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Grey cast irons — Classification

Fontes à graphite lamellaire — Classification

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 25, *Cast irons and pig irons*.

This fourth edition cancels and replaces the third edition (ISO 185:2019), of which it constitutes a minor revision. The changes to the previous edition are as follows:

— Correction to typographical error for relevant wall thickness of ISO 185/JL/HBW235 in Table 2; corrected from “4” to “40”. As a result of this change, the year of publication of ISO 185 in Annex D, Table D.1, column 1, updated from 2019 to 2020 to conform with this new edition.

— Symbols for Brinell hardness and relative hardness updated to H_B and H_R, respectively, in B.2 and Figure B.1.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document deals with the classification of grey cast irons, subdivided into two groups:

— materials specified by their tensile strength;

— materials specified by their hardness.

It is also possible to specify grey cast irons by a combination of tensile strength and hardness.

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

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

For many applications, tensile strength and hardness are not the only properties of interest to casting designers. Other mechanical or physical properties can be decisive for the use of grey iron. For example:

— the thermal capacity and the thermal diffusivity for disc brakes;

— 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.

Furthermore:

— 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;

— Annex D provides cross-references of ISO 185 grade designations to other standard grades of grey cast irons.

Grey cast irons — Classification

1 Scope

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

This document specifies the characterizing properties of grey cast irons by any of the following:

a) the tensile strength of cast samples;

b) if agreed by the manufacturer and the purchaser, the tensile strength of samples cut from a casting;

c) if agreed between the manufacturer and the purchaser, the hardness of the material determined on castings or on a cast-on knob.

If agreed by the manufacturer and the purchaser, the combination of tensile strength from option a) or option b) and plus hardness from option c) can be specified. Information on specifying a combination of tensile strength and hardness is given in Annex B.

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

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

This document does not cover technical delivery conditions for grey iron castings.

NOTE General information on the engineering properties of grey cast irons is provided in ISO/TR 10809-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 945-1, *Microstructure of cast irons — Part 1: Graphite classification by visual analysis*

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

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

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 to entry: Grey cast iron is also known as “flake graphite cast iron” and, less commonly, as “lamellar graphite cast iron”.

Note 2 to entry: Graphite form, distribution and size are specified in ISO 945-1.

3.2
relevant wall thickness
section of the casting, agreed between the manufacturer and the purchaser, to which the determined mechanical properties apply

3.3
separately cast sample
sample cast in a separate sand mould under representative manufacturing conditions and material

3.4
side-by-side cast sample
sample cast in the mould alongside the casting, with a connected but separate running system

3.5
cast-on sample
sample attached directly to the casting

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.

The number in position 3 of the designation in Table 1 is the minimum tensile strength of the grade as determined by test pieces machined from standardized 30 mm test bars or from cast samples of corresponding relevant wall thickness.

The number in position 3 of the designation in Table 2 is the maximum Brinell hardness value of the grade for relevant wall thickness > 40 mm to ≤ 80 mm.

5 Order information

The following information shall be supplied by the purchaser:

a) the complete designation of the material;

b) any special requirements that 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

Unless otherwise specified by the purchaser, the method of manufacture of grey cast irons, including their chemical composition, to obtain the specified mechanical properties shall be left to the discretion of the manufacturer.

The manufacturer shall ensure that the requirements of this document are met for the material grade specified in the order.

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.

7 Requirements

7.1 Mechanical properties

The order shall specify, in an unambiguous manner, whether the characterizing property is tensile strength determined on cast samples or Brinell hardness determined on the casting, or both tensile strength and Brinell hardness.

If the order does not specify the characterizing property, then the manufacturer shall characterize the material according to tensile strength.

7.2 Tensile properties

7.2.1 General

The property values apply to grey cast irons cast in sand moulds or in moulds of comparable thermal behaviour. Subject to amendments to be agreed upon in the order, the property values may be applied to castings obtained by alternative methods.

