
Grey cast irons — Classification

Fontes à graphite lamellaire — Classification

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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 185 was prepared by Technical Committee ISO/TC 25, *Cast irons and pig irons*, Subcommittee SC 3, *Grey cast irons*.

This second edition cancels and replaces the first edition (ISO 185:1988), which has been technically revised.

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Introduction

This International Standard deals with the classification of grey cast irons, subdivided into two groups, specified by their tensile strength and hardness, respectively.

The properties of grey cast irons depend on the form and distribution of the graphite and the structure of the matrix.

However, for many applications, tensile strength or hardness are not the only interesting or determining properties. Other mechanical or physical properties can be decisive for the use of grey cast iron, for example:

- the thermal capacity and the thermal diffusivity for disc brakes as well as radiators;
- the damping capacity for engine blocks or machine beds;
- the thermocycle fatigue for exhaust manifolds or ingot moulds.

Therefore, Annex A provides additional information of interest to casting designers.

In addition:

- Annex B contains “Additional information on the relationship between hardness and tensile strength”;
- Annex C contains “Additional information on the relationship between tensile strength, hardness and wall thickness of grey iron castings”.

NOTE This International Standard does not cover technical delivery conditions for grey iron castings.

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Grey cast irons — Classification

1 Scope

This International Standard specifies the properties of unalloyed and low-alloyed grey cast irons used for castings, which have been manufactured in sand moulds or in moulds with comparable thermal behaviour.

This International Standard specifies the characterizing properties of grey cast iron by either

- a) the tensile strength of separately cast samples, or if agreed by the manufacturer and the purchaser, of cast-on samples or samples cut from a casting (see Table 1), or
- b) if agreed between the manufacturer and the purchaser, the hardness of the material measured on castings (see Table 2) or on a cast-on knob.

If agreed by the manufacturer and the purchaser, the combination of both tensile strength from option a) and hardness from option b) may be specified. When specifying a combination of tensile strength and hardness, it is recommended to consult the information in Annex B.

This International Standard does not apply to grey cast irons used for pipes and pipe fittings and continuous cast products.

This International Standard specifies eight grades of grey cast iron according to the tensile strength (see Table 1) and six grades of grey cast iron according to the Brinell hardness (see Table 2).

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 945, *Cast iron — Designation of microstructure of graphite*

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

ISO 6892, *Metallic materials — Tensile testing at ambient temperature*

ISO/TR 15931, *Designation system for cast irons and pig irons*

3 Terms and definitions

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

3.1

grey cast iron

cast material, iron and carbon based, carbon being present mainly in the form of flake (lamellar) graphite particles

NOTE 1 Grey cast iron is also known as flake graphite cast iron, and less commonly as lamellar graphite cast iron.

NOTE 2 Graphite form, distribution and size are specified in ISO 945.

3.2

relevant wall thickness

section of the casting, agreed between the manufacturer and the purchaser, to which the determined mechanical properties apply

4 Designation

The material shall be designated as given in either Table 1 or Table 2. The designation system is given in ISO/TR 15931.

5 Order information

The following information shall be supplied by the purchaser:

- a) the complete designation of the material;
- b) any special requirements which have to be agreed between the manufacturer and the purchaser.

All agreements between the manufacturer and the purchaser shall be made by the time of acceptance of the order.

6 Manufacture

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

NOTE For grey cast irons 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.

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7 Requirements

7.1 Mechanical properties

The order shall specify, in an unambiguous manner, whether the tensile strength measured on separately cast samples, or the Brinell hardness measured on the casting, is the characterizing property. If it does not do so, then the manufacturer shall characterize the material according to tensile strength.

7.2 Tensile properties

7.2.1 Test pieces machined from separately cast samples

The tensile properties of the eight grades of grey cast iron specified by tensile strength, when measured in accordance with 9.1 using test pieces machined from separately cast samples, shall be in accordance with the requirements of Table 1.

The number in position 3 of the designation is the minimum tensile strength of the grade. The maximum tensile strength of the grade is the minimum value plus 100 N/mm².

7.2.2 Test pieces machined from cast-on samples

The tensile properties of test pieces machined from cast-on samples, for the eight grades of grey cast iron defined by tensile strength, shall be in accordance with the requirements of Table 1.

7.2.3 Test pieces cut from a casting

If applicable, the tensile properties of test pieces cut from a casting, for the eight grades of grey cast iron defined by tensile strength, shall be agreed between the manufacturer and the purchaser, and these tensile properties shall be in accordance with the requirements in the agreement.

