



**SLOVENSKI STANDARD**  
**SIST EN 1564:1998**  
**01-avgust-1998**

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**Livarstvo - Bainitna železova litina**

Founding - Austempered ductile cast irons

Gießereiwesen - Bainitisches Gußeisen

Fonderie - Fonte bainitique

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**Ta slovenski standard je istoveten z: EN 1564:1997**

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EUROPEAN STANDARD

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NORME EUROPÉENNE

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Descriptors: foundry engineering, cast iron, grades: quality, designation, classifications, mechanical properties, tensile strength, elongation, hardness, sampling, mechanical tests

English version

## Founding - Austempered ductile cast irons

Fonderie - Fonte bainitique

Gießereiwesen - Bainitisches Gußeisen

This European Standard was approved by CEN on 1997-05-02. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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**CEN**

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

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## Contents

	Page		Page
<b>Foreword</b> .....	3	<b>9.2 Impact test</b> .....	9
<b>Introduction</b> .....	4	<b>9.3 Hardness test</b> .....	9
<b>1 Scope</b> .....	4	<b>10 Retests</b> .....	9
<b>2 Normative references</b> .....	4	10.1 Need for retests .....	9
<b>3 Definitions</b> .....	5	10.2 Procedure for retests .....	9
3.1 austempered ductile cast iron .....	5	<b>11 Re-heat-treatment</b> .....	9
3.2 graphite spheroidizing treatment .....	5	<b>Figure 1: Separately cast samples</b>	
3.3 austenite transformation treatment .....	5	(option 1) .....	10
<b>4 Designation</b> .....	5	<b>Figure 2: Separately cast samples</b>	
<b>5 Order information</b> .....	5	(option 2) .....	11
<b>6 Manufacture</b> .....	5	<b>Figure 3: Separately cast samples</b>	
<b>7 Requirements</b> .....	5	(option 3) .....	12
7.1 Test pieces machined from separately		<b>Figure 4: Tensile test piece</b> .....	13
cast samples .....	5	<b>Figure 5: Charpy-notched impact test piece</b> ..	14
7.2 Test pieces machined from cast-on		<b>Figure 6: Cast-on sample</b> .....	15
samples .....	6	<b>Annex A (normative) Information on</b>	
7.3 Test pieces machined from samples		hardness .....	16
cut from a casting .....	6	<b>Annex B (informative) Bibliography</b> .....	17
<b>8 Sampling</b> .....	6	<b>Annex C (normative) Manufacture</b> .....	17
8.1 General .....	6	<b>Annex D (normative) Impact resistance</b> ....	17
8.2 Separately cast samples .....	7	<b>Annex E (normative) Formation of test units</b>	
8.3 Cast-on samples .....	7	and number of tests .....	18
8.4 Samples cut from a casting .....	8		
<b>9 Test methods</b> .....	8		
9.1 Tensile test .....	8		

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## 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 2.30 "Spheroidal graphite and austempered ductile iron" to prepare the following standard:

EN 1564

Founding – Austempered ductile 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

This European Standard deals with the classification of austempered ductile cast iron<sup>1)</sup> in accordance with the mechanical properties of the material.

The properties of austempered ductile cast iron depend on its structure.

The mechanical properties of the material may be evaluated on machined test pieces prepared from:

- separately cast samples;
- samples cast onto either the casting or the running system, hereafter referred to as cast-on samples;
- samples cut from a casting (only when an agreement is made between the manufacturer and the purchaser).

The grade of the material is defined from the mechanical properties measured on machined test pieces prepared from separately cast samples.

If hardness is a requirement of the purchaser as being important for the application, then annex A provides means for its determination.

## 1 Scope

This European Standard defines the grades and the corresponding properties of austempered ductile cast irons.

This European Standard specifies a classification based on mechanical properties measured on machined test pieces prepared from:

- separately cast samples;
- cast-on samples;
- samples cut from a casting.

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

## 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 10002-1  
Metallic materials – Tensile testing – Part 1: Method of test (at ambient temperature)

EN 10003-1  
Metallic materials – Brinell hardness test – Part 1: Test method

EN 10045-1  
Metallic materials – Charpy impact test – Part 1: Test method

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

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<sup>1)</sup> Austempered ductile cast iron is sometimes called ADI.

### 3 Definitions

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

#### 3.1 austempered ductile cast iron

Cast material, iron and carbon based, the latter element being present mainly in the form of the spheroidal particles, which, compared with the spheroidal graphite iron grades (see EN 1563), combines higher strength and toughness properties as the result of heat treatment.

