

# **Founding — Grey cast irons**

**Replaces DIN 1691;1985-05 and DIN 50109;1989-04**

The European Standard EN 1561 : 1997 has the status of a  
British Standard

ICS 77.140.80

## National foreword

This British Standard is the English language version of EN 1561 : 1997. It supersedes BS 1452 : 1990, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/35, Cast iron, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

### Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or by using the 'Find' facility of the BSI Standards Electronic Catalogue.

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English version

## Founding — Grey cast irons

Fonderie — Fonte à graphite lamellaire

Gießereiwesen — Gußeisen mit Lamellengraphit

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**CEN**

European Committee for Standardization  
Comité Européen de Normalisation  
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

## Foreword

This European Standard 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of an identical text or by endorsement, at the latest by December 1997, and conflicting national standards shall be withdrawn at the latest by December 1997.

Within its programme of work, Technical Committee CEN/TC 190 requested CEN/TC 190/WG 2.10, Grey cast iron, to prepare the following standard:

EN 1561 *Founding — Grey cast irons*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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## Introduction

Grey cast iron is a casting alloy, iron and carbon based, the latter element being present mainly in the form of lamellar graphite particles.

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

This European Standard deals with the classification of grey cast iron in accordance with the mechanical properties of the material, either tensile strength or hardness.

Further technical data on grey cast irons are given in annexes A to C.

Annex A (informative) contains 'additional information on mechanical and physical properties in addition to tables 1 and 2'.

Annex B (informative) contains 'additional information on the relationship between hardness and tensile strength'.

Annex C (informative) contains 'additional information on the relationship between tensile strength, hardness and section thickness of grey iron castings'.

NOTE. This standard does not cover technical delivery conditions for grey iron castings. Reference should be made to EN 1559-1 and EN 1559-3.

## 1 Scope

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

This 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 by the time of acceptance of the order, of cast-on samples or samples cut from a casting (see table 1); or
- b) if agreed by the manufacturer and the purchaser by the time of acceptance of the order, the hardness of the material measured on castings (see table 2) or on a cast-on knob.

This European Standard does not apply to grey cast iron used for pipes and fittings according to prEN 877-1.

This European Standard specifies six grey cast irons according to the tensile strength (see table 1) and six grey cast irons according to the Brinell hardness (see table 2).

## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1559-1	<i>Founding — Technical conditions of delivery — Part 1: General</i>
EN 1559-3	<i>Founding — Technical conditions of delivery — Part 3: Additional requirements for iron castings</i>
EN 10002-1	<i>Metallic materials — Tensile testing — Part 1: Method of test (at ambient temperature)</i>
EN 10003-1	<i>Metallic materials — Brinell hardness test — Part 1: Test method</i>

NOTE. Informative references used in the preparation of this standard, and cited at the appropriate places in the text, are listed in a bibliography, see annex D.

## 3 Definitions

For the purposes of this standard, the following definitions apply:

### 3.1 grey cast iron

Iron-carbon cast material in which the free carbon is present as graphite, mainly in lamellar form (flake graphite).

NOTE. Graphite form and distribution are specified in EN ISO 945.

### 3.2 relative hardness

Quotient of measured hardness to the hardness calculated from the measured tensile strength by means of an empirical relationship (also referred to as RH).

NOTE. RH is influenced mainly by the raw materials, the melting process and the metallurgical working method and usually varies between 0,8 and 1,2.

### 3.3 relevant wall thickness

Wall thickness for which the mechanical properties apply.

NOTE. The relevant wall thickness is twice the modulus or twice the volume/surface area ratio.

## 4 Designation

The material shall be designated either by symbol or by number as given in either table 1 or table 2.

## 5 Order information

The following information shall be supplied by the purchaser:

- a) the number of this European Standard (EN 1561);
- b) the designation of the material;
- c) any special requirements which have to be agreed by the time of acceptance of the order (see EN 1559-1 and EN 1559-3).

## 6 Manufacture

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

NOTE. 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 by the time of acceptance of the order.

## 7 Requirements

### 7.1 Mechanical properties

In addition to EN 1559-1 and EN 1559-3 the order should specify in an unambiguous manner as to 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.

The characterizing property shall be checked only when this has been agreed by the time of acceptance of the order.

### 7.2 Tensile properties

#### 7.2.1 Test pieces machined from separately cast samples

The tensile properties of the six grey cast irons defined 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.

#### 7.2.2 Test pieces machined from cast-on samples

The tensile properties of test pieces machined from cast-on samples for the six grey cast irons 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 six grey cast irons defined by tensile strength shall be agreed between the manufacturer and the purchaser by the time of acceptance of the order, and these tensile properties shall be in accordance with the requirements in the agreement.

### 7.3 Hardness properties

The Brinell hardness values of the six grey cast irons defined by hardness when measured in accordance with 9.2 shall be as given in table 2.

If it is not possible to use the Brinell test method in accordance with EN 10003-1 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 upon by the time of the acceptance of the order. The values given for wall thicknesses over 40 mm and up to and including 80 mm in table 2 against the various grades shall be mandatory hardness values for that wall thickness range.

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. The hardness values given for smaller thickness ranges  $\leq 40$  mm are anticipated values only.

NOTE 4. For a relevant wall thickness above 80 mm, grades are not classified by hardness.

