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Grey cast iron — Classification

Fontes grises de moulage — Classification

Reference number
ISO 185 : 1988 (E)

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 approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 185 was prepared by Technical Committee ISO/TC 25, *Cast iron and pig iron.*

It cancels and replaces ISO Recommendation R 185 : 1961, of which it constitutes a technical revision.

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

Introduction

Grey cast iron is a casting material, mainly iron and carbon based, the latter element being present as flake graphite corresponding to form I of ISO 945.

Grey iron castings are used extensively throughout industry. The mass of a casting may vary from a few grams to over 100 t. The casting section thickness may also vary greatly.

The properties of grey cast iron depend on its structure, i.e. the amount of graphite present, the form in which the graphite is present, and the structure of the iron matrix. The structure may be controlled by varying the production conditions, the chemical composition, solidification time, and the cooling rate in the solid state. Castings may be produced with properties appropriate to meet requirements for machinability and operating stresses.

This International Standard deals with the classification of grey cast iron according to the tensile properties of the material in test pieces machined from separately cast or cast-on test samples. The results of a tensile test give an indication of the quality of the material and an indication of the properties of the material in the casting.

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Grey cast iron — Classification

1 Scope

This International Standard establishes a classification for grey cast iron. The classification comprises six grades based on the tensile properties of test pieces machined from separately cast test samples.

NOTES

1 In cases where the casting thickness is greater than 20 mm and the mass is more than 200 kg, the testing may also be carried out using cast-on test samples. The properties of the test pieces machined from cast-on test samples are normally more similar to the properties of the material in the casting than those of separately cast test samples due to differences in the cooling conditions.

2 By agreement between the manufacturer and the purchaser the material may also be tested using test pieces machined from test samples cut from the casting.

Where the hardness of the material in the casting is of main interest to the purchaser, reference should be made to annex A, which is not a mandatory part of this International Standard.

This standard applies only to grey cast iron, cast in sand moulds or moulds of comparable thermal diffusivity.

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 listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 945: 1975, *Cast iron — Designation of microstructure of graphite.*

ISO 6892: 1984, *Metallic materials — Tensile testing.*

3 Production

The method of producing the grey cast iron and its composition are left to the discretion of the manufacturer, who shall ensure that the property requirements defined in this International Standard are complied with for the grade of material specified in the order.

However, for grey cast iron to be used in special applications, the chemical composition and heat treatment may be the subject of an agreement between the manufacturer and the purchaser.

4 Tensile properties

4.1 Tensile properties of test pieces machined from separately cast test samples

The tensile properties of the six grades of grey cast iron when measured in accordance with clause 5 using test pieces machined from separately cast test samples shall be as given in table 1.

Table 1 — Tensile properties of test pieces machined from separately cast test samples

Grade	Tensile strength*) of test pieces machined from separately cast test samples $R_{m, min.}$ N/mm²**)
100	100
150	150
200	200
250	250
300	300
350	350

*) For the purpose of acceptance, cast iron of grade n shall have a tensile strength between n and $(n + 100)$ N/mm².

**) 1 N/mm² = 1 MPa

As a guide for design purposes, the anticipated tensile properties of the material in the castings are given in table 2, for information only. By agreement between the manufacturer and the purchaser, the R_m values in table 2 may be made mandatory.

4.2 Tensile properties of test pieces machined from cast-on test samples

The tensile properties of test pieces machined from cast-on test samples shall be as given in table 3.

Table 2 — Anticipated tensile properties for the castings (for information only)

Grade	Casting section thickness mm		Anticipated tensile strength *)**) R_{m}, min.
	over	up to and including †)	N/mm² ***)
100	2,5	10	120
	10	20	90
150	2,5	10	155
	10	20	130
	20	30	115
	30	50	105
200	2,5	10	205
	10	20	180
	20	30	160
	30	50	145
250	4,0	10	250
	10	20	225
	20	30	205
	30	50	185
300	10	20	270
	20	30	245
	30	50	225
350	10	20	315
	20	30	290
	30	50	270

*) By agreement between the manufacturer and the purchaser, the material may be ordered specifying the use of test samples cut from the casting when the above properties are anticipated.

**) Refer to annex B for relationship between hardness and tensile strength.

***) 1 N/mm² = 1 MPa

†) This table gives guidance to the likely variation in tensile strength for different casting section thicknesses when a given grade of grey cast iron is cast into a casting of simple shape and uniform thickness. For castings of non-uniform section or castings containing cored holes, the table provides only an approximate guide to the likely tensile strength in different sections, and casting design should be based on the measured tensile strength in critical parts of the casting.

