

CAST IRON



TECHNICAL AND PHYSICAL PROPERTIES

DIMENSIONAL TABLES AND WEIGHTS

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CONTINUOUS CASTING

General technical information

1. CAST IRON IN CONTINUOUS CASTING



The continuous casting process involves melting the metal in the melting furnace and transferring it to the casting furnace. From there, the liquid metal feeds the bar continuously throughout production, ensuring proper compensation for shrinkage during cooling.

Potential defects, such as refractory particles or gas bubbles, are driven upward and removed as slag, preventing inclusions or blowholes in the product. If any gas or slag reaches the casting zone, it becomes trapped within the solidifying outer shell of the bar, while the internal structure remains unaffected.

The bar undergoes forced cooling through a graphite mold which, in direct contact with the metal and aided by an external coolant flow, ensures optimal heat dissipation.
This process produces a compact bar featuring a characteristic “Double Structure”:

- An outer ring predominantly ferritic
- An inner zone predominantly pearlitic

This structure results from the combination of rapid external cooling and the annealing effect generated by the still-liquid core on the already solidified outer layer.



1.1 ADVANTAGES OF CONTINUOUS CASTING

compared to castings produced in sand molds

- No shrinkage
- No porosity
- Concentration of defects on the outer zone of the bar
- More compact structure
- Fast delivery times

CONTINUOUS CASTING

1.2 CLASSIFICATION OF CAST IRON IN CONTINUOUS CASTING

Reference standard: UNI EN 16482:2024

Cast iron is an iron–carbon alloy containing more than 2.1% carbon. During solidification, the carbon dissolved in the molten metal precipitates as graphite. Based on the morphology of this graphite, cast irons are classified into two main groups, each of which is further divided into two subgroups according to the amount of carbon bound within the iron matrix.

LAMELLAR GRAPHITE CAST IRON	SPHEROIDAL GRAPHITE CAST IRON
Ferritic	Ferritic
Pearlitic	Pearlitic

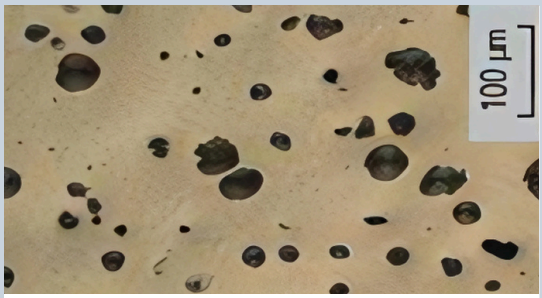
- **Ferritic cast irons** exhibit low wear resistance and hardness, but offer greater dimensional stability at high temperatures, higher ductility (in spheroidal grades), and superior heat dissipation. Fully ferritic cast irons are produced through a complete ferritization heat treatment.
- **Pearlitic cast irons** provide higher wear resistance, greater hardness and rigidity, and overall superior mechanical properties compared to ferritic grades.

LAMELLAR - GJL-



The defining characteristic of lamellar graphite cast iron is the formation of graphite in thin flakes, which introduce discontinuities within the ferrous matrix. This structure provides a natural self-lubricating effect, minimizing the risk of galling and enabling the material to break into very fine chips (almost powder) during machining. However, these discontinuities also limit the alloy's deformability, resulting in a brittle material with minimal elongation before fracture.

SPHEROIDAL - GJS -



The defining feature of spheroidal graphite cast iron is the formation of graphite in spheroidal shapes. This structure provides higher tensile strength than lamellar cast iron, good elongation before fracture and continuity within the ferrous matrix.
However, it limits the self-lubricating effect of graphite and produces small chips during machining, but without the need for deburring as with steels.



1.3 CLASSIFICATION OF CONTINUOUS CAST IRON according to standard: UNI EN 16482:2024

LAMELLAR : **EN-GJL-XXXC**

EN	EUROPEAN NORM
GJL	LAMELLAR GRAPHITE CAST IRON
XXX	TENSILE STRENGTH VALUE Rm (in MPa)
C	PRODUCED BY CONTINUOUS CASTING

SPHEROIDAL : **EN-GJS-XXX-YYC**

EN	EUROPEAN NORM
GJS	SPHEROIDAL GRAPHITE CAST IRON
XXX	TENSILE STRENGTH VALUE Rm (in MPa)
YY	ELONGATION PERCENTAGE
C	PRODUCED BY CONTINUOUS CASTING

1.4 BAR LENGTHS

STANDARD LENGTH	generally 3000 mm (tolerance -0/+150 mm)
> Ø400 and > 250x250	lengths vary between 1000 mm, 1880 mm and 3000 mm.