Material designation		Relevant wall thickness <sup>1)</sup>		Tensile strength $R_m$ <sup>2)</sup> mandatory values		Tensile strength $R_m$ <sup>4)</sup> anticipated values in casting <sup>5)</sup>
		mm		N/mm <sup>2</sup>		N/mm <sup>2</sup>
Symbol	Number	over	up to and including	in separately cast sample <sup>3)</sup>	in cast-on sample (min.)	(min.)
EN-GJL-100	EN-JL1010	5 <sup>6)</sup>	40	100 to 200 <sup>7)</sup>	—	—
EN-GJL-150	EN-JL1020	2,5 <sup>6)</sup>	5	150 to 250 <sup>7)</sup>	—	180
		5	10		—	155
		10	20		—	130
		20	40		120	110
		40	80		110	95
		80	150		100	80
EN-GJL-200	EN-JL1030	150	300	200 to 300 <sup>7)</sup>	90 <sup>5)</sup>	—
		2,5 <sup>6)</sup>	5		—	230
		5	10		—	205
		10	20		—	180
		20	40		170	155
		40	80		150	130
EN-GJL-250	EN-JL1040	80	150	250 to 350 <sup>7)</sup>	140	115
		150	300		130 <sup>5)</sup>	—
		5 <sup>6)</sup>	10		—	250
		10	20		—	225
		20	40		210	195
		40	80		190	170
EN-GJL-300	EN-JL1050	80	150	300 to 400 <sup>7)</sup>	170	155
		150	300		160 <sup>5)</sup>	—
		10 <sup>6)</sup>	20		—	270
		20	40		250	240
		40	80		220	210
		80	150		210	195
EN-GJL-350	EN-JL1060	150	300	350 to 450 <sup>7)</sup>	190 <sup>5)</sup>	—
		10 <sup>6)</sup>	20		—	315
		20	40		290	280
		40	80		260	250
		80	150		230	225
		150	300		210 <sup>5)</sup>	—

<sup>1)</sup> If a cast-on sample is to be used the relevant wall thickness of the casting shall be agreed upon by the time of acceptance of the order.

<sup>2)</sup> If by the time of acceptance of the order proving of the tensile strength has been agreed, the type of the sample is also to be stated on the order (see 8.2). If there is lack of agreement the type of sample is left to the discretion of the manufacturer.

<sup>3)</sup> For the purpose of acceptance the tensile strength of a given grade shall be between its nominal value  $n$  (position 5 of the material symbol) and  $(n+100)$  N/mm<sup>2</sup>.

<sup>4)</sup> This column gives guidance to 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.

<sup>5)</sup> These values are guideline values. They are not mandatory.

<sup>6)</sup> This value is included as the lower limit of the relevant wall thickness range.

<sup>7)</sup> The values relate to samples with an as-cast casting diameter of 30 mm, this corresponds to a relevant wall thickness of 15 mm.

NOTE 1. 1 N/mm<sup>2</sup> is equivalent to 1 MPa.

NOTE 2. For high damping capacity and thermal conductivity, EN-GJL-100 (EN-JL1010) is the most suitable material.

NOTE 3. The material designation is in accordance with EN 1560.

NOTE 4. The figures given in bold indicate the minimum tensile strength to which the symbol of the grade is related.

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

Material designation		Relevant wall thickness mm		Brinell hardness <sup>1)2)</sup> HB 30	
Symbol	Number	over	up to and including	min.	max.
EN-GJL-HB155	EN-JL2010	<b>40<sup>3)</sup></b>	<b>80</b>	—	<b>155</b>
		20	40	—	160
		10	20	—	170
		5	10	—	185
		2,5	5	—	210
EN-GJL-HB175	EN-JL2020	<b>40<sup>3)</sup></b>	<b>80</b>	<b>100</b>	<b>175</b>
		20	40	110	185
		10	20	125	205
		5	10	140	225
		2,5	5	170	260
EN-GJL-HB195	EN-JL2030	<b>40<sup>3)</sup></b>	<b>80</b>	<b>120</b>	<b>195</b>
		20	40	135	210
		10	20	150	230
		5	10	170	260
		4	5	190	275
EN-GJL-HB215	EN-JL2040	<b>40<sup>3)</sup></b>	<b>80</b>	<b>145</b>	<b>215</b>
		20	40	160	235
		10	20	180	255
		5	10	200	275
EN-GJL-HB235	EN-JL2050	<b>40<sup>3)</sup></b>	<b>80</b>	<b>165</b>	<b>235</b>
		20	40	180	255
		10	20	200	275
EN-GJL-HB255	EN-JL2060	<b>40<sup>3)</sup></b>	<b>80</b>	<b>185</b>	<b>255</b>
		20	40	200	275

<sup>1)</sup> For each grade, Brinell hardness decreases with increasing wall thickness.

<sup>2)</sup> 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.

<sup>3)</sup> Reference relevant wall thickness for the grade.

NOTE 1. Information on the relationship between Brinell hardness and tensile strength is indicated in figure B.1 and the relationship between Brinell hardness and relevant wall thickness in figure C.2 of annexes B and C respectively.

NOTE 2. The material designation is in accordance with EN 1560.

NOTE 3. The figures given in bold indicate the minimum and maximum Brinell hardness, to which the symbol of the grade is related and the corresponding reference relevant wall thickness range limits.

## 8 Sampling

### 8.1 General

Samples shall be supplied in order to characterize the grade of the material.

If heat treatment is used to modify the properties of the material, then the samples shall be heat treated in the same way as the castings they represent.

### 8.2 Tensile test

#### 8.2.1 Separately cast samples

The separately cast samples to establish the material grade shall be cast vertically (see figure 1). The moulds shall be either sand moulds or moulds with comparable thermal diffusivity. The moulds may be made for casting several samples simultaneously. The length  $L$  shall be determined according to the length of the test piece A or B (see 9.1) and the clamping device used.

Other dimensions of the mould shall meet the dimensional requirements of figure 1.