Table 3 — Tensile properties of test pieces machined from cast-on test samples

Grade	Casting section thickness **) mm		Tensile strength, R_{m}, min. N/mm² ***)	
	over	up to and including	Cast-on test samples	In the castings (for information only)
100 *)	—	—	—	—
150	20	40	120 †)	110
	40	80	110 †)	95
	80	150	100 ††)	80
	150	300	90 ††)	—
200	20	40	170 †)	155
	40	80	150 †)	130
	80	150	140 ††)	115
	150	300	130 ††)	—
250	20	40	210 †)	195
	40	80	190 †)	170
	80	150	170 ††)	155
	150	300	160 ††)	—
300	20	40	250 †)	240
	40	80	220 †)	210
	80	150	210 ††)	195
	150	300	190 ††)	—
350	20	40	290 †)	280
	40	80	260 †)	250
	80	150	230 ††)	225
	150	300	210 ††)	—

*) Owing to its low tensile strength in heavy sections, grade 100 is found to have no practical application.

**) For casting section thicknesses greater than 300 mm, the tensile properties shall be the subject of an agreement between the manufacturer and the purchaser.

***) 1 N/mm² = 1 MPa

†) Test sample diameter 30 mm

††) Test sample diameter 50 mm

5 Tensile test

5.1 The tensile test shall be carried out in accordance with the requirements of ISO 6892, but using a test piece in accordance with 5.2.

5.2 The tensile test shall be carried out on test piece A, described in 6.3. By agreement between purchaser and manufacturer, test piece B may be used (see also 6.3).

For the same material and grade, the results achieved using test piece A will be higher than those achieved by using test piece B.

6 Test samples and test pieces

Separately cast test samples shall be used unless otherwise agreed between manufacturer and purchaser (see 6.2).

6.1 Separately cast test samples and machined test pieces

6.1.1 Preparation of separately cast test samples

The separately cast test samples shall be cast vertically in rigid sand moulds or in sand moulds with comparable thermal diffusivity or, by agreement between the manufacturer and the purchaser, in greensand moulds. The moulds may be made for casting several test samples simultaneously. The free distance between test samples in the same mould shall be at least 50 mm, as shown in figure 1.

Dimensions in millimetres

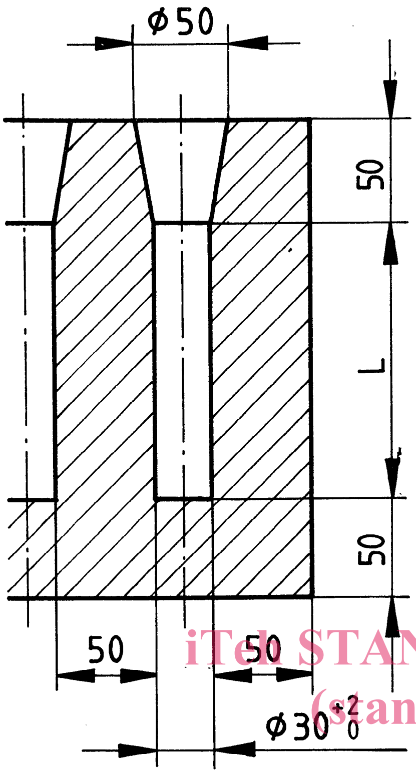


Figure 1 — Test samples

Test samples shall be poured from the same ladle of metal as that used to produce the castings.

The test samples shall be stripped from the mould at a temperature not exceeding 500 °C.

Where castings are taken out of their moulds at a temperature higher than 500 °C, the test samples may by agreement between the purchaser and the manufacturer be taken out of their moulds at a temperature similar to that at which the castings they represent are taken from their moulds.

If heat treatment is required, the test samples shall be given the same heat treatment as the castings they represent.

6.1.2 Preparation of test pieces from separately cast test samples

The test pieces used for the tests specified in clause 5 or as required by clauses 9 and 10 shall be machined from uniform cylindrical test samples, as indicated by figure 1. The test pieces shall be in accordance with 5.2.

Dimension *L* shall be determined according to the length of the test piece and clamping device (see 6.3).

6.2 Cast-on test samples

Cast-on test samples may be used by agreement between the manufacturer and purchaser when a casting is more than 20 mm thick and the mass is more than 200 kg.

The test pieces used for the tests specified in clause 5 or as required by clauses 9 and 10 shall be machined from a cast-on test sample, as indicated in figures 2 and 3. The test pieces shall be in accordance with 5.2. The type of test sample shall be chosen to provide approximately the same cooling conditions as for the casting to be represented. The type of test sample and the location of the test sample on the casting shall be agreed between the purchaser and the manufacturer. If there is no such agreement, it shall be at a representative point on the casting. The diameter of the test sample shall be either 30 mm or 50 mm. The other dimensions are given in the figures.

The dimension *L* shall be determined according to the length of the test piece and the clamping device (see 6.3).

If the casting is heat-treated, the test samples shall be given the same heat treatment and shall not be cut off from the casting until after the heat treatment.