#### 3.2 graphite spheroidizing treatment

Treatment which brings the liquid iron into contact with a substance to produce graphite in the spheroidal form during solidification.

#### 3.3 austenite transformation treatment

Heat treatment which consists of the transformation of austenite usually in the temperature range between 250 °C and 400 °C to form a predominantly austenitic-ferritic matrix structure. This treatment is an integral part of the production process.

### 4 Designation

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

### 5 Order information

The following information shall be supplied by the purchaser:

- a) the number of this European Standard (EN 1564);
- b) the designation of the material;
- c) any special requirements which have to be agreed by the time of acceptance of the order.

### 6 Manufacture

The method of manufacturing austempered ductile iron as well as its chemical composition and heat treatment, unless specified by the purchaser, shall be left to the discretion of the manufacturer (see also annex C).

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

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### 7 Requirements

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

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##### 7.1.1 General

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The mechanical properties of austempered ductile cast iron shall be as specified in table 1 and in annexes A and D, and, if applicable, in accordance with the requirements given in 7.1.2.

##### 7.1.2 Impact test

The particular impact resistance value specified in annex D for EN-GJS-800-8-RT (EN-JS1104) for room temperature applications, if applicable, shall only be determined if specified by the purchaser by the time of acceptance of the order.



**Table 1: Mechanical properties measured on test pieces machined from separately cast samples**

Material designation		Tensile strength $R_m$	0,2% proof stress $R_{p0,2}$	Elongation $A$
Symbol	Number	N/mm <sup>2</sup> min.	N/mm <sup>2</sup> min.	% min.
EN-GJS-800-8	EN-JS1100	800	500	8
EN-GJS-1000-5	EN-JS1110	1 000	700	5
EN-GJS-1200-2	EN-JS1120	1 200	850	2
EN-GJS-1400-1	EN-JS1130	1 400	1 100	1

NOTE 1: The values for these materials apply to castings cast in sand moulds of comparable thermal diffusivity. Subject to amendments to be agreed upon in the order, they can apply to castings obtained by alternative methods.

NOTE 2: Whatever the method used for obtaining the castings, the grades are based on the mechanical properties measured on test pieces taken from samples separately cast in a sand mould or a mould of comparable thermal diffusivity.

NOTE 3: 1 N/mm<sup>2</sup> is equivalent to 1 MPa.

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

## 7.2 Test pieces machined from cast-on samples

In case of an agreement on the properties of test pieces machined from cast-on samples, the material designation by symbol shall be followed by letter U and the last character of the designation by number shall be 2.

NOTE: The properties of test pieces machined from cast-on test samples cannot reflect exactly the properties of the casting itself, but may be a better approximation than those obtained on test pieces machined from separately cast test samples.

## 7.3 Test pieces machined from samples cut from a casting

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

- the place(s) on a casting where the sample(s) shall be taken;
- the mechanical properties that shall be measured;
- the values of these mechanical properties.

NOTE: The properties of castings are not uniform because of the complexity and variation in section thickness.

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## 8 Sampling

### 8.1 General

Samples shall be provided to represent the casting(s) produced.

Samples shall be made from the metal used to produce the castings which they represent (see annex E).



## 8.2 Separately cast samples

### 8.2.1 Frequency and number of tests

Samples representative of the material shall be produced at a frequency in accordance with the in-process quality assurance procedures adopted by the manufacturer.

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

When impact tests are agreed by the time of acceptance of the order, samples shall be produced at a frequency to be agreed between the manufacturer and the purchaser.

### 8.2.2 Samples and test pieces

The samples shall be cast separately in sand moulds at the same time as the castings and under representative spheroidization and inoculation conditions.

The samples shall meet the requirements of either figures 1, 2 or 3.

The samples shall not be removed from the mould at a temperature higher than that of the castings.

If the graphite spheroidizing treatment is carried out in the mould (in-mold method), the samples may be

- either cast side-by-side with the castings, with a joint running system
- or cast separately using a similar treatment method in the sample mould as the method used to produce the casting.

The samples shall be subjected to the same heat treatment as the castings which they represent.

The tensile test piece shown in figure 4 shall be machined from the sample shown in figures 1 and 2 (hatched part) or from the sample shown in figure 3. Unless otherwise agreed, the choice of the option is left to the discretion of the manufacturer.

The Charpy-notched impact test piece shall be in accordance with figure 5.