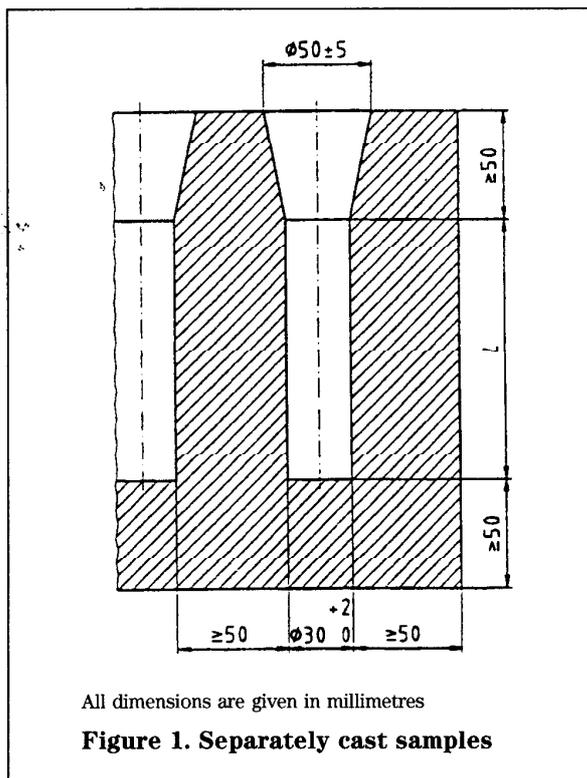


Figure 1. Separately cast samples

Samples of other dimensions and using other casting procedures may be agreed between the manufacturer and the purchaser for the purpose of representing the properties of particular castings (an indication of the likely values of tensile strength is given in figure C.1).

Samples shall be made from the metal used to produce the castings which they represent and during the same period as when the castings are made.

The frequency of casting the separately cast samples shall be in accordance with the in-process quality assurance procedures adopted by the manufacturer.

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

NOTE. However, the samples may by agreement between the manufacturer and the purchaser be taken from their moulds at a temperature in excess of 500 °C, if the castings are also to be removed at this temperature.

#### 8.2.2 Cast-on samples

The test pieces used for the tests specified in clause 7 shall be machined from a cast-on sample, as indicated in figures 2 or 3. The test pieces shall be in accordance with 7.2.2. The type of sample shall be chosen in such a way as to provide approximately the same cooling conditions as for the casting to be represented. The type of sample and the location of the sample on the casting shall be agreed between the manufacturer and the purchaser. If there is no such agreement, the manufacturer shall decide on the type of sample and it shall be located at a representative position on the casting.

NOTE 1. Two possible sets of sizes are shown in figures 2 and 3, with the larger test piece size option being shown in brackets. The small size set is used for castings less than 80 mm wall thickness and the large size set is used for castings equal to or greater than 80 mm wall thickness.

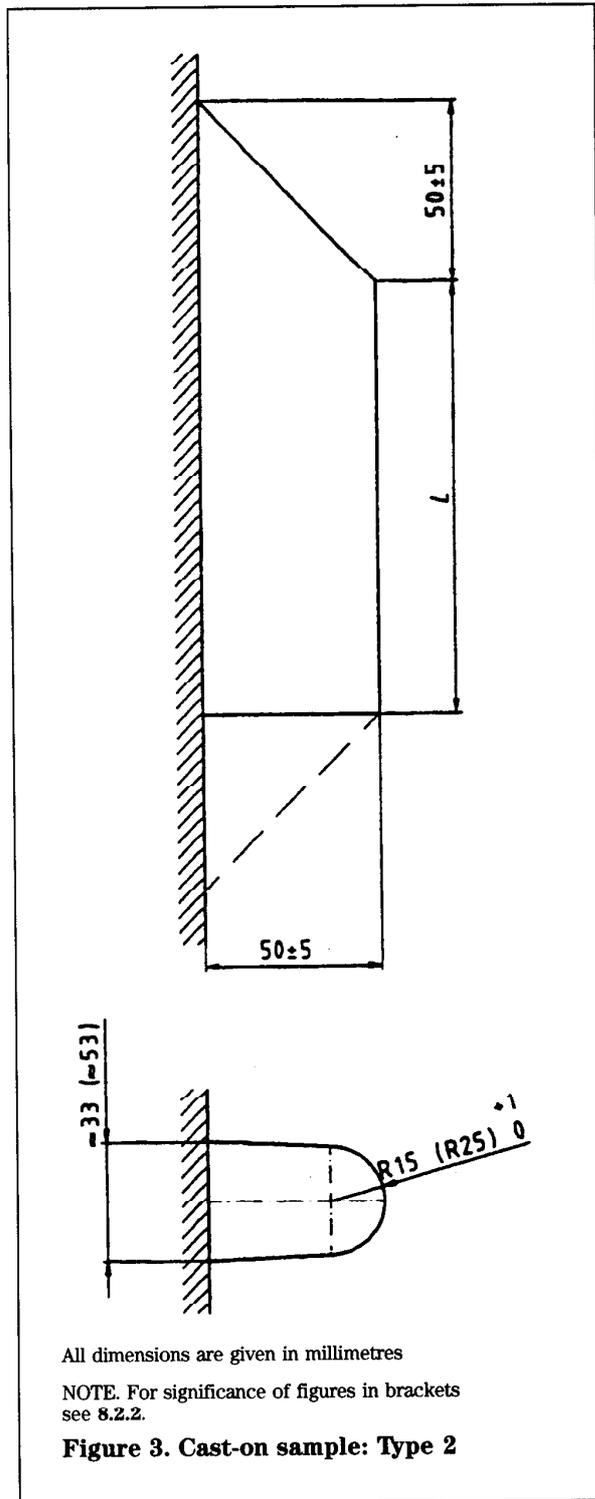
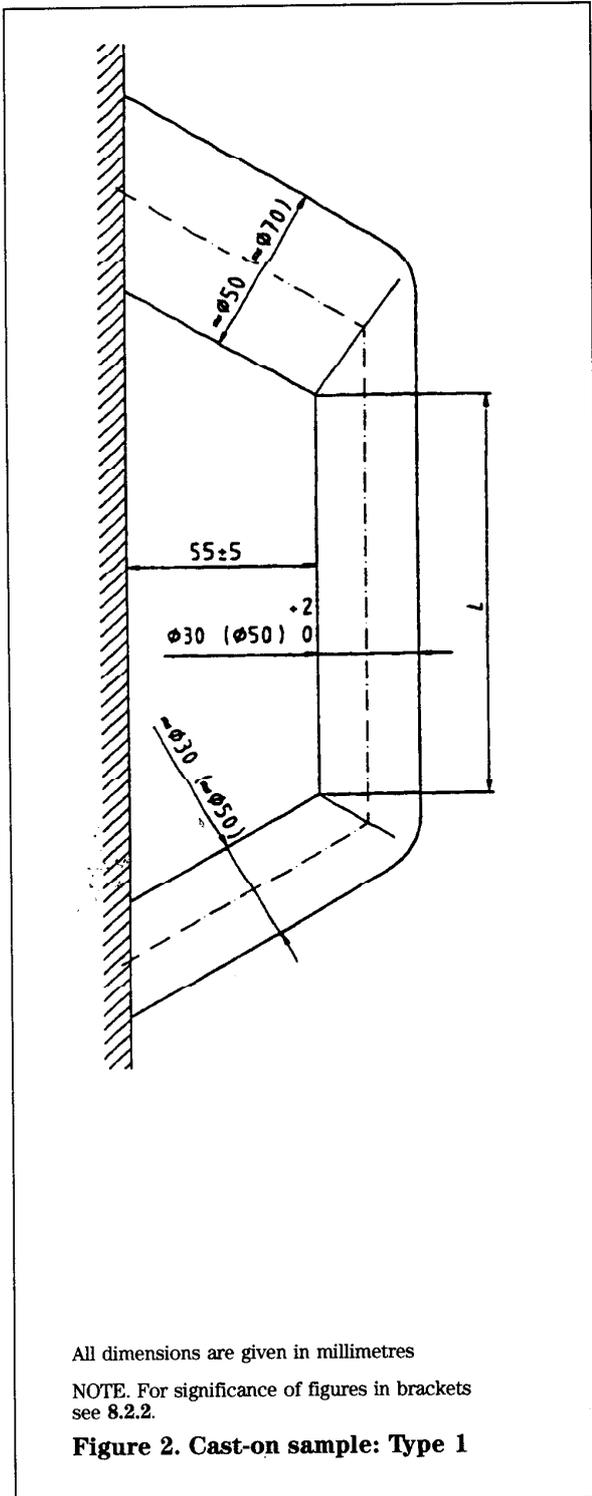
The length  $L$  shall be determined according to the length of the test piece and the clamping device.

