BS EN 12513:2011

BSI Standards Publication

Founding — Abrasion resistant cast irons

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National foreword

This British Standard is the UK implementation of EN 12513:2011. It supersedes BS EN 12513:2000, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/111, Steel Castings and Forgings.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 12513:2011) 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of an identical text or by endorsement, at the latest by August 2011, and conflicting national standards shall be withdrawn at the latest by August 2011.

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

This document supersedes EN 12513:2000.

Within its programme of work, Technical Committee CEN/TC 190 requested CEN/TC 190/WG 8 "High alloyed cast iron" to revise EN 12513:2000.

Annexes A, B, C, D and E are informative.

Annex F provides information about significant technical changes between this European standard and the previous edition.

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 and United Kingdom.

Introduction

This European Standard deals with the classification of abrasion resistant white cast irons in accordance with their chemical composition and hardness. Such cast irons are widely used in the mining, earth moving, milling and manufacturing industries where high resistance to abrading minerals and other abrading solids is required.

The abrasion resistance of these cast irons depends on them having the appropriate structure and hardness for the application. These properties are obtained by careful control of the material composition and the processing route.

In this edition of EN 12513, the designation by symbol is based on Brinell hardness instead of Vickers hardness, because it corresponds better with the measurement method applied in practice.

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

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

1 Scope

This European Standard defines the grades of abrasion resistant white cast irons. It specifies the grades in terms of:

— chemical composition;

— hardness.

The types of abrasion resistant white cast irons covered by this standard are:

a) unalloyed or low alloy cast irons;

b) nickel-chromium cast irons covering two general types:

   — 4 % Ni 2 % Cr cast irons;

   — 9 % Cr 5 % Ni cast irons;

c) high chromium cast irons covering four ranges of chromium content:

   — 11 % < Cr ≤ 14 %;

   — 14 % < Cr ≤ 18 %;

   — 18 % < Cr ≤ 23 %;

   — 23 % < Cr ≤ 30 %.

This European Standard does not define the abrasion resistant grades of ausferritic spheroidal graphite cast irons which are subject of EN 1564.

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 ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1:2005)*

3 Terms and definitions

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

3.1
unalloyed or low alloy abrasion-resistant cast iron
cast iron having a structure which consists of eutectic iron carbides in a predominantly pearlitic matrix

3.2
nickel-chromium abrasion-resistant cast iron
cast iron having a structure consisting of either

— simple eutectic carbides M_3C type (M = Fe, Cr) in a matrix which is predominantly martensitic, referred to as 4 % Ni 2 % Cr cast irons,

or

— complex eutectic carbides (M_7C_3 and M_3C) in a matrix which is predominantly martensitic, referred to as 9 % Cr 5 % Ni cast irons.

NOTE 1 Both of these materials can contain some bainite and retained austenite.

NOTE 2 All these grades referred to in this sub-clause are free of pearlite.

3.3
high chromium abrasion resistant cast iron
cast iron containing between 11 % and 30 % Cr having a structure consisting of complex carbides in a matrix which, in the hardened condition, is predominantly martensitic but which can also contain some austenite or other transformation products of austenite

3.4
relevant wall thickness
wall thickness representative for 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, in accordance with the designations given in Table 1 to Table 3.

NOTE Comparison of EN 12513 grade designations to the grades from the current ISO standard for abrasion resistant cast iron (ISO 21988) is given in Annex E.

5 Order information

The following information shall be supplied by the purchaser:

a) the number of this European Standard (EN 12513);

b) the designation of the material;

c) any special requirements which have to be agreed upon between the manufacturer and the purchaser by the time of the acceptance of the order (see EN 1559-1 and EN 1559-3).

6 Manufacture

6.1 General

The manufacturing methods for abrasion-resistant cast irons, unless otherwise specified by the purchaser, shall be left to the discretion of the manufacturer.

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

6.2 Heat treatment

Unless otherwise specified by the purchaser castings can be supplied in one of the following conditions:

— as-cast;

— as-cast and stress relieved;

— hardened;

— hardened and stress relieved;

— soft annealed.

When it is required to machine castings produced in the high chromium cast iron grades, they can be ordered in the soft annealed condition. When the purchaser specifies delivery in the soft annealed condition any subsequent machining or heat treatment shall be the responsibility of the purchaser.