Check actual length at the time of order.

Cutting of bars is done by breaking; therefore, the cut surface on raw bars will always be irregular.

Special lengths can be produced on request.

CONTINUOUS CASTING

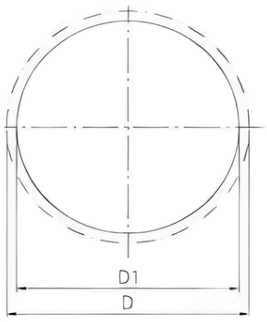
1.5 MINIMUM MACHINING ALLOWANCES

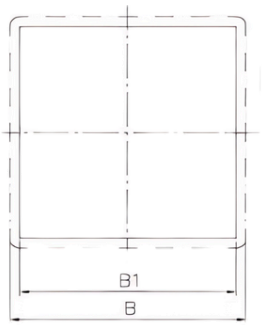
The machining allowance is the surface layer that must be removed from bars produced by continuous casting. This process eliminates the outer zone, which has a different structure than the core, and removes surface imperfections such as ovalization or bulges typical of continuous casting.

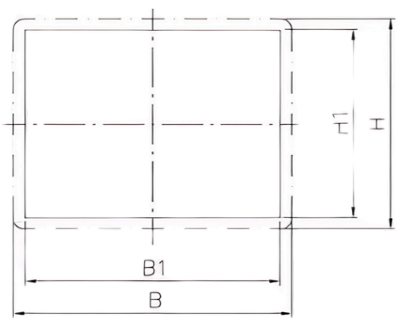
MINIMUM MACHINING ALLOWANCES (in mm) *(b)*

DIAMETER D OR WIDTH B *(a)*	ROUND SECTIONS		RECT. AND SQUARE SECTIONS	
	LAMELLAR	SPHEROIDAL	LAMELLAR	SPHEROIDAL
20 < D o B ≤ 50	1,5	2	2	3
50 < D o B ≤ 100	2,5	3	3	4
100 < D o B ≤ 200	3,5	4,5	4	5
200 < D o B ≤ 300	5,5	6,5	6	7
300 < D o B ≤ 400	6,5	7,5	7,5	8,5
400 < D o B ≤ 500	7,5	8,5	9	10
500 < D o B ≤ 700	10	12	12	14

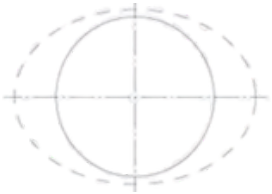
- *(a)* For rectangular bars, use the larger side of the section as reference and apply the same value to the smaller side.
- *(b)* The machining allowance must be considered on the radius (D/2) for round bars and on half the thickness “B” for square or rectangular bars.



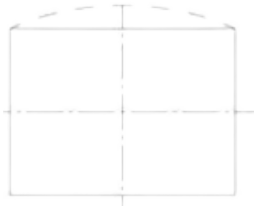




Ovalization:
Maximum measurable diameter on the circular section.



Bulging:
Maximum thickness/width: The largest dimension measured on a rectangular section.

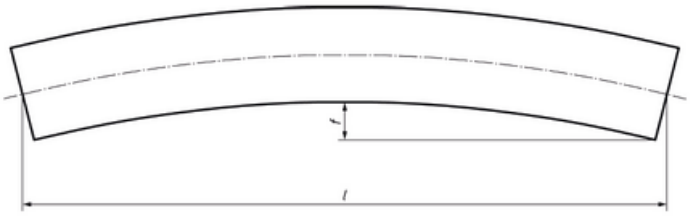


1.6 MINIMUM DIMENSIONAL TOLERANCES

MINIMUM RAW BARS ALLOWANCES				
BAR DIAMETER D OR WIDTH B *(a)*	LAMELLAR CAST IRON - GJL-		SPHEROIDAL CAST IRON -GJS-	
	ROUND	RECT./SQUARE	ROUND	RECT./SQUARE
20 < D o B ≤ 50	0/+1	0/+1	0/+1	0/+1
50 < D o B ≤ 100	0/+2	0/+2	0/+2	0/+2
100 < D o B ≤ 200	0/+3	0/+2	-0.5/+3	-0.5/+3
200 < D o B ≤ 300	-1/+3	-1/+3	-1/+3	-1/+3
300 < D o B ≤ 400	-1/+4	-1/+4	-1/+4	-1/+4
400 < D o B ≤ 500	-1/+5	-1/+5	-1/+6	-1/+6
500 < D o B ≤ 700	-3/+7	-3/+7	-3/+7	-3/+7