NOTE 2. Cast-on samples should only be used when a casting is more than 20 mm thick and the mass is more than 200 kg.

#### 8.2.3 Test pieces cut from a casting

Table 1 shows anticipated minimum values of tensile strength for test pieces cut from a casting with uniform section of simple shape.

NOTE. Values obtained in castings of variable wall thickness can differ from those given in table 1.



### 8.3 Hardness test

Hardness tests may be carried out on the separately cast samples described in 8.2.1.

Alternatively, the Brinell hardness test may be carried out, by agreement between the manufacturer and the purchaser, on a test piece ('Brinell knob') which is cast on to the casting as shown in figure 4. The position of the Brinell knob, and its size and shape, shall be agreed between the manufacturer and purchaser by the time of acceptance of the order.

In order to carry out the Brinell hardness test, the test piece is removed from the casting, ground on the cut surface and then tested on the ground surface.

If the casting is heat-treated, the Brinell knob shall not be detached from the casting until the heat-treatment process has been concluded.

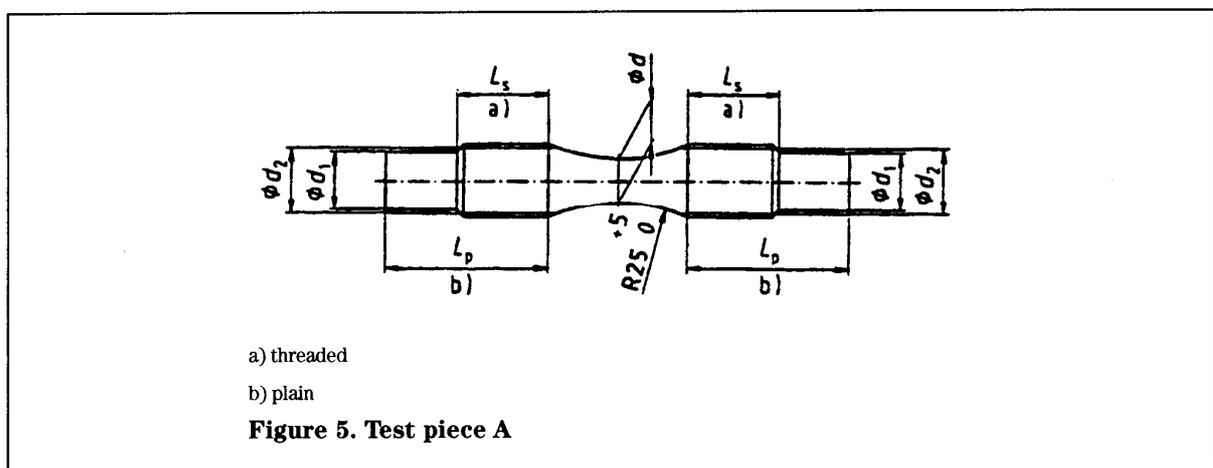
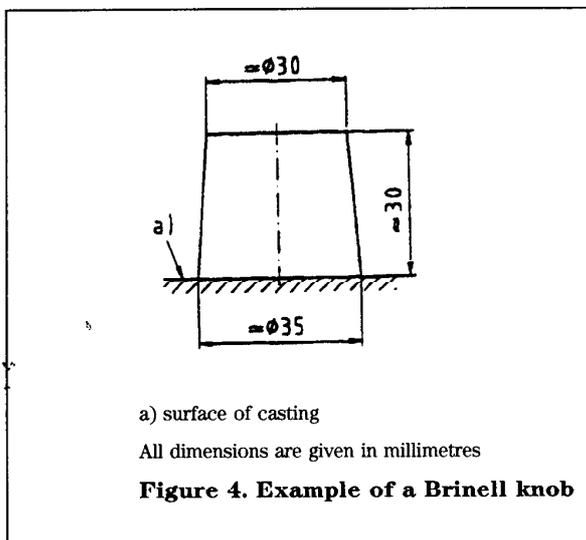
## 9 Test methods