NOTE Annex A gives guidance on the types of heat treatment which can be used to obtain the required hardness, structure and properties.

7 Requirements

7.1 Chemical composition

The chemical composition of the grades of abrasion-resistant cast iron shall be in accordance with Tables 1, 2 or 3. Unless otherwise specified by the purchaser, the manufacturer shall choose the appropriate chemical composition to obtain the required properties of the casting.

NOTE Unless otherwise specified, other elements may be present, at the discretion of the manufacturer.

7.2 Brinell hardness

The Brinell hardness of the grades of abrasion-resistant cast iron shall be in accordance with Tables 1, 2 or 3.

7.3 Microstructure

Microstructure examination, if required, shall be agreed by the time of acceptance of the order. Where a microstructure examination is agreed, the location for sampling, the methods used to examine the microstructure, and acceptance criteria shall be subject to that agreement. The microstructure examination shall be performed in accordance with 9.3.

8 Sampling

8.1 Frequency of sampling for chemical analysis

Samples representative of the material shall be produced at a frequency in accordance with the process quality assurance procedures used by the manufacturer or as agreed with the purchaser.

Samples for chemical analysis shall be cast in a manner which ensures that their representative chemical composition can be determined.

8.2 Number and frequency of Brinell hardness tests

Unless otherwise specified by the purchaser by the time of acceptance of the order, the number and frequency of Brinell hardness tests shall be in accordance with the process quality assurance procedures used by the manufacturer.

In the absence of a process quality assurance procedure or any other agreement between the manufacturer and the purchaser, a minimum of one sample shall be produced to confirm the material grade, at a frequency to be agreed between the manufacturer and the purchaser at the time of the acceptance of the order.

9 Test methods

9.1 Chemical analysis

The methods used to determine the chemical composition of the material shall be in accordance with validated methods. Any requirement for traceability shall be agreed between the manufacturer and the purchaser at the time of the acceptance of the order. The chemical analysis shall be carried out on a test sample made from the same melt as the castings the sample represents.

NOTE Optical emission spectrometry and X-ray fluorescence techniques are acceptable methods of analysis.

9.2 Hardness test

9.2.1 Brinell hardness test shall be carried out in accordance with EN ISO 6506-1, preferably using the 3 000 kgf load. Other hardness testing methods and corresponding hardness values can be agreed between the manufacturer and the purchaser.

NOTE Hardness determined by one test method is not necessarily comparable to hardness determined by other test methods. Conversions between Brinell, Vickers and Rockwell C hardness considered to be applicable to abrasion resistant cast irons are given in Annex B, for guidance only.

9.2.2 Each Brinell hardness test shall be carried out on a casting at locations agreed by the manufacturer and purchaser, or on a test block cast-on to the casting itself.

Unless otherwise specified by the purchaser, the dimensions and location of the cast-on block shall be left to the discretion of the manufacturer.

NOTE A cast-on test block can be used when the size of the casting or the number of castings to be tested makes direct testing on the castings impracticable.

9.2.3 If the test is to be carried out on a cast-on block the latter shall not be removed until after any required heat treatment has been carried out.

9.2.4 When castings are too large or too difficult to be tested in a conventional hardness testing machine or when there is need for on-line inspection of a large number of castings, a portable hardness testing device may be used. When using portable hardness testing devices, its accuracy shall be validated using a calibrated test block. The use of such devices shall be agreed upon between the manufacturer and the purchaser at the time of the acceptance of the order.

9.3 Microstructure examination

Microstructure examination shall be performed on a sample cut from a casting, or from a separately cast, side-by-side cast or cast-on sample. The sample shall have comparable solidification and cooling conditions as the critical sections of the casting.

NOTE Descriptions of typical microstructures are given for guidance in Annex D.

10 Retests

10.1 Need for retests

Retests shall be carried out if a test is not valid (see 10.2).

Retests are permitted to be carried out if a test result does not meet the specified requirements for the specified grade (see 10.3).

10.2 Test validity

A test is not valid if there is:

a) a faulty mounting of the test piece or defective operation of the test machine;

b) a defective test piece because of incorrect pouring or incorrect machining.

In the above cases, a new test piece shall be taken from the same cast sample or from a duplicate sample cast at the same time to replace those invalid test results.