Tensile properties are dependent upon wall thickness as shown in Table 1. For process quality assurance purposes, standardized 30 mm test bars are commonly used.

NOTE Tensile testing requires sound test pieces in order to guarantee pure uniaxial stress during the test.

7.2.2 Test pieces machined from cast samples

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

7.2.3 Test pieces cut from a casting

If test pieces are to be machined from samples cut from a casting, the manufacturer and the purchaser shall agree on:

— the locations on a casting where the samples shall be taken;

— the minimum value or the allowable range of values for the tensile properties, when determined in accordance with 9.1.

NOTE 1 The properties and the structure of castings are not uniform and depend on the complexity of the castings and their variation in section thickness.

NOTE 2 Tensile properties for test pieces machined from samples cut from a casting are affected not only by material properties (subject of this document) but also by the local casting soundness (not subject of this document).

Table 1 — Tensile strength of grey cast irons determined on test pieces machined from cast samples

Material designation	Relevant wall thickness t		Tensile strength R_m		
			in separately cast samples or side-by-side cast samples		in cast-on samples
	mm		MPa		MPa
	≥	≤	≥	≤	≥
ISO 185/JL/100	5	40	**100**	200	—
ISO 185/JL/150	2,5	5	**150**	250	—
	5	10			—
	10	20			—
	20	40			125
	40	80			110
	80	150			100
	150	300			90
ISO 185/JL/200	2,5	5	**200**	300	—
	5	10			—
	10	20			—
	20	40			170
	40	80			155
	80	150			140
	150	300			130
ISO 185/JL/225	5	10	**225**	325	—
	10	20			—
	20	40			190
	40	80			170
	80	150			155
	150	300			145

For each grade, the figure in bold indicates the minimum tensile strength to which the material designation of the grade relates, based on separately cast or side-by-side cast 30 mm test samples.

Minimum and maximum tensile strength values are mandatory for separately cast samples and for side-by-side cast samples.

Tensile strength values are mandatory for cast-on samples representing the relevant wall thickness, which shall be agreed by the manufacturer and the purchaser.

For relevant wall thicknesses greater than 300 mm, the manufacturer and the purchaser shall agree on the type and size of the cast sample and on the minimum required tensile strength value.

If a particular 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 or side-by-side cast sample;

/U = cast-on sample;

/C = sample cut from casting.

If tensile strength is specified as a characterizing property, the type of the sample should be stated in the order. If not stated in the order, the type of sample is left to the discretion of the manufacturer.

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

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

Table 1 *(continued)*

Material designation	Relevant wall thickness t		Tensile strength R_m		
			in separately cast samples or side-by-side cast samples		in cast-on samples
	mm		MPa		MPa
	≥	≤	≥	≤	≥
ISO 185/JL/250	5	10	**250**	350	—
	10	20			—
	20	40			210
	40	80			190
	80	150			170
	150	300			160
ISO 185/JL/275	10	20	**275**	375	—
	20	40			230
	40	80			210
	80	150			190
	150	300			180
ISO 185/JL/300	10	20	**300**	400	—
	20	40			250
	40	80			225
	80	150			210
	150	300			190
ISO 185/JL/350	10	20	**350**	450	—
	20	40			290
	40	80			260
	80	150			240
	150	300			220

For each grade, the figure in bold indicates the minimum tensile strength to which the material designation of the grade relates, based on separately cast or side-by-side cast 30 mm test samples.

Minimum and maximum tensile strength values are mandatory for separately cast samples and for side-by-side cast samples.

Tensile strength values are mandatory for cast-on samples representing the relevant wall thickness, which shall be agreed by the manufacturer and the purchaser.

For relevant wall thicknesses greater than 300 mm, the manufacturer and the purchaser shall agree on the type and size of the cast sample and on the minimum required tensile strength value.

If a particular 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 or side-by-side cast sample;

/U = cast-on sample;

/C = sample cut from casting.

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