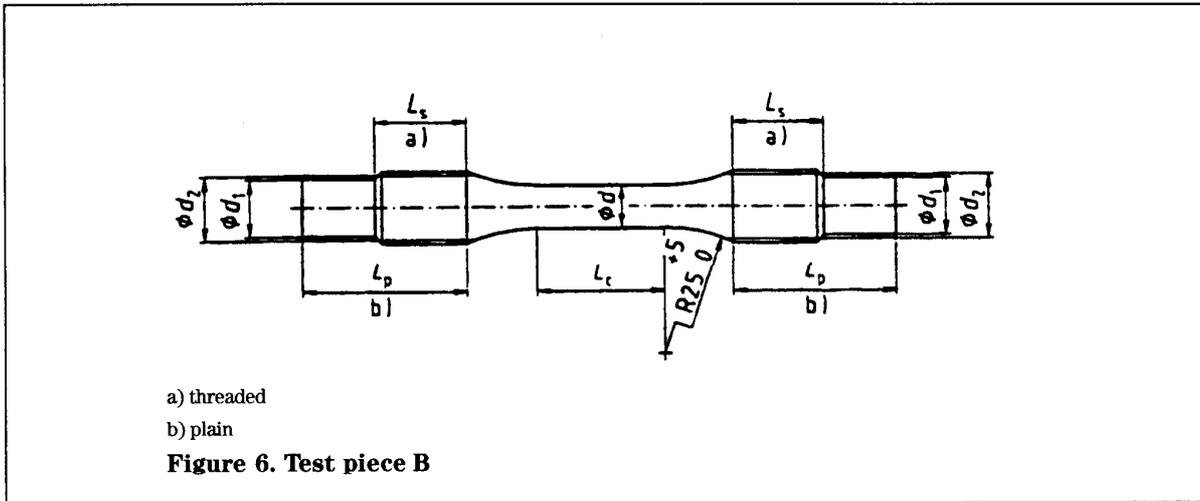
### 9.1 Tensile test

The tensile test shall be carried out in accordance with the requirements of EN 10002-1, using a test piece in conformance either with figure 5 or figure 6.

The dimensions of the test piece shall conform to the dimensions given in table 3. The gripped parts may be either threaded or plain to suit the clamping device.

NOTE. For the same material, the results achieved using test piece A (symbols table 3) can be slightly higher than those achieved by using test piece B.





**Table 3. Dimensions of test pieces A and B**

					Values in millimetres
Diameter $d^1$	Thread type for threaded test pieces <sup>2)</sup>	Thread length $L_s^2)$	Diameter $d_1$ for plain ends <sup>2)</sup>	Threaded test piece A total length	Test piece B parallel length $L_c$
$6 \pm 0,1$	M10	13	8	46	18
$8 \pm 0,1$	M12	16	10	53	24
$10 \pm 0,1$	M16	20	12	63	30
$12,5 \pm 0,1$	M20	24	15	73	36,5
$16 \pm 0,1$	M24	30	20	87	48
<b><math>20 \pm 0,1</math></b>	<b>M30</b>	<b>36</b>	<b>23</b>	<b>102</b>	<b>60</b>
$25 \pm 0,1$	M36	44	30	119	75
$32 \pm 0,1$	M45	55	40	143	96

<sup>1)</sup> The cross-sectional area  $S_0$  shall be calculated.  
<sup>2)</sup> Recommended dimensions.  
 NOTE 1.  $L_p > L_s$ , to suit clamping device.  
 NOTE 2. The row in bold indicates the preferred dimensions for the test pieces.

**9.2 Brinell hardness test**

The Brinell hardness test, if required, shall be carried out at an agreed position on the casting in accordance with the requirements of EN 10003-1.

**10 Retests**

The test shall be disregarded if unacceptable results are obtained which are due not to the quality of the cast iron itself, but to any of the following reasons:

- a) faulty mounting of the test piece or defective operation of the testing machine;
- b) defective sample or machining of the test piece;
- c) casting defects in the test piece, revealed after fracture.

In the above cases, a new test piece shall be taken from the same test unit and the results obtained substituted for those of the defective test piece. Should the tensile test fail to meet the specified minimum tensile strength requirements, other than for the reasons given above, two retests shall be carried out.

If both retests pass, the material shall be deemed to conform to this European Standard.

If one or both retests fail to meet the specified minimum tensile strength requirement, the material shall be deemed not to conform to this European Standard.

**Annex A (informative)**

**Additional information on mechanical and physical properties in addition to that given in tables 1 and 2**

Information on mechanical properties is given in table A.1.

Information on physical properties is given in table A.2.

If agreed by the manufacturer and the purchaser by the time of acceptance of the order alternative test procedures may be used, for example wedge penetration test for assessment of tensile strength.

Table A.1 Mechanical properties in separately cast test pieces with 30 mm as-cast casting diameter

Characteristic	Symbol	SI unit	Material designation <sup>1)</sup>				Bibliographical references (see annex D)
			EN-GJL-150 (EN-JL1020)	EN-GJL-200 (EN-JL1030)	EN-GJL-250 (EN-JL1040)	EN-GJL-300 (EN-JL1050)	
		Basic structure					
		ferritic/pearlitic	pearlitic				
Tensile strength	$R_m$	N/mm <sup>2</sup>	150 to 250	200 to 300	250 to 350	300 to 400	350 to 450
0,1 % proof stress	$R_{p0,1}$	N/mm <sup>2</sup>	98 to 165	130 to 195	165 to 228	195 to 260	228 to 285
Elongation	$A$	%	0,8 to 0,3	0,8 to 0,3	0,8 to 0,3	0,8 to 0,3	0,8 to 0,3
Compression strength	$\sigma_{db}$	N/mm <sup>2</sup>	600	720	840	960	1080
0,1 % compression yield point	$\sigma_{d0,1}$	N/mm <sup>2</sup>	195	260	325	390	455
Bending strength	$\sigma_{bB}$	N/mm <sup>2</sup>	250	290	340	390	490
Shear strength	$\sigma_{aB}$	N/mm <sup>2</sup>	170	230	290	345	400
Torsional strength <sup>2)</sup>	$\tau_{tB}$	N/mm <sup>2</sup>	170	230	290	345	400
Modulus of elasticity <sup>3)</sup>	$E$	kN/mm <sup>2</sup>	78 to 103	88 to 113	103 to 118	108 to 137	123 to 143
Poisson's ratio	$\nu$	—	0,26	0,26	0,26	0,26	0,26
Bending fatigue strength <sup>4)</sup>	$\sigma_{bW}$	N/mm <sup>2</sup>	70	90	120	140	145
Fatigue limit under reversed tension-compression stresses <sup>5)</sup>	$\sigma_{zdW}$	N/mm <sup>2</sup>	40	50	60	75	85
Fracture toughness	$K_{Ic}$	N/mm <sup>3/2</sup>	320	400	480	560	650