The result of the retest shall be used.

10.3 Nonconforming test results

If any test gives results which do not conform to the specified requirements, for reasons other than those given in 10.2, the manufacturer shall have the option to conduct retests. If the manufacturer conducts retests, two retests shall be carried out for each failed test.

If both retests give results that meet the specified requirements, the material shall be deemed to conform to this European standard.

If one or both retests give results that fail to meet the specified requirements, the material shall be deemed not to conform to this European standard.

10.4 Heat treatment of samples and castings

Unless otherwise specified, in the case of castings in the as-cast condition with properties not in conformance with this European Standard, a heat treatment may be carried out.

In the case of castings which have undergone a heat treatment and for which the test results are not valid or not satisfactory, the manufacturer shall be permitted to re-heat treat the castings and the representative samples. In this event, the samples shall receive the same number of heat treatments as the castings.

If the results of the tests carried out on the re-heat treated samples are satisfactory, then the re-heat treated castings shall be regarded as conforming to the specified requirements of this European Standard.

The number of re-heat treatment cycles shall not exceed two.

The heat treatment terms are defined in EN 10052.

Table 1 — Brinell hardness and chemical composition of unalloyed or low alloy abrasion resistant cast iron

Material designation		Brinell hardness HBW	Chemical composition in % (mass fraction)			
Symbol	Number	min.	C	Si	Mn	Cr
EN-GJN-HB340	5.5600	340	2,4 to 3,9	0,4 to 1,5	0,2 to 1,0	max. 2,0
EN-GJN-HB400	5.5601	400	2,4 to 3,9	0,4 to 1,5	0,2 to 1,0	max. 2,0
NOTE The material designation is in accordance with EN 1560						

Table 2 — Brinell hardness and chemical composition of nickel-chromium abrasion resistant cast irons

Material designation		Brinell hardness HBW	Chemical composition in % (mass fraction)						
Symbol	Number	min.	C	Si	Mn	P max.	S max.	Ni	Cr
EN-GJN-HB480	5.5602	480	2,5 to 3,0	max. 0,8	max. 0,8	0,10	0,10	3,0 to 5,5	1,5 to 3,0
EN-GJN-HB500	5.5603	500	2,4 to 2,8	1,5 to 2,2	0,2 to 0,8	0,06	0,06	4,0 to 5,5	8,0 to 10,0
EN-GJN-HB510	5.5604	510	3,0 to 3,6	max. 0,8	max. 0,8	0,10	0,10	3,0 to 5,5	1,5 to 3,0
EN-GJN-HB555	5.5605	555	2,5 to 3,5	1,5 to 2,5	0,3 to 0,8	0,08	0,08	4,5 to 6,5	8,0 to 10,0
EN-GJN-HB630	5.5606	630	3,2 to 3,6	1,5 to 2,2	0,2 to 0,8	0,06	0,06	4,0 to 5,5	8,0 to 10,0

NOTE 1 For guidance on the relationship between relevant wall thickness and composition, see Tables C.1 and C.2.

NOTE 2 Both toughness and resistance to repeated impact increase as the carbon content decreases. Resistance to abrasion increases as the carbon content increases.

NOTE 3 For castings with alloy contents at the low end of the range and supplied in the as-cast condition or in the case of castings with greater thicknesses, it can be difficult to obtain the minimum hardness. The requirements for such castings should be agreed between the manufacturer and the purchaser.

NOTE 4 The material designation is in accordance with EN 1560.

Table 3 — Chemical composition and Brinell hardness of high chromium abrasion resistant cast irons

Material designation		Chemical composition in % (mass fraction)									Brinell hardness
		C	Si	Mn	P	S	Cr	Ni	Mo	Cu	HBW
Symbol	Number		max.		max.	max.		max.	max.	max.	min.
EN-GJN-HB555(XCr11)	5.5607	1,8 to 3,6	1,0	0,5 to 1,5	0,08	0,08	11,0 to 14,0	2,0	3,0	1,2	550
EN-GJN-HB555(XCr14)	5.5608	1,8 to 3,6	1,0	0,5 to 1,5	0,08	0,08	14,0 to 18,0	2,0	3,0	1,2	550
EN-GJN-HB555(XCr18)	5.5609	1,8 to 3,6	1,0	0,5 to 1,5	0,08	0,08	18,0 to 23,0	2,0	3,0	1,2	550
EN-GJN-HB555(XCr23)	5.5610	1,8 to 3,6	1,0	0,5 to 1,5	0,08	0,08	23,0 to 30,0	2,0	3,0	1,2	550

NOTE 1 In order to reach the required minimum hardness in the as cast condition the chemical composition for each material shall be adjusted depending on the casting dimensions and the production method. The minimum hardness values can also be met by heat treatment.

