



SLOVENSKI STANDARD

SIST EN 16124:2012

01-februar-2012

Livarstvo - Malolegirana nodularna litina za uporabo pri povišanih temperaturah

Founding - Low alloyed ferritic spheroidal graphite cast iron for elevated temperature applications

Gießereiwesen - Niedriglegiertes ferritisches Gusseisen mit Kugelgraphit für Anwendungen bei höheren Temperaturen

Fonderie - Fontes ferritiques à graphite sphéroïdal faiblement alliées pour applications à haute température

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Ta slovenski standard je istoveten z: EN 16124:2011

ICS:

77.140.80 Železni in jekleni ulitki Iron and steel castings

SIST EN 16124:2012

en,fr,de

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EUROPEAN STANDARD

EN 16124

NORME EUROPÉENNE

EUROPÄISCHE NORM

November 2011

ICS 77.080.10

English Version

Founding - Low-alloyed ferritic spheroidal graphite cast irons for elevated temperature applications

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Foreword

This document (EN 16124:2011) 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of an identical text or by endorsement, at the latest by May 2012, and conflicting national standards shall be withdrawn at the latest by May 2012.

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.

Within its programme of work, Technical Committee CEN/TC 190 requested CEN/TC 190/WG 7 "Spheroidal graphite, silicon molybdenum and austempered ductile iron" to prepare EN 16124.

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 the United Kingdom.

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EN 16124:2011 (E)**Introduction**

This European Standard classifies low-alloyed ferritic spheroidal graphite cast irons, principally used for their heat and oxidation resistance properties.

NOTE Ferritic spheroidal graphite cast irons alloyed with silicon and molybdenum is also known as SiMo cast irons.

Due to the ferritic structure and the silicon and molybdenum content, these cast irons allow producing castings which are resistant to distortion and oxidation at high temperatures.

Nine grades of low-alloyed ferritic spheroidal graphite cast iron are defined by their silicon and molybdenum content.

Typical applications for the first three grades are medium to heavy castings like turbine housings and compressor parts. The other six grades are mainly applied for exhaust manifolds and turbocharger parts in automotive applications.

The mechanical properties of the material can be evaluated on machined test pieces prepared from cast samples or samples cut from a casting.

Additional information on technical properties for low-alloyed ferritic spheroidal graphite cast iron is given in Annex B and Annex C.

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1 Scope

This European Standard defines the grades and the corresponding requirements for low-alloyed ferritic spheroidal graphite cast irons for elevated temperature applications.

These requirements are specified in terms of

- chemical composition: as given for each of the grades,
- graphite form and matrix structure: spheroidal graphite in a predominantly ferritic matrix,
- mechanical properties measured on machined test pieces prepared from cast samples.

This European 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 10204, *Metallic products — Types of inspection documents*

EN ISO 945-1:2008, *Microstructure of cast irons — Part 1: Graphite classification by visual analysis (ISO 945-1:2008)*

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

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

3 Terms and definitions

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

3.1

low alloyed ferritic spheroidal graphite cast iron

cast iron material with carbon mainly present in the form of spheroidal graphite particles, alloyed with silicon in order to produce a predominantly ferritic matrix and alloyed with molybdenum to improve mechanical properties at elevated temperatures

3.2

graphite spheroidizing treatment

operation that brings the liquid iron into contact with a substance to produce graphite in the predominantly spheroidal (nodular) form during solidification

NOTE This operation is often followed by a second one called inoculation.

3.3

cast sample

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

3.4

separately cast sample

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

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- 3.5 side-by-side cast sample**
sample cast in the mould alongside the casting, with a joint running system
- 3.6 cast-on sample**
sample attached directly to the casting
- 3.7 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 Table 1.

NOTE The designation system is in accordance with EN 1560 [3].

In the case of samples cut from the casting, the letter C is added at the end of the designation by symbol.