1) When there are special requirements relating to machinability or magnetic properties, then EN-GJL-100 (EN-JL1010) is used. The required properties can be obtained by means of a structure-changing heat-treatment process EN-GJL-100 (EN-JL1010) is not cited here.

2) Torsional fatigue strength  $\tau_{tW} \approx 0,42 \times R_m$  [3].

3) Depends on the quantity and form of the graphite as well as on the loading.

4) The following approximately applies:  $\sigma_{bW} \approx 0,35 - 0,50 \times R_m$  [3].

5) The following approximately applies:  $\sigma_{zdW} \approx 0,53 \times \sigma_{bW} \approx 0,26 \times R_m$  [3].

NOTE. 1 N/mm<sup>2</sup> is equivalent to 1 MPa.

Table A.2 Physical properties in separately cast test pieces with 30 mm as-cast casting diameter									
Characteristic	Symbol	SI unit	Material designation <sup>1)</sup>					Bibliographical references (see annex D)	
			EN-GJL-150 (EN-JL1020)	EN-GJL-200 (EN-JL1030)	EN-GJL-250 (EN-JL1040)	EN-GJL-300 (EN-JL1050)	EN-GJL-350 (EN-JL1060)		
Density	$\rho$	g/cm <sup>3</sup>	7,10	7,15	7,20	7,25	7,30	—	
Specific heat capacity between 20 °C and 200 °C between 20 °C and 600 °C	$c$	J/(kg·K)	460						[5]
			535						
Linear expansion coefficient between -100 °C and +20 °C between 20 °C and 200 °C between 20 °C and 400 °C	$\alpha$	mm/(m·K)	10,0						[5]
			11,7						
			13,0						
Thermal conductivity at 100 °C at 200 °C at 300 °C at 400 °C at 500 °C	$\lambda$	W/(m·K)	52,5	50,0	48,5	47,5	45,5	[5]	
			51,0	49,0	47,5	46,0	44,5		
			50,0	48,0	46,5	45,0	43,5		
			49,0	47,0	45,0	44,0	42,0		
			48,5	46,0	44,5	43,0	41,5		
Resistivity	$\rho$	$\Omega \cdot \text{mm}^2/\text{m}$	0,80	0,77	0,73	0,70	0,67	[5]	
Coercivity	$H_0$	A/m	560 to 720					[5], [6]	
Maximum permeability	$\mu$	$\mu\text{H}/\text{m}$	220 to 330					[5], [6]	
Hysteresis losses at $B = 1\text{T}$		J/m <sup>3</sup>	2 500 to 3 000					[5], [6]	

<sup>1)</sup> When there are special requirements relating to machinability or magnetic properties, then EN-GJL-100 (EN-JL1010) is used. The required properties can be obtained by means of a structure-changing heat-treatment process. EN-GJL-100 (EN-JL1010) is not cited here.

**Annex B (informative)**

**Additional information on the relationship between hardness and tensile strength**

Hardness and tensile strength as well as Young's modulus and the modulus of rigidity of grey cast iron of a given grade are approximately related to each other. In most cases, an increase in the value of one property results in an increase in the values of other properties [7] to [9] (see annex D). The following empirical relationship between hardness and tensile strength exists:

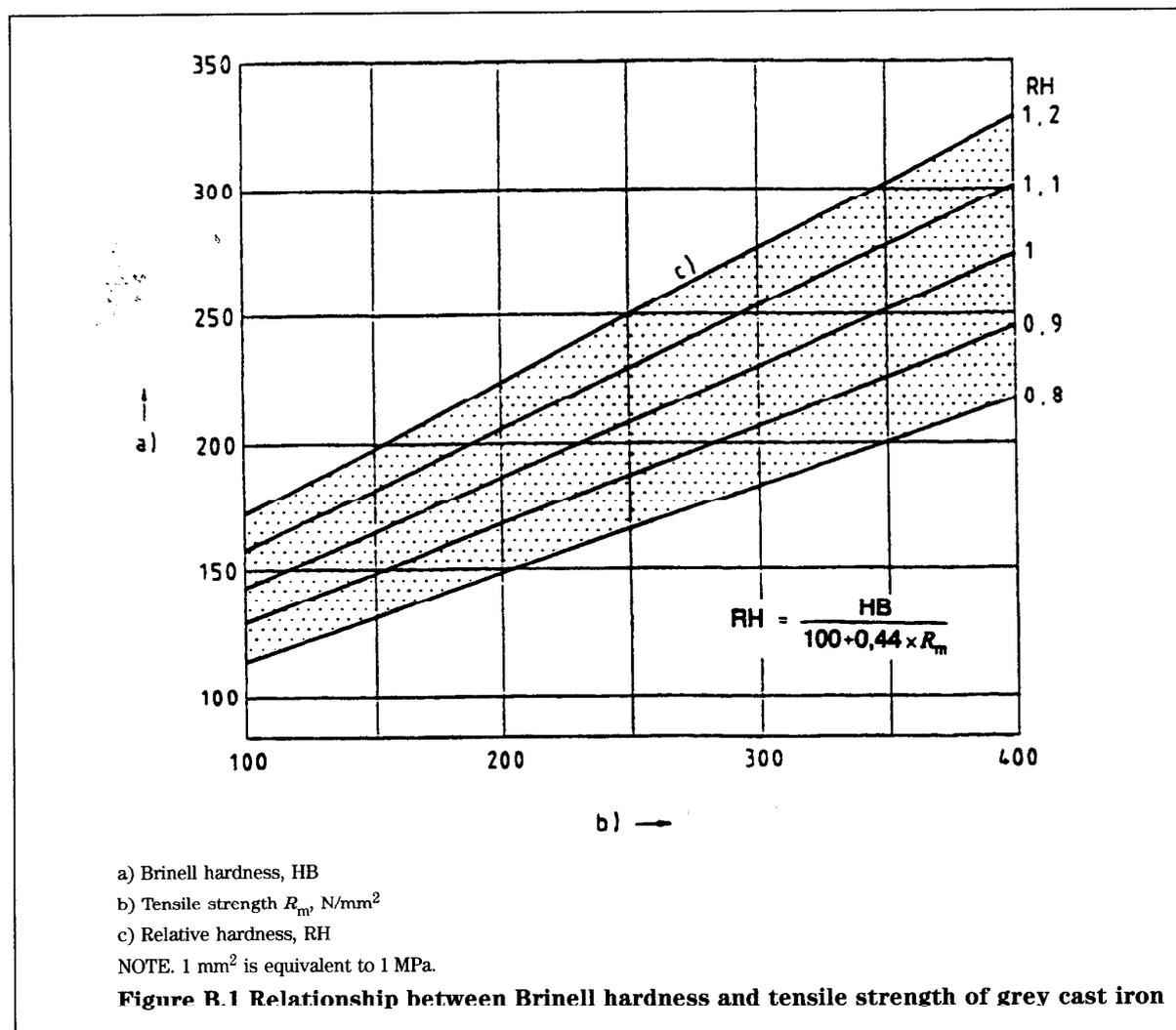
$$HB = RH \times (A + B \times R_m)$$

Commonly accepted values for the constants are:

$$A = 100, B = 0,44 [10], [11].$$

The factor RH is called relative hardness. This parameter has been found to vary between 0,8 and 1,2. Because of the variation in relative hardness it is difficult to give definitive limits in a standard for both tensile strength and hardness (see figure B.1). More details concerning RH are discussed in literature [10] to [17] (see annex D).

The factor RH is influenced mainly by the raw materials, the melting process and the metallurgical working method. Within one foundry these influences can be maintained nearly constant. The manufacturer can therefore indicate both hardness and the corresponding tensile strength.



**Annex C (informative)**

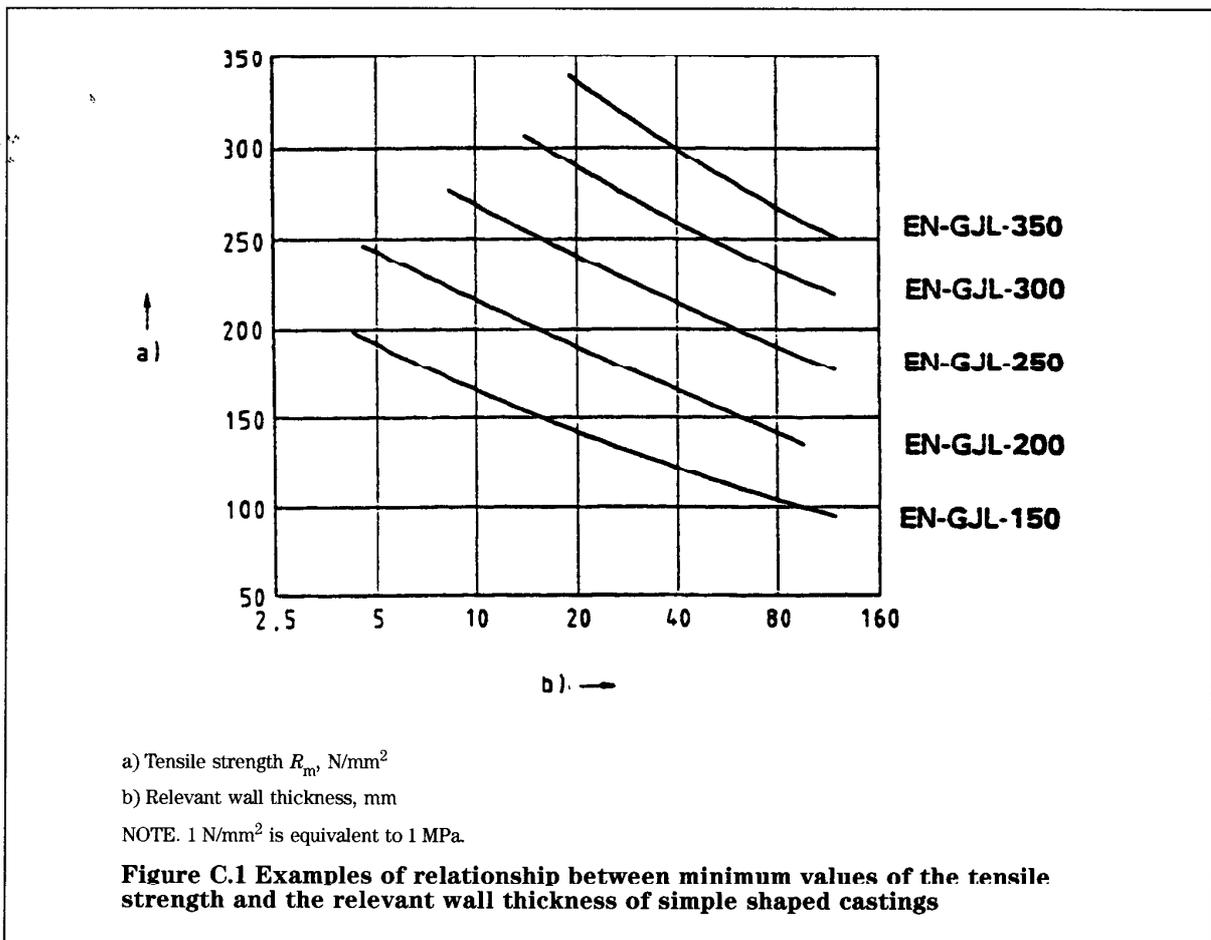
**Additional information on the relationship between tensile strength, hardness and wall thickness of grey iron castings**