6.3 The dimensions of the test piece shall be as given in table 4. The ends of test pieces may be either threaded or plain to suit the clamping device.

7 Formation of batches

A batch shall consist of the castings poured from the same ladle of metal.

The maximum mass of a batch is normally 2 000 kg of fettled castings. This mass may be varied where practical by agreement between the manufacturer and the purchaser.

A single casting shall constitute a batch if its mass equals or exceeds 2 000 kg.

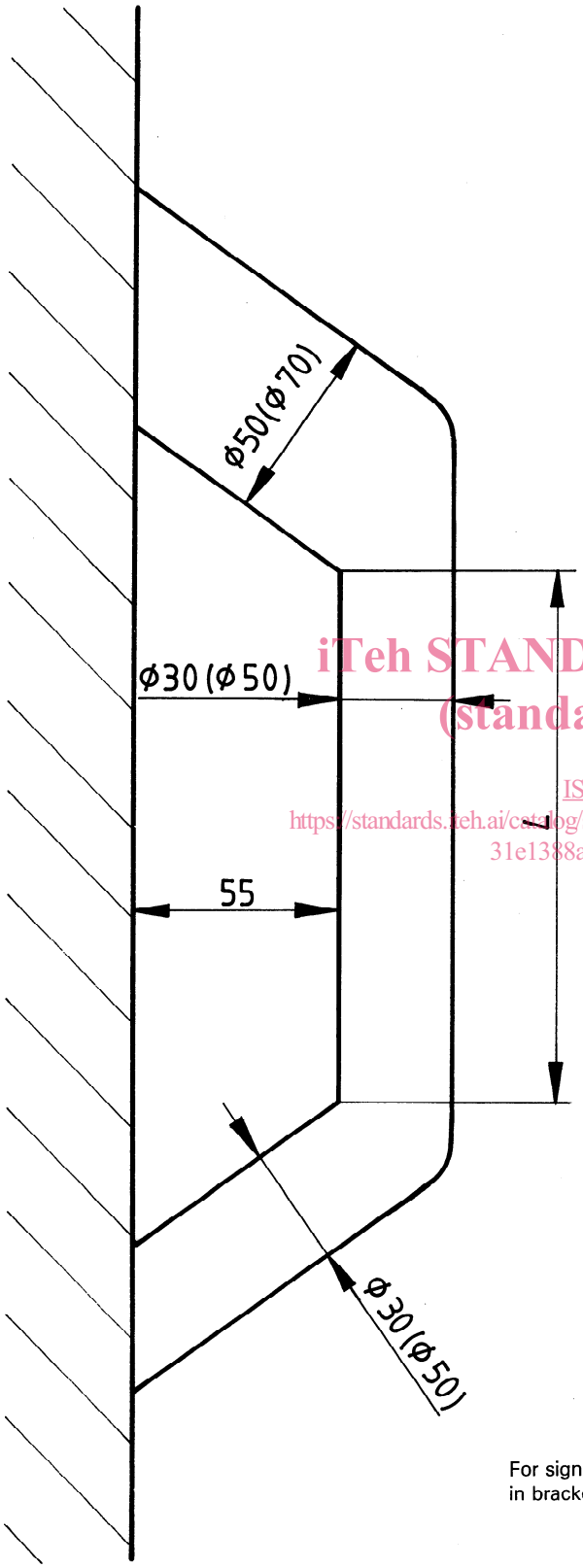
For continuous melting of the same grade of grey cast iron in large tonnages, the maximum mass of a batch shall be restricted to 2 h of pouring.

8 Number of tests per batch

One tensile test shall be carried out for each batch.

As an exception to the first requirement of clause 7, several batches may be grouped for acceptance by agreement between manufacturer and purchaser. If one grade is melted in large quantitites and if production is carefully monitored by systematic checking of the melting process, sets of test samples may be taken at longer intervals. The condition for this is continuous process control techniques of other types, for example chill testing, chemical analysis, thermal analysis.

Dimensions in millimetres



For significance of figures in brackets, see 6.2.