5 Order information

The following information shall be supplied by the purchaser:

- a) the number of this European Standard;
- b) the designation of the material;
- c) the relevant wall thickness of the casting; [SIST EN 16124:2012](https://standards.iteh.ai/catalog/standards/sist/f3a447fe-73e5-42be-a836-2740ec131797/sist-en-16124-2012)
- d) any special requirements. <https://standards.iteh.ai/catalog/standards/sist/f3a447fe-73e5-42be-a836-2740ec131797/sist-en-16124-2012>

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 low-alloyed ferritic spheroidal graphite cast irons and any heat treatment required to obtain the specified mechanical properties and microstructure 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.

7 Requirements

7.1 Chemical composition

The silicon and molybdenum content of low-alloyed ferritic spheroidal graphite cast iron grades shall be in accordance with Table 1.

Unless otherwise agreed, the content of other elements shall be left to the discretion of the manufacturer.

If the presence of any element specified in Table 1 is required to be outside the limits indicated, or if any other alloying elements are required, their contents shall be agreed between the manufacturer and the purchaser and specified in the order.

Table 1 — Chemical composition

Material designation		Silicon % (mass fraction)	Molybdenum % (mass fraction)
Symbol	Number		
EN-GJS-SiMo25-5	5.3111	2,3 to 2,7	0,4 to 0,6
EN-GJS-SiMo30-7	5.3112	2,8 to 3,2	0,6 to 0,8
EN-GJS-SiMo35-5	5.3113	3,3 to 3,7	0,4 to 0,6
EN-GJS-SiMo40-6	5.3114	3,8 to 4,2	0,5 to 0,7
EN-GJS-SiMo40-10	5.3115		0,8 to 1,1
EN-GJS-SiMo45-6	5.3116	4,3 to 4,7	0,5 to 0,7
EN-GJS-SiMo45-10	5.3117		0,8 to 1,1
EN-GJS-SiMo50-6	5.3118	4,8 to 5,2	0,5 to 0,7
EN-GJS-SiMo50-10	5.3119		0,8 to 1,1

7.2 Microstructure

7.2.1 Graphite structure

The graphite structure shall be mainly of form V and VI in accordance with EN ISO 945-1. A more precise definition may be agreed upon by the time of acceptance of the order.

NOTE Annex E gives more information on nodularity.

7.2.2 Matrix structure

The matrix structure shall consist of minimum 85 % ferrite, the balance consisting of pearlite and carbides.

Carbides can be present to a maximum of 5 %.

Other limits may be agreed upon by the time of acceptance of the order.

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7.3 Mechanical properties

7.3.1 Tensile properties

The mechanical properties of the grades of cast irons obtained from cast samples with a thickness equal or less than 30 mm shall be in accordance with Table 2.

Other requirements, such as the mechanical properties to be met on samples with a thickness > 30 mm or at specified locations on the castings, shall be agreed between the manufacturer and the purchaser and specified in the order. If applicable, the position of the cast-on sample or the specified location on the casting shall be agreed between the manufacturer and the purchaser and specified in the order.

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

7.3.2 Hardness

Guidance values for the Brinell hardness range of the material grades are given in Table 2 and are applicable to the casting.

Table 2 — Mechanical properties measured at ambient temperature on test pieces machined from cast samples of low-alloyed ferritic spheroidal graphite cast irons

Material designation	0,2 % proof strength	Tensile strength	Elongation	Brinell hardness range ^a	
Symbol	Number	$R_{p0,2}$ MPa min.	R_m MPa min.	A % min.	
EN-GJS-SiMo25-5	5.3111	SIST EN 16124:2012 https://standards.iteh.ai/catalog/standards/sist/f3a447fe-73e5-42be-a836-2740ec131797/sist-en-16124-2012 Guidance values are given in Annex A			
EN-GJS-SiMo30-7	5.3112				
EN-GJS-SiMo35-5	5.3113				
EN-GJS-SiMo40-6	5.3114	380	480	8	190 to 240
EN-GJS-SiMo40-10	5.3115	400	510	6	190 to 240
EN-GJS-SiMo45-6	5.3116	420	520	7	200 to 250
EN-GJS-SiMo45-10	5.3117	460	550	5	200 to 250
EN-GJS-SiMo50-6	5.3118	480	580	4	210 to 260
EN-GJS-SiMo50-10	5.3119	500	600	3	210 to 260

^a Values for information, measured on the casting.