NOTE 2 The material designation by symbol is in accordance with EN 1560 with additional information in brackets regarding their chemical composition. The material designations by numbers are in accordance with EN 1560.

Annex A
(informative)

Heat treatment of abrasion resistant cast irons

A.1 Unalloyed or low alloy cast irons

Unalloyed or low alloy cast iron castings are normally supplied in the as-cast condition and do not require to be heat treated.

Should a heat treatment be required to improve machinability, this should be agreed between the manufacturer and the purchaser at the time of acceptance of the order.

A.2 Nickel chromium cast irons

A.2.1 4 % Ni 2 % Cr cast irons

4 % Ni 2 % Cr cast iron castings are frequently supplied and used in the as-cast condition. For certain applications, castings can benefit from a heat treatment at 250 °C to 300 °C for 8 h to 16 h followed by air or furnace cooling. This treatment relieves residual casting stresses.

For improved resistance to repeated impact, to help the complete breakdown of as-cast austenite, castings can be tempered at the higher temperature of 425 °C to 475 °C.

A typical cycle is as follows:

— heat treatment at 425 °C to 475 °C for 4 h to 6 h followed by air or furnace cooling; and then

— heat treatment at 250 °C to 300 °C for 8 h to 16 h followed by air or furnace cooling.

A.2.2 9 % Cr 5 % Ni cast irons

9 % Cr 5 % Ni cast iron castings can be heat treated in one of two ways depending on casting complexity.

a) For simple shapes, a single heat treatment is adequate, involving heat treatment at 800 °C to 850 °C for 6 h to 12 h followed by air or furnace cooling.

b) Where maximum resistance to repeated impact is required, castings can benefit from a heat treatment at 800 °C to 850 °C for 8 h to 16 h, followed by air or furnace cooling, followed by 250 °C to 300 °C for 8 h to 16 h followed by air or furnace cooling.

NOTE Air cooling from 850 °C to 800 °C may be undesirable for heavy sections of complex design as cracking may occur.

A.3 High chromium cast irons

A.3.1 General

High chromium cast iron castings can be supplied in either the as-cast or heat treated condition. An appropriately balanced combination of chemical composition and heat treatment is necessary for satisfactory results. Typical heat treatments are hardening, tempering and soft annealing.

NOTE A high risk of cracking exists during heat treatment of large castings, particularly with large changes in section thickness. Heating up rates less than 50 °C/h may be necessary.

A.3.2 Hardening

Hardening involves slowly heating up the casting to a defined temperature range and holding for a time appropriate to its thickness and chemical composition, followed by rapid cooling. Only simple shaped castings can be oil quenched without the risk of cracking, so rapid cooling is most frequently carried out by air/gas cooling. The air/gas cooling can be carried out by fan cooling, forced gas or atomised liquid spray techniques. It can be necessary to cool complex shaped castings in still air. In such circumstances, it is important that the material chemical composition makes provision for sufficient hardenability.

A typical hardening cycle is:

— slowly heating up to a temperature within the range of 900 °C to 1050 °C;

— holding for a determined period of time; and

— then cooling with a sufficient cooling rate.

A.3.3 Tempering

Tempering may be required in order to reduce the hardness of the material.

A typical tempering cycle involves:

— slowly heating up to a temperature within the range of 400 °C to 750 °C;

— holding for a period of time appropriate to the required hardness;

— followed by air or furnace cooling.

A.3.4 Soft annealing

If casting hardness below 380 HBW is required (e.g. to facilitate machining) soft annealing can be carried out.)

An example of a soft annealing method is:

— slowly heating up to a temperature within the range of 920 °C to 975 °C;

— holding for at least 1 h for each 25 mm of thickness;

— then slowly cooling down in the furnace to about 810 °C; and

— then further cooling down to 600 °C at a rate not exceeding 55 °C/h;

— followed by air or furnace cooling.