CONTINUOUS CASTING

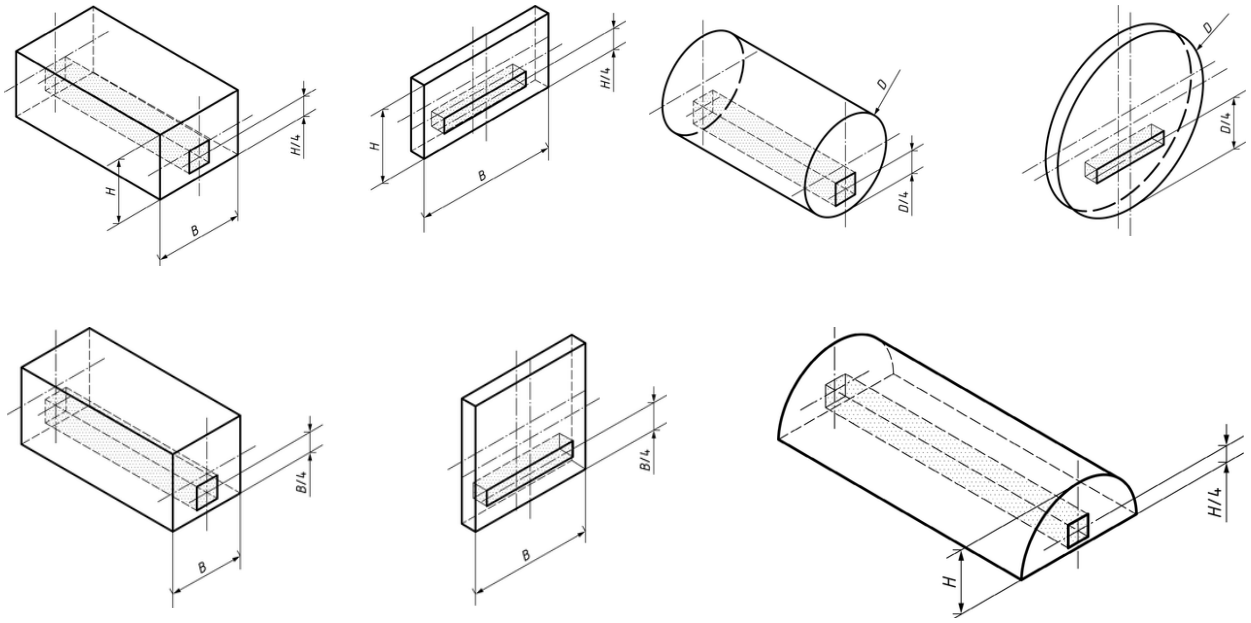
1.7 STRAIGHTNESS TOLERANCE OF BARS



LENGTH (l)	NON-ANNEALED (f)	ANNEALED/FERRITIZED (f)
1000	2 mm	3 mm
2000	4 mm	6 mm
3000	6 mm	9 mm

f : deviation from straight line
l : distance of measurement

1.8 SAMPLING AREA FOR TECHNICAL CHARACTERISTICS VERIFICATION



Mechanical properties are measured on specimens taken directly from the bar. Thanks to the isotropic property of cast iron, samples can be taken longitudinally or transversely, but always at ¼ of the thickness or diameter.

CONTINUOUS CASTING

1.9 TECHNICAL CHARACTERISTICS: LAMELLAR CAST IRON

MATERIAL DESIGNATION		DIAMETER OF THE BAR	MINIMUM TENSILE STRENGTH	MATRIX STRUCTURE	BRINELL HARDNESS RANGE HBW	
Symbol	Number	D in mm	Rm in MPa		MIN	MAX
EN-GJL-150C	5.1102	20< D≤ 50	110	Ferritic. Produced through annealing heat treatment	110	180
		50< D≤100	100			
Material produced through annealing of EN-GJL-250C		100< D≤200	90		Designation according to HB: **EN-GJL-HB150**	
		200< D≤400	80			
EN-GJL-200C	5.1202	20< D≤ 50	155	ferritic-pearlitic	140	210
		50< D≤100	140			
Material available exclusively upon request		100< D≤200	125		Designation according to HB: **EN-GJL-HB175**	
		200< D≤400	115			
EN-GJL-250C	5.1203	20< D≤ 50	195	pearlitic-ferritic	170	240
		50< D≤100	180			
COLOR CODE FOR IDENTIFICATION		100< D≤200	165		Designation according to HB: **EN-GJL-HB200**	
		200< D≤400	155			
EN-GJL-300C	5.1308	20< D≤ 50	220	Primarily pearlitic	200	290
		50< D≤100	205			
COLOR CODE FOR IDENTIFICATION		100< D≤200	195		Designation according to HB: **EN-GJL-HB250**	
		200< D≤400	185			
Glass Mold Iron **GMI**		All sections	170	Ferritic. Produced via annealing heat treatment.	130	210
COLOR CODE FOR IDENTIFICATION		Special cast iron designed for molds used in direct contact with molten glass.				