8 Sampling

8.1 General

Samples shall be made from the same material as that used to produce the casting(s) which they represent.

Several types of samples (separately cast samples, cast-on samples, side-by-side cast samples, samples cut from a casting) can be used, depending on the mass and wall thickness of the casting.

When relevant, the type of sample should be agreed between the manufacturer and the purchaser. Unless otherwise agreed the choice of the option is left to the discretion of the manufacturer.

When the mass of the casting exceeds 2 000 kg and its thickness exceeds 60 mm, cast-on samples should preferably be used; the dimensions and the location of the cast-on sample shall be agreed between the manufacturer and the purchaser by the time of acceptance of the order.

If the spheroidizing treatment is carried out in the mould (in-mould process), the separately cast sample should be avoided.

All samples shall be adequately marked to guarantee full traceability to the castings which they represent.

The samples shall be subject to the same heat treatment, as that of the castings they represent, if any.

Tensile test pieces shall be finally machined from the samples after the heat treatment.

The samples for chemical analysis shall be cast in a manner which ensures that the accurate chemical composition can be determined.

Due to post inoculation treatments, slight differences regarding the silicon content may be admitted.

8.2 Cast samples for tensile testing

8.2.1 Size of cast samples

The size of the sample shall be in correspondence with the relevant wall thickness of the casting as shown in Table 3.

If other sizes are used, this shall be agreed between the manufacturer and purchaser.

Table 3 — Types and size of cast sample and size of tensile test pieces in relation to relevant wall thickness of the casting

Relevant wall thickness t mm	Type of sample				Preferred diameter of tensile test piece ^a d mm
	Option 1 U-shaped (see Figure 1)	Option 2 Y-shaped (see Figure 2)	Option 3 round bar (see Figure 3)	Cast-on sample (see Figure 4)	
$t \leq 12,5$	—	I	Types b, c	A	7 (Option 3: 14 mm)
$12,5 < t \leq 30$	—	II	Types a, b, c	B	14
$30 < t \leq 60$	b	III	—	C	14
$60 < t \leq 200$	—	IV	—	D	14

^a Other diameters, in accordance with Figure 5, may be agreed between the manufacturer and the purchaser.

^b The cooling rate of this cast sample corresponds to that of a 40 mm thick wall.

EN 16124:2011 (E)**8.2.2 Frequency and number of tests**

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

In the absence of either a process quality assurance procedure or any agreement between the manufacturer and the purchaser, a minimum of one cast sample for the tensile test shall be produced to confirm the material grade, at a frequency to be agreed between the manufacturer and the purchaser.

8.2.3 Separately cast samples

The samples shall be cast separately in sand moulds and under representative manufacturing conditions.

The moulds used to cast the separately cast samples shall have comparable thermal behaviour to the moulding material used to cast the castings.

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

The samples shall be removed from the mould at a temperature similar to that of the castings.

8.2.4 Side-by-side cast samples

Side-by-side cast samples are representative of the castings concurrently cast and also of all other castings of a similar relevant wall thickness from the same test unit.

When mechanical properties are required for a series of castings belonging to the same test unit, the side-by-side cast sample(s) shall be produced in the last mould(s) poured.

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

8.2.5 Cast-on samples

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Cast-on samples are representative of the castings to which they are attached and also of all other castings of a similar relevant wall thickness from the same test unit.

When mechanical properties are required for a series of castings belonging to the same test unit, the cast-on sample(s) shall be produced in the last mould(s) poured.

The sample shall have a general shape as indicated in Figure 4 and the dimensions shown therein.

The location of the cast-on sample 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.

8.2.6 Test pieces machined from cast samples

The tensile test piece shown in Figure 5 shall be machined from a sample shown in Figure 3 or from the hatched part of Figures 1, 2 or 4.

The sectioning procedure for cast samples according to Figure 2 and 4 shall be in accordance with Annex F.

Unless otherwise agreed, the preferred diameter for the test piece shall be used.