NOTE Instead of slowly cooling the casting through the transition temperature are, a fixed holding temperature may be used for an appropriate time interval.

A.3.5 Annealing

Casting in as-cast condition can be annealed in order to transform any retained austenite to martensite.

A typical annealing cycle involves:

— slowly heating up to a temperature within the range of 200 °C to 500 °C;

— holding for at least 4 h;

— followed by air or furnace cooling.

A.3.6 Stress relieving

If the castings require reduced internal stresses a stress relieving treatment should be made.

— slowly heating up to a temperature of 400 °C to 500 °C;

— holding for at least 1 h for each 25 mm of thickness;

— then slowly cooling down in the furnace to about 200 °C.

Annex B
(informative)

Conversion between Brinell, Vickers and Rockwell C hardness

Table B.1 shows approximate hardness conversions between Brinell, Vickers and Rockwell C according to the cast iron table of EN ISO 18265.

Table B.1 — Approximate conversions between Brinell, Vickers and Rockwell C hardness for abrasion resistant cast irons

Brinell[a] HBW	Vickers[b] HV	Rockwell C HRC
333	350	35,5
380	400	40,8
428	450	45,3
475	500	49,1
494	520	50,5
523	550	52,3
570	600	55,2
618	650	57,8
–	700	60,1
–	750	62,2

[a] The maximum hardness range for the Brinell hardness test is 650 HBW according to EN ISO 6506-1.

[b] Unless otherwise agreed, the minimum scale to be used is HV 30.

Annex C
(informative)

Relationship between relevant wall thickness and chemical composition for nickel-chromium cast irons

Annex C gives the relationship between relevant wall thickness and chemical composition for nickel-chromium cast irons.

Tables C.1 and C.2 show typical chemical compositions, which ensure the formation of a white cast iron and a pearlite-free matrix structure in castings of various thickness.

Table C.1 — Relationship between relevant wall thickness and chemical composition for nickel-chromium abrasion resistant cast irons (4 % Ni 2 % Cr cast irons)

Relevant wall thickness t	**Chemical composition in % (mass fraction)**			
mm	Si	Mn	Ni	Cr
$t \leq 25$	0,50	0,40	3,4	1,8
$25 < t \leq 50$	0,40	0,50	3,8	2,0
$50 < t \leq 100$	0,40	0,50	4,2	2,5
$100 < t$	0,40	0,60	4,5	3,0
NOTE Higher nickel contents should be used if thicknesses significantly above 100 mm are involved.				

Table C.2 — Relationship between relevant wall thickness and chemical composition for nickel-chromium abrasion resistant cast irons (9 % Cr 5 % Ni cast irons)

Relevant wall thickness t	**Chemical composition in % (mass fraction)**			
mm	Si	Mn	Ni	Cr
$t \leq 25$	1,90	0,40	4,5	8,5
$25 < t \leq 50$	1,80	0,50	5,0	9,0
$50 < t \leq 100$	1,80	0,50	5,0	9,0
$100 < t$	1,60	0,60	5,5	9,5
NOTE Higher nickel contents should be used if thicknesses significantly above 100 mm are involved.				

Annex D
(informative)

Typical microstructures of abrasion resistant cast irons

D.1 Unalloyed or low alloyed abrasion-resistant cast irons

The microstructure consists of continuous hard iron carbides and pearlite. The structure is normally free of graphite except where its occurrence is unavoidable, as in heavy slow cooled sections, or where its presence is specifically requested or permitted by the purchaser.

D.2 Nickel-chromium abrasion-resistant cast irons

The microstructure consists of either eutectic carbides M_3C or complex carbides M_7C_3 and M_3C (M = Fe, Cr) in a matrix which consists mainly of martensite and possibly some bainite, together with some retained austenite.

D.3 High chromium abrasion-resistant cast irons

The microstructure exhibits two general types:

a) Hypoeutectic, consisting of eutectic carbides in a matrix of primary austenitic dendrites and eutectic austenite.

   During hardening, the austenite phase transforms to predominantly martensite containing a fine dispersion of secondary carbides. The structure may also contain retained austenite, and other transformation products of austenite.

b) Hypereutectic, consisting of primary carbides and eutectic carbides in an eutectic austenite matrix.

