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Founding - Austenitic cast irons

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Gießereiwesen - Austenitische Gusseisen

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Foreword

This document (EN 13835:2012) has been prepared by Technical Committee CEN/TC 190 "Foundry technology", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2012, and conflicting national standards shall be withdrawn at the latest by July 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. CEN [and/or] CENELEC shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13835:2002.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

Within its programme of work, Technical Committee CEN/TC 190 requested CEN/TC 190/WG 8 "High alloyed cast iron" to revise EN 13835:2002.

Annex H provides details of significant technical changes between this European Standard and the previous edition.

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According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard classifies a range of cast irons principally used for their heat and corrosion resistance properties. These properties are obtainable from the engineering grades in this European Standard. The special purpose grades also exhibit heat and corrosion resistance properties, but are used principally for their magnetic properties, or very low expansion characteristics.

The austenitic cast irons are a range of high-alloyed materials with an austenitic matrix, containing nickel, manganese and sometimes copper and chromium. Carbon is present either as graphite flakes or as spheroids. The spheroidal graphite grades have superior mechanical properties.

The properties of the austenitic cast irons depend upon them having the appropriate structure and mechanical properties for the application. These properties are dependent upon the control of metal composition within the specified grades and the metal processing route.

Typical applications for the various grades are given in Annex A.

In this European Standard a new designation system by number, as established in EN 1560 [3], is given.

NOTE This designation system by number is based on the structure and rules of EN 10027-2 [4] and so corresponds with the European numbering system for steel and other materials.

Some austenitic cast iron grades can be used for pressure equipment.

The permitted material grades of austenitic cast iron for pressure applications and the conditions for their use are given in specific product or application standards.

For the design of pressure equipment, specific design rules apply.

Annex ZA gives information relating to the conformance of permitted austenitic cast iron grades to the Pressure Equipment Directive 97/23/EC.

1 Scope

This European Standard specifies the grades and corresponding requirements for austenitic cast irons. These requirements are specified in terms of:

- graphite form and metal structure: either flake or spheroidal graphite in an austenitic matrix;
- chemical composition: as given for each of the grades;
- mechanical properties measured on machined test pieces prepared from cast samples.

This standard does not cover technical delivery conditions for iron castings, see EN 1559-1 [1] and EN 1559-3 [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.

EN 764-5:2002, *Pressure equipment — Part 5: Compliance and inspection — Documentation of materials*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN ISO 148-1:2010, *Metallic materials — Charpy impact test — Part 1: Test method (ISO 148-1:2009)*

EN ISO 945-1, *Microstructure of cast irons — Part 1: Graphite classification by visual analysis (ISO 945-1)*

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

EN ISO 6892-1:2009, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2009)*

3 Terms and definitions

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

3.1

austenitic cast iron

cast material with an austenitic matrix which is iron, carbon and silicon based and alloyed with nickel, manganese, copper and/or chromium in order to stabilize the austenitic structure at room temperature; the graphite can be present in flake or spheroidal form

3.2

cast sample

quantity of material cast to represent the cast material, including separately cast sample, side by side cast sample and cast-on sample

3.3

separately cast sample

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

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- 3.4 side-by-side cast sample**
sample cast in the mould alongside the casting, with a joint running system
- 3.5 cast-on sample**
sample attached directly to the casting
- 3.6 relevant wall thickness**
wall thickness representative of the casting defined for the determination of the size of the cast samples to which the mechanical properties apply

4 Designation

The material shall be designated either by symbol or by number as given in Tables 1 to 4.

NOTE The comparison of EN 13835 grade designations with the grades from ISO 2892:2007 [5] is given in Annex B.

5 Order information

The following information shall be supplied by the purchaser:

- a) number of this European Standard;
- b) designation of the material;
- c) relevant wall thickness; [SIST EN 13835:2012](https://standards.iteh.ai/catalog/standards/sist/dc97c98b-8415-441d-8878-3018c78d4e6b/sist-en-13835-2012)
- d) any special requirements. <https://standards.iteh.ai/catalog/standards/sist/dc97c98b-8415-441d-8878-3018c78d4e6b/sist-en-13835-2012>

All requirements shall be agreed between the manufacturer and the purchaser by the time of acceptance of the order (e.g. technical delivery conditions according to EN 1559-1 and EN 1559-3).

6 Manufacture

Unless otherwise specified by the purchaser, the method of manufacture of austenitic cast irons shall be left to the discretion of the manufacturer.

The manufacturer shall ensure that the requirements defined in this European Standard are met for the material grade specified in the order.

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

NOTE For certain applications heat treatment of austenitic cast irons is beneficial, but should only be specified where service conditions demand such treatment. The heat treatment processes employed are stress relieving and high temperature stabilising treatments. Details of these treatments are given in Annex C.

7 Requirements

7.1 Chemical composition

The chemical composition of austenitic cast iron grades shall be in accordance with Table 1 for the engineering grades and Table 2 for the special purpose grades. Spheroidal graphite grades are produced either by magnesium treatment or by treatment with another suitable nodulariser. Unless otherwise specified, other elements may be present at the discretion of the manufacturer provided that they do not alter the structure or adversely affect the properties. If the presence of any element specified in Tables 1 or 2 is required to be outside the limits indicated, or if any other elements are required, their contents shall be agreed between the manufacturer and the purchaser and specified in the order.

For information about the effect of alloying elements see Annex D.

7.2 Mechanical properties

7.2.1 General

The property values given in Tables 3 and 4 apply to austenitic cast iron cast in sand moulds or moulds of comparable thermal behaviour. Subject to amendments to be agreed upon in the order, they can apply to castings obtained by alternative methods.

Requirements regarding mechanical testing are described in 9.2 and 9.3.

