



SLOVENSKI STANDARD

SIST EN 16079:2012

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Livarstvo - Železove litine s kompaktnim (vermikularnim) grafitom

Founding - Compacted (vermicular) graphite cast irons

Gießereiwesen - Gusseisen mit Vermiculargraphit

Fonderie - Fontes à graphite vermiculaire (compacté)

Ta slovenski standard je istoveten z: EN 16079:2011

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ICS:

77.140.80 Železni in jekleni ulitki Iron and steel castings

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EUROPEAN STANDARD
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Founding - Compacted (vermicular) graphite cast irons

Fonderie - Fontes à graphite vermiculaire (compacté)

Gießereiwesen - Gusseisen mit Vermiculargraphit

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Foreword

This document (EN 16079:2011) 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of an identical text or by endorsement, at the latest by May 2012, and conflicting national standards shall be withdrawn at the latest by May 2012.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 5 "Grey cast iron and compacted graphite cast iron" to prepare EN 16079.

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 16079:2011 (E)**Introduction**

This European Standard classifies compacted (vermicular) graphite cast irons (CGI), in accordance with the mechanical properties of the material.

The properties of compacted (vermicular) graphite cast irons depend on their graphite and matrix microstructure.

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

- separately cast samples,
- side by side cast samples,
- cast-on samples or
- samples cut from a casting.

Annex A (informative) gives additional information on properties and typical applications of compacted (vermicular) graphite cast irons.

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1 Scope

This European Standard defines the grades and the corresponding requirements for compacted (vermicular) graphite cast irons.

This European Standard specifies 5 grades of compacted (vermicular) graphite cast iron by a classification based on 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, *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 6506-1:2005)*

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

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3 Terms and definitions

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

3.1

compacted (vermicular) graphite cast iron

cast material, iron and carbon based, the carbon being present mainly in the form of compacted (vermicular) graphite particles that appear vermicular on a two-dimensional plane of polish, the graphite particles being embedded in a matrix consisting of ferrite, ferrite/pearlite, or pearlite

3.2

graphite modification treatment

process that brings the liquid iron into contact with a substance to produce graphite in the predominantly compacted (vermicular) form during solidification

3.3

vermicularity

percentage of graphite particles that are of form III according EN ISO 945-1

3.4

cast sample

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

3.5

separately cast sample

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

3.6

side-by-side cast sample

sample cast in the mould alongside the casting, with a joint running system

EN 16079:2011 (E)**3.7****cast-on sample**

sample attached directly to the casting

3.8**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.

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

NOTE The comparison of EN 16079 grade designations with the grades from the ISO standard for compacted (vermicular) cast irons, ISO 16112:2006 [3], is given in Annex B.

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;
- d) any special requirements.

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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 compacted (vermicular) graphite cast irons 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 standard are met for the material grade specified in the order.

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

NOTE When compacted (vermicular) graphite cast iron is to be used for special applications, the chemical composition and heat treatment may be agreed between the manufacturer and the purchaser.

7 Requirements**7.1 General**

The property values apply to compacted (vermicular) graphite cast iron cast in sand moulds or moulds of comparable thermal behaviour. Subject to amendments to be agreed upon in the order, they can apply to castings obtained by alternative methods.

The material designation is based on the minimum mechanical properties obtained in cast samples with a thickness or diameter of 25 mm. The designation is irrespective of the type of cast sample.

Mechanical properties are wall thickness dependant as shown in Table 1.

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

7.2 Test pieces machined from cast samples

The mechanical properties of compacted graphite cast iron shall be as specified in Table 1.

Table 1 — Mechanical properties measured on test pieces machined from cast samples

Material designation		Relevant wall thickness t mm	0,2 % proof strength $R_{p0,2}$ MPa min.	Tensile strength R_m MPa min.	Elongation A % min.
Symbol	Number				
EN-GJV-300	5.2100	$t \leq 30$	210	300	2,0
		$30 < t \leq 60$	195	275	2,0
		$60 < t \leq 200$	175	250	2,0
EN-GJV-350	5.2200	$t \leq 30$	245	350	1,5
		$30 < t \leq 60$	230	325	1,5
		$60 < t \leq 200$	210	300	1,5
EN-GJV-400	5.2201	$t \leq 30$	280	400	1,0
		$30 < t \leq 60$	260	375	1,0
		$60 < t \leq 200$	230	325	1,0
EN-GJV-450	5.2300	$t \leq 30$	315	450	1,0
		$30 < t \leq 60$	280	400	1,0
		$60 < t \leq 200$	260	375	1,0
EN-GJV-500	5.2301	$t \leq 30$	350	500	0,5
		$30 < t \leq 60$	315	450	0,5
		$60 < t \leq 200$	280	400	0,5

NOTE For relevant wall thicknesses more than 200 mm, the manufacturer and the purchaser shall agree on the type and size of the cast sample and the minimum values to be obtained.

7.3 Test pieces machined from samples cut from a casting

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

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

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

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

7.4 Hardness

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

Information regarding hardness is given in Annex E.

7.5 Graphite structure

Compacted (vermicular) graphite cast irons shall have a minimum of 80 % of the graphite particles in the vermicular form (form III in accordance with EN ISO 945-1), when viewed on a two-dimensional plane of polish. The remaining 20 % of the graphite particles should be of form IV, form V and form VI in accordance with EN ISO 945-1.

Flake (lamellar) graphite (form I and form II according to EN ISO 945-1) is not permitted, except at the rim zone of the casting. The thickness of the rim zone shall be agreed between the manufacturer and the purchaser by the time of acceptance of the order.

Although the definition of compacted (vermicular) graphite cast iron is within the range of 80 % to 100 % of graphite particles of form III, a separate agreement may be made for a lower limit. However, this limit shall be not less than 70 %.

NOTE This could be the case for parts which require higher strength and/or parts with large wall thickness.

Compacted (vermicular) graphite cast iron reference images are shown in Annex F.

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 option 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.

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

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

8.2 Cast samples

8.2.1 Size of cast sample

The size of the sample shall be in correspondence with the relevant wall thickness of the casting as shown in Table 2.

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

Table 2 — 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.					

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 procedures adopted by the manufacturer or as agreed with the purchaser.

In the absence of a process quality assurance procedure or any other agreement between the manufacturer and the purchaser, a minimum of one cast sample 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.

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

8.2.5 Cast-on samples

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 poured.

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

The location of 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.

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 shall be in accordance with Annex G.

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

8.3 Samples cut from a casting

In addition to the requirements of the material, the manufacturer and the purchaser may agree on the properties required (for information, see Annex D) at stated locations in the casting.

These properties shall be determined by testing test pieces machined from samples cut from the casting at these stated locations.

The manufacturer and the purchaser shall agree on the dimensions of these test pieces.

In the absence of any directions by the purchaser, the manufacturer may choose the locations from which to cut the samples and the dimensions of the test pieces.