   During hardening, the austenite phase transforms to predominantly martensite containing a fine dispersion of secondary carbides. The structure may also contain retained austenite, and other transformation products of austenite.

Annex E
(informative)

Comparison of abrasion resistant cast iron material designations according to EN 1560 and ISO/TR 15931

This informative annex compares the material designation of the standardized grades based on the ISO and EN designation systems.

Table E.1 — Material designations of abrasion resistant cast irons

EN 12513:2010		EN 12513:2000		ISO 21988:2005
Symbol	Number	Symbol	Number	
EN-GJN-HB340	5.5600	EN-GJN-HV350	EN-JN2019	ISO 21988/JN/HBW340
EN-GJN-HB400	5.5601	—	EN-JN2059	ISO 21988/JN/HBW400
EN-GJN-HB480	5.5602	EN-GJN-HV520	EN-JN2029	ISO 21988/JN/HBW480Cr2
EN-GJN-HB500	5.5603	—	EN-JN2069	ISO 21988/JN/HBW500Cr9
EN-GJN-HB510	5.5604	EN-GJN-HV550	EN-JN2039	ISO 21988/JN/HBW510Cr2
EN-GJN-HB555	5.5605	EN-GJN-HV600	EN-JN2049	ISO 21988/JN/HBW555Cr9
EN-GJN-HB630	5.5606	—	EN-JN2079	ISO 21988/JN/HBW630Cr9
EN-GJN-HB555(XCr11)	5.5607	EN-GJN-HV600(XCr11)	EN-JN3019	ISO 21988/JN/HBW555XCr13
EN-GJN-HB555(XCr14)	5.5608	EN-GJN-HV600(XCr14)	EN-JN3029	ISO 21988/JN/HBW555XCr16
EN-GJN-HB555(XCr18)	5.5609	EN-GJN-HV600(XCr18)	EN-JN3039	ISO 21988/JN/HBW555XVCr21
EN-GJN-HB555(XCr23)	5.5610	EN-GJN-HV600(XCr23)	EN-JN3049	ISO 21988/JN/HBW555XCr27

Annex F
(informative)

Significant technical changes between this European Standard and its previous edition

This European Standard includes the following significant technical changes compared to the previous edition:

Clause/Paragraph/Table/Figure	Change
Introduction	The designation by symbol is based now on Brinell hardness instead of Vickers hardness.
2	Normative references have been modified.
3.2 and 3.3	Have been modified.
3.4	Definition for "relevant wall thickness" added.
6.1 and 6.2	Have been modified.
7.1 and 7.2	Have been modified.
7.1, Table 1	Material grade EN-GJN-HB400 (5.5601) has been added
7.1, Table 2	Material grades EN-GJN-HB500 (5.5603) and EN-GJN-HB630 (5.5606) have been added.
7.3	Requirements for "Microstructure" added.
9.1 and 9.2	Have been modified
9.3	"Microstructure examination" added.
10	Completely revised.
Annex A	Modified and sub-clauses "A.3.5 Annealing" and "A.3.6 Stress relieving" added
Annex B	Values for Brinell and Rockwell hardness in Table B.1 modified.
Annexes D, E and F	Added.
Bibliography	Added
NOTE The technical changes referred include the significant technical changes from the EN revised but is not a exhaustive list of all modifications from the previous version.	

Bibliography

[1] EN 1559-1, *Founding — Technical conditions of delivery — Part 1: General*

[2] EN 1559-3, *Founding — Technical conditions of delivery — Part 3: Additional requirements for iron castings*

[3] EN 1560, *Founding — Designation system for cast iron — Material symbols and material numbers*

[4] EN 1564, *Founding — Austempered ductile cast irons*

[5] EN 10052, *Vocabulary of heat treatment terms for ferrous products*

[6] EN ISO 6507-1, *Metallic materials - Vickers hardness test — Part 1: Test method (ISO 6507-1:2005)*

[7] EN ISO 18265, *Metallic materials — Conversion of hardness values (ISO 18265:2003)*

[8] EN ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T) (ISO 6508-1:2005)*

[9] ISO 21988, *Abrasion-resistant cast irons — Classification*

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

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