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

Additional information on mechanical and physical properties is given in Annex E.

7.2.2 Test pieces machined from cast samples

The mechanical properties of the grades of austenitic cast irons obtained from cast samples with a thickness or a diameter equal to or smaller than 25 mm shall be in accordance with:

- Table 3 for austenitic spheroidal graphite cast iron grades, with specified minimum impact energy;
- Table 4 for austenitic grey iron grades and austenitic spheroidal graphite cast iron grades, without specified minimum impact energy.

The impact energy values given in Table 3 at room temperature, if applicable, shall only be determined if specified by the purchaser by the time of acceptance of the order.

Other requirements, such as the mechanical properties to be met on samples with a thickness more than 25 mm shall be agreed between the manufacturer and the purchaser and specified in the order.

7.2.3 Test pieces machined from samples cut from a casting

If applicable, the manufacturer and the purchaser shall agree on:

- location(s) on a casting where the sample(s) shall be taken;
- mechanical properties that shall be measured;
- minimum values, or allowable range of values, for these mechanical properties.

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

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NOTE 2 Mechanical properties for test pieces cut from a casting are affected not only by material properties (subject of this European Standard) but also by the local casting soundness (not subject of this European Standard).

7.2.4 Hardness

Brinell hardness and its range values for the grades listed in Tables 1 and 2 shall only be specified when agreed between the manufacturer and the purchaser by the time of acceptance of the order.

Information regarding Brinell hardness is given in Annex E.

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Table 1 — Chemical composition of austenitic cast irons — Engineering grades

Graphite form	Material designation		Chemical composition in % (mass fraction)						
	Symbol	Number	C	Si	Mn	Ni	Cr	P	Cu
Flake	EN-GJLA-XNiCuCr15-6-2	5.1500	max. 3,0	1,0 to 2,8	0,5 to 1,5	13,5 to 17,5	1,0 to 3,5	max. 0,25	5,5 to 7,5
Spheroidal	EN-GJSA-XNiCr20-2	5.3500	max. 3,0	1,5 to 3,0	0,5 to 1,5	18,0 to 22,0	1,0 to 3,5	max. 0,08	max. 0,50
	EN-GJSA-XNiMn23-4	5.3501	max. 2,6	1,5 to 2,5	4,0 to 4,5	22,0 to 24,0	max. 0,2	max. 0,08	max. 0,50
	EN-GJSA-XNiCrNb20-2 ^a	5.3502 ^a	max. 3,0	1,5 to 2,4	0,5 to 1,5	18,0 to 22,0	1,0 to 3,5	max. 0,08	max. 0,50
	EN-GJSA-XNi22	5.3503	max. 3,0	1,0 to 3,0	1,5 to 2,5	21,0 to 24,0	max. 0,5	max. 0,08	max. 0,50
	EN-GJSA-XNi35	5.3504	max. 2,4	1,5 to 3,0	0,5 to 1,5	34,0 to 36,0	max. 0,2	max. 0,08	max. 0,50
	EN-GJSA-XNiSiCr35-5-2	5.3505	max. 2,0	4,0 to 6,0	0,5 to 1,5	34,0 to 36,0	1,5 to 2,5	max. 0,08	max. 0,50

^a Good weldability of this material with: % Nb ≤ [0,353 – 0,032 (% Si + 64 × % Mg)]. The normal range of Nb is 0,12 % to 0,20 %.

Table 2 — Chemical composition of austenitic cast irons — Special purpose grades

Graphite form	Material designation		Chemical composition in % (mass fraction)						
	Symbol	Number	C	Si	Mn	Ni	Cr	P	Cu
Flake	EN-GJLA-XNiMn13-7	5.1501	max. 3,0	1,5 to 3,0	6,0 to 7,0	12,0 to 14,0	max. 0,2	max. 0,25	max. 0,5
Spheroidal	EN-GJSA-XNiMn13-7	5.3506	max. 3,0	2,0 to 3,0	6,0 to 7,0	12,0 to 14,0	max. 0,2	max. 0,08	max. 0,5
	EN-GJSA-XNiCr30-3	5.3507	max. 2,6	1,5 to 3,0	0,5 to 1,5	28,0 to 32,0	2,5 to 3,5	max. 0,08	max. 0,5
	EN-GJSA-XNiSiCr30-5-5	5.3508	max. 2,6	5,0 to 6,0	0,5 to 1,5	28,0 to 32,0	4,5 to 5,5	max. 0,08	max. 0,5
	EN-GJSA-XNiCr35-3	5.3509	max. 2,4	1,5 to 3,0	0,5 to 1,5	34,0 to 36,0	2,0 to 3,0	max. 0,08	max. 0,5

Table 3 — Mechanical properties measured at $(23 \pm 5) ^\circ\text{C}$ on test pieces machined from cast samples of austenitic spheroidal graphite cast irons — Grades with specified minimum impact energy

Graphite form	Material designation		0,2 % proof strength $R_{p0,2}$ MPa min.	Tensile strength R_m MPa min.	Elongation A % min.	Mean value of impact energy of 3 tests V-notch Charpy J min.
	Symbol	Number				
Spheroidal	EN-GJSA-XNiCr20-2	5.3500	210	370	7	13 ^a
	EN-GJSA-XNiMn23-4	5.3501	210	440	25	24
	EN-GJSA-XNiCrNb20-2	5.3502	210	370	7	13 ^a
	EN-GJSA-XNi22	5.3503	170	370	20	20
	EN-GJSA-XNi35	5.3504	210	370	20	13 ^a
	EN-GJSA-XNiSiCr35-5-2	5.3505	200	370	10	7 ^a
	EN-GJSA-XNiMn13-7	5.3506	210	390	15	16

^a Optional requirement by agreement between the manufacturer and the purchaser.