manufacturer shall be able to go ahead with the acceptance without the presence of the purchaser or his representative.

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