Figure 2 — Cast-on test sample: Type 1

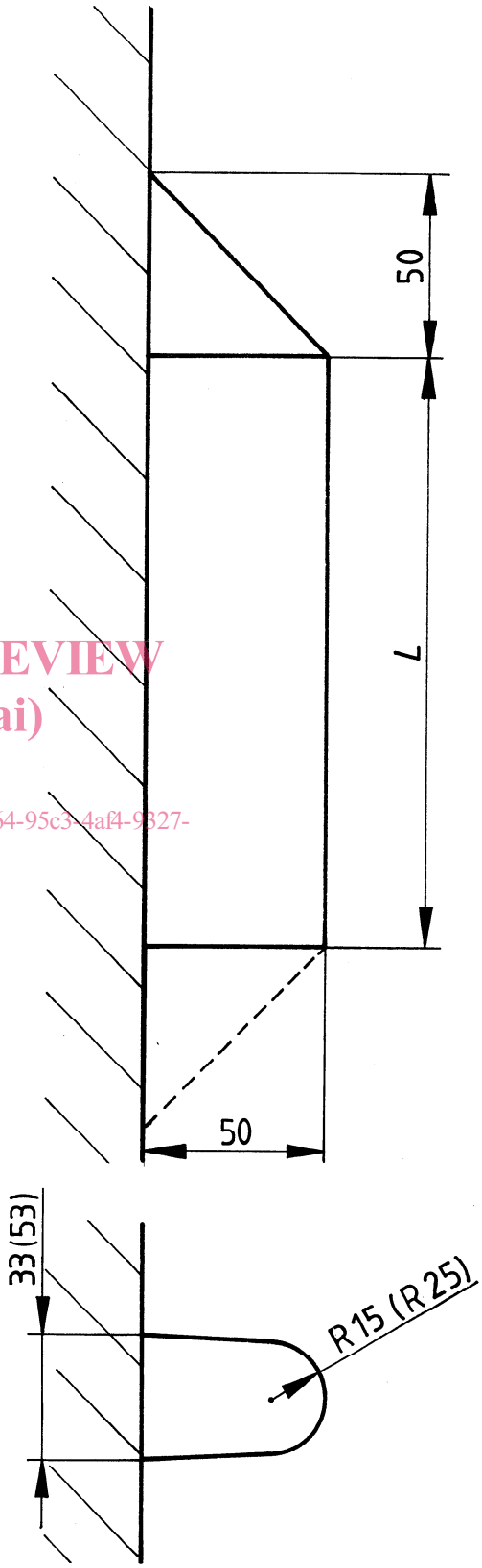


Figure 3 — Cast-on test sample: Type 2

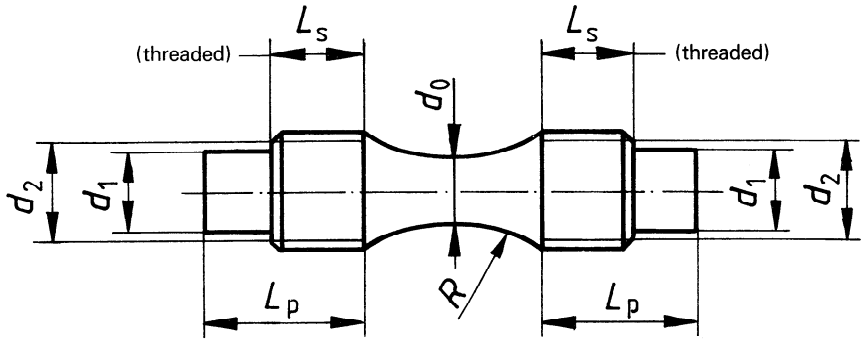


Figure 4 — Test piece A[1)]

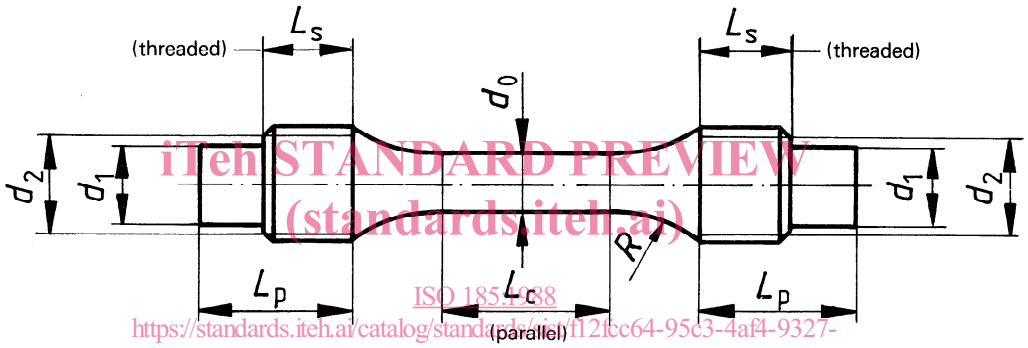


Figure 5 — Test piece B[1)]

Table 4 — Dimensions of test pieces

Values in millimetres

		Dimension	Machining tolerance
Minimum length of parallel-sided section (L_c)		60	
Gauge diameter (d_0)		20	± 0,105
Minimum radius (R)		25	+ 5 0
Plain ends	Minimum diameter (d_1)	23	
	Minimum length (L_p)	65	
Threaded ends	Minimum diameter at root of thread (d_2)	25	
	Minimum length (L_s)	30	

1) For the same material and grade, the results achieved using test piece A will be higher than those achieved using test piece B.