## 8.3 Cast-on samples

### 8.3.1 Frequency and number of tests

Cast-on samples are representative of the castings to which they are attached and also of all other castings of a similar wall thickness from the same test unit or produced at the same time interval in accordance with the in-process quality assurance procedure used by the manufacturer.

One tensile test shall be carried out to confirm the material unless there has been a special agreement made between the manufacturer and the purchaser.

When impact tests are agreed by the time of acceptance of the order, samples shall be produced at a frequency to be agreed between the manufacturer and the purchaser.

### 8.3.2 Samples and test pieces

The samples from which the test pieces for tensile and/or impact test shall be made are cast-on to the castings or the running system. Cast-on samples should be chosen in preference to separately cast samples when the unit mass of the castings is equal to or greater than 2 000 kg or when the relevant wall thickness varies between 30 mm and 200 mm.

When the mass of the casting exceeds 2 000 kg and its thickness exceeds 200 mm, only cast-on samples shall be used. In this case, the dimensions of the cast-on sample shall be agreed by the manufacturer and the purchaser by the time of acceptance of the order.

The positioning of the cast-on samples shall be agreed between the manufacturer and the purchaser by the time of acceptance of the order, taking into account the shape of the casting and the running system, in order to avoid any unfavourable effect on the properties of the adjacent material.

The samples shall have the shape and dimensions indicated in figure 6.

Unless otherwise agreed, the cast-on samples shall not be separated from the castings until after the heat treatment.

The test pieces shall be in accordance with figures 4 and 5.

## 8.4 Samples cut from a casting

### 8.4.1 General

In addition to the requirements of the material, the manufacturer and the purchaser may agree on the properties required at stated positions in the casting. These properties shall be determined by testing machined test pieces cut from the casting at these stated positions.

### 8.4.2 Other conditions

The position on the casting from where the sample is cut shall be in an area where the casting wall thickness is close to the relevant wall thickness of the casting.

For the purpose of determining the size of the test piece to be used, the purchaser shall, by the time of acceptance of the order, indicate to the manufacturer which are the important sections. In the absence of any direction by the purchaser, the manufacturer may choose the diameter of the test piece to be used.

## 9 Test methods

### 9.1 Tensile test

The tensile test shall be carried out in accordance with EN 10002-1. The preferred test piece diameter is 14 mm, but, for technical reasons and for test pieces machined from castings, it is permitted to use a test piece of different diameter (see figure 4). In either case the original gauge length of the test piece shall conform to the formula:

$$L_0 = 5,65 \times \sqrt{S_0} = 5 \times d$$

where:

$L_0$  is the original gauge length;

$S_0$  is the original cross-section area of the test piece;

$d$  is the diameter of the test piece along the gauge length.

If the above formula for  $L_0$  is not applicable, then an agreement shall be made between the manufacturer and the purchaser on the dimensions of the test piece.

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## 9.2 Impact test

The impact test shall be carried out on three Charpy impact test pieces (see figure 5), in accordance with EN 10045-1, using test equipment with available energy compatible with the properties of the austempered ductile cast iron being tested.

## 9.3 Hardness test

When agreed between the manufacturer and the purchaser, the hardness shall be determined as Brinell hardness in accordance with EN 10003-1. Other hardness tests may be agreed.

The hardness values shall be agreed between the manufacturer and the purchaser by the time of acceptance of the order.

The test shall be carried out on the test pieces or at one or several points on the castings after preparation of the testing area in accordance with the agreement made by the manufacturer and purchaser.

If the measuring points are not the subject of an agreement, they shall be chosen by the manufacturer.

Further information on hardness is given in annex A.

## 10 Retests

### 10.1 Need for retests

Retesting shall be carried out if a test is not valid.

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;
- c) a fracture of the tensile test piece outside the gauge length;
- d) a casting defect in the test piece, evident after fracture.

In all cases, a new test piece shall be taken from the same sample or a duplicate sample cast at the same time. The result of the retest shall be used.

### 10.2 Procedure for retests

If any test gives results which do not conform to the specified requirements, for reasons other than those given in 10.1, two retests shall be carried out for each failed test.

The casting(s) represented by the test shall be regarded as conforming to the specified requirements if both of the retests give satisfactory results as indicated in 7.1, 7.2 and 7.3.

However, the castings represented by the retests shall be regarded as non conforming to this standard if the retests are valid but one of the results does not satisfy the specified property.

## 11 Re-heat-treatment

If the test is valid, but the results do not conform with the specified properties, 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 test results of the test pieces machined from the re-heat-treated samples conform to the specified properties, then the re-heat-treated castings shall be accepted.