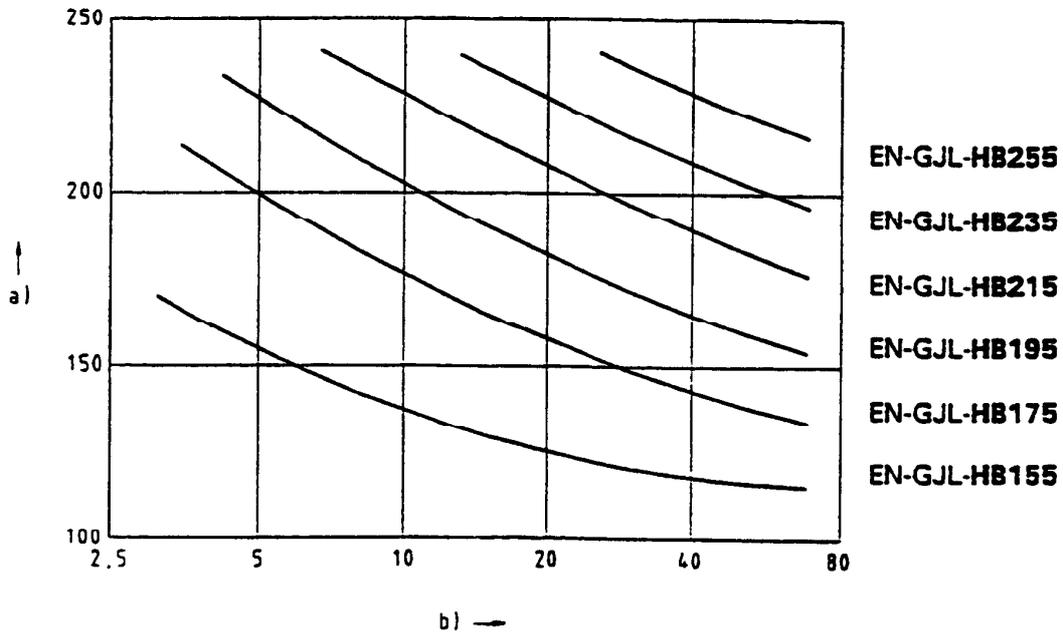
Figure C.1 provides additional general information on the expected relationship between minimum tensile strength and relevant wall thickness.

Figure C.2 provides information on average Brinell hardness and relevant wall thickness of castings.

Not all castings can be produced in any material hardness grade given in table 2 for any relevant wall thickness, and this is reflected in figure C.2. To meet the requirements of any hardness range, more than one material grade can be used, depending on the relevant wall thickness involved.

This illustrates the importance of reaching an agreement between the manufacturer and the purchaser on the specification of the hardness required in castings and also the location where a hardness test should be carried out.





a) Brinell hardness, HB 30  
b) Relevant wall thickness, mm

**Figure C.2 Typical relationship between average values of the Brinell hardness and the relevant wall thickness of simple shaped castings**

## Annex D (informative)

### Bibliography

In the preparation of this European Standard, use was made of a number of documents for reference purposes. These informative references are cited at the appropriate places in the text and the publications are listed hereafter.

prEN 877-1 *Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings — Part 1: Technical specifications*

EN 1560 *Founding — Designation system for cast iron — Material symbols and material numbers*

EN ISO 945 *Cast iron — Designation of microstructure of graphite (ISO 945 : 1975)*

- [1] *Engineering data on grey cast irons — SI units.* G. N. J. Gilbert. 2nd rev. ed. publ. British Cast Iron Research Association. Alvechurch/Birmingham 1977
- [2] Nechtelberger, E.: *Österreichisches Giesserei-Institut. Report A-No, 18 670.* Leoben 1973
- [3] Hänchen, R.: *Dauerfestigkeitsbilder für Stahl und Gusseisen.* Carl Hanser Verlag, München 1963
- [4] Speidel, M. O.: *Z. Werkstofftechn.* 12 (1981) No. 11, p. 387-402
- [5] Angus, H. T.: *Cast iron — Physical and engineering properties.* 2nd ed. London: Butterworths 1976
- [6] Dietrich, H.: *Giesserei, technisch-wissenschaftliche Beihefte, 14 (1962) No. 2, p. 79-91*
- [7] Collaud, A.: *Giesserei, technisch-wissenschaftliche Beihefte, 6 (1954) No. 14, p. 709-726; (1955) No. 15, p. 767-799*
- [8] Sy, A. de; Eeghem, J. van: *Giesserei 47 (1960) No. 12, p. 315-323*
- [9] Weis, W.; Orths, K.: *34. Internationaler Giessereikongress. Paris 1967. Report No. 11; see also Giessereiforschung 21 (1969) No. 3, p. 113-124*
- [10] MacKenzie, J. T.: *Foundry 74 (1946) No. 10, p. 88-93, 191, 194*
- [11] Patterson, W.: *Giesserei 45 (1958) No. 14, p. 385-387*
- [12] Patterson, W.; Döpp, R.: *Giesserei 47 (1960) No. 7, p. 175-180*
- [13] Patterson, W.; Döpp, R.: *Giesserei 60 (1973) No. 2, p. 32-39*

- [14] Döpp, R.: *Giesserei 66 (1979) No. 2, p. 40-43*
- [15] Bauer, W.; Nechtelberger, E.: *55. International Foundry Congress Moskva 1988. Moskva 1988; see also Giesserei-Rundschau 35 (1988) No. 11/12, p. 10-15*
- [16] Motz, J. M.: *Giesserei 69 (1982) No. 18, p. 485-492*
- [17] Motz, J. M.: *Giesserei 74 (1987) No. 7, p. 214-221*

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Replaces DIN 1691;1985-05 and DIN 50109;1989-04