Table 1 — Tensile strength of grey cast irons

Material designation	Relevant wall thickness ^a <i>t</i>		Tensile strength R_m^b mandatory values		Tensile strength R_m^c anticipated values in casting ^d N/mm ² min.
	mm		in separately cast sample ^f N/mm ²	in cast-on sample N/mm ²	
	>	≤	min.	min.	
ISO 185/JL/100	5 ^e	40	100	—	—
ISO 185/JL/150	2,5 ^e	5	150	—	180
	5	10		—	155
	10	20		—	130
	20	40		120	110
	40	80		110	95
	80	150		100	80
	150	300		90 ^d	—
ISO 185/JL/200	2,5 ^e	5	200	—	230
	5	10		—	205
	10	20		—	180
	20	40		170	155
	40	80		150	130
	80	150		140	115
	150	300		130 ^d	—
ISO 185/JL/225	5 ^e	10	225	—	230
	10	20		—	205
	20	40		190	170
	40	80		170	150
	80	150		155	135
	100	300		145 ^d	—
	ISO 185/JL/250	5 ^e		10	250
10		20	—	225	
20		40	210	195	
40		80	190	170	
80		150	170	155	
150		300	160 ^d	—	
ISO 185/JL/275		10 ^e	20	275	
	20	40	230		220
	40	80	205		190
	80	150	190		175
	150	300	175 ^d		—

Table 1 (continued)

Material designation	Relevant wall thickness ^a <i>t</i>		Tensile strength <i>R_m</i> ^b mandatory values		Tensile strength <i>R_m</i> ^c anticipated values in casting ^d N/mm ² min.
	mm		in separately cast sample ^f N/mm ²	in cast-on sample N/mm ²	
	>	≤	min.	min.	
ISO 185/JL/300	10 ^e	20	300	—	270
	20	40		250	240
	40	80		220	210
	80	150		210	195
	150	300		190 ^d	—
ISO 185/JL/350	10 ^e	20	350	—	315
	20	40		290	280
	40	80		260	250
	80	150		230	225
	150	300		210 ^d	—

NOTE 1 1 N/mm² is equivalent to 1 MPa.

NOTE 2 For high damping capacity and thermal conductivity, ISO 185/JL/100 is the most suitable material.

NOTE 3 The figures given in bold indicate the minimum tensile strength to which the material designation of the grade is related.

NOTE 4 If the type of sample is to be specified, a "/" is added to the designation, followed by a letter indicating the type of sample:

/S = separately cast sample;

/U = cast-on sample.

^a If a cast-on sample is to be used, the relevant wall thickness of the casting shall be agreed.

^b If tensile strength is specified as a characterizing property, the type of the sample (see 8.2) should also to be stated in the order. If not stated on the order, the type of sample is left to the discretion of the manufacturer.

^c This column gives guidance only about the likely variation in tensile strength for different casting wall thicknesses when a casting of simple shape and uniform wall thickness is cast in a given grey cast-iron material. For castings of non-uniform wall thickness, or castings containing cored holes, the table values are 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.

^d These values are guideline values. They are not mandatory.

^e This value is included as the lower limit of the relevant wall-thickness range.

^f The values relate to an as-cast test-bar diameter of 30 mm; this corresponds to a relevant wall thickness of 15 mm.

7.3 Hardness properties

The Brinell hardness values of the six grades of grey cast iron specified by hardness, when measured in accordance with 9.2, shall be as given in Table 2. The number in position 3 of the designation is the maximum Brinell hardness value for a relevant wall thickness $t > 40$ mm and $t \leq 80$ mm.

If it is not possible to use the Brinell test method in accordance with ISO 6506-1, alternative test methods may be used, which shall have correlated values with Brinell hardness.

If a casting is ordered on the basis of hardness, the relevant wall thickness and the position of the test shall be agreed. Minimum and maximum Brinell hardness values, for the relevant wall thickness specified by the purchaser, shall be mandatory for the castings covered by the order.

- NOTE 1 This subclause establishes hardness grades for grey cast iron.
- NOTE 2 This classification is applicable principally where machinability or wear resistance are of importance.
- NOTE 3 For a relevant wall thickness $t > 80$ mm, grades are not classified by hardness.

Table 2 — Brinell hardness of castings of grey cast iron, mandatory and anticipated values at the agreed test position

Material designation	Relevant wall thickness t mm		Brinell hardness ^{a, b} HBW	
	$>$	\leq	min.	max.
ISO 185/JL/HBW155	40^c	80	—	155
	20	40	—	160
	10	20	—	170
	5	10	—	185
	2,5	5	—	210
ISO 185/JL/HBW175	40^c	80	100	175
	20	40	110	185
	10	20	125	205
	5	10	140	225
	2,5	5	170	260
ISO 185/JL/HBW195	40^c	80	120	195
	20	40	135	210
	10	20	150	230
	5	10	170	260
	4	5	190	275
ISO 185/JL/HBW215	40^c	80	145	215
	20	40	160	235
	10	20	180	255
	5	10	200	275
ISO 185/JL/HBW235	40^c	80	165	235
	20	40	180	255
	10	20	200	275
ISO 185/JL/HBW255	40^c	80	185	255
	20	40	200	275

NOTE 1 Information on the relationship between Brinell hardness and tensile strength is indicated in Annex B, and on the relationship between Brinell hardness and relevant wall thickness is indicated in Annex C.

NOTE 2 The figures given in bold indicate the minimum and maximum Brinell hardness, to which the material designation of the grade is related, and the corresponding reference relevant wall-thickness range limits.

^a For each grade, Brinell hardness decreases with increasing wall thickness.

^b By agreement between the manufacturer and the purchaser, a narrower hardness range may be adopted at the agreed position on the casting, provided that this is not less than 40 Brinell hardness units. An example of such a circumstance could be castings for long-series production.

^c Reference relevant wall thickness for the grade.