*The hardness of the cast iron decreases as the diameter or thickness of the bar increases.

The hardness of cast iron decreases as the diameter or thickness of the bar increases. Therefore, if hardness (HB) is a higher priority than tensile strength, this requirement must be specified when placing the order, indicating the desired material using the designation **EN-GJL-HBxxx** (see Table 3, **UNI EN 16482:2024**).

1.9.1 MICROSTRUCTURE OF LAMELLAR CAST IRON



EN-GJL-150C



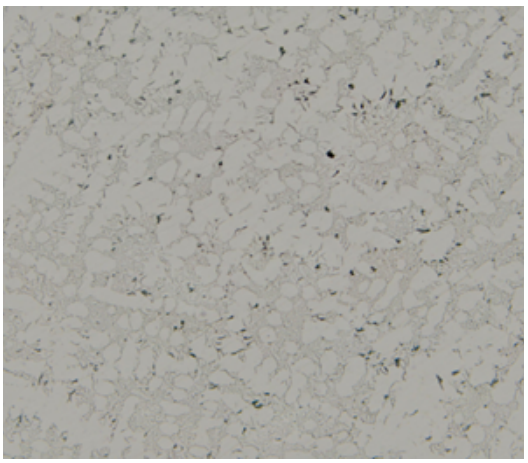
EN-GJL-250C



EN-GJL-300C

In the outer zone of the bar, the graphite features a Type “I”, Class “D” structure (maximum 15% of types E and A).

In the inner zone of the bar, the graphite features a Type “I”, Class “A” structure (maximum 20% of types B, D, and E).



G.M.I. (GLASS MOLD IRON)

Throughout the entire bar section, the graphite features a Type “I”, Class “D”, Size “6–8” structure, ensuring high compactness. This cast iron, specifically developed for glass mold applications, contains extremely fine graphite, which provides excellent surface finish (mirror-like), superior machinability, good thermal conductivity, and promotes strong adhesion of welding deposits.

CONTINUOUS CASTING

1.10 TECHNICAL CHARACTERISTICS: SPHEROIDAL CAST IRON

MATERIAL DESIGNATION SYMBOL AND NUMBER	DIAMETER OF THE BAR D in mm	0,2 % PROOF STRENGTH Rp0,2 - MPa	TENSILE STRENGTH Rm in MPa	A % min	MATRIX STRUCTURE	BRINELL HARDNESS HBW MIN	BRINELL HARDNESS HBW MAX
EN-GJS-350-22C-LT 5.3120	20<D≤60	220	350	22	Ferritic Heat treatment	/	170
	60<D≤120	210	330	18			
UPON REQUEST	120<D≤400	200	320	15			
EN-GJS-350-22C-RT 5.3121	20<D≤60	220	350	22	Ferritic Heat treatment	/	170
	60<D≤120	220	330	18			
UPON REQUEST	120<D≤400	210	320	15			
EN-GJS-350-22C 5.3122	20<D≤60	220	350	22	Ferritic Heat treatment	/	170
	60<D≤120	220	330	18			
UPON REQUEST	120<D≤400	210	320	15			
EN-GJS-400-18C-LT 5.3123	20<D≤60	240	400	18	Ferritic Heat treatment	120	180
	60<D≤120	230	380	15			
UPON REQUEST	120<D≤400	220	360	12			
EN-GJS-400-18C-RT 5.3124	20<D≤60	250	400	18	Ferritic Heat treatment	120	180
	60<D≤120	250	390	15			
UPON REQUEST	120<D≤400	240	370	12			
EN-GJS-400-18C 5.3125	20<D≤60	250	400	18	Ferritic Heat treatment	120	180
	60<D≤120	250	390	15			
UPON REQUEST	120<D≤400	240	370	12			
EN-GJS-400-15C 5.3126	20<D≤60	250	400	15	Ferritic Heat treatment	120	180
	60<D≤120	250	390	14			
UPON REQUEST	120<D≤400	240	370	11			
EN-GJS-400-7C 5.3202	20<D≤60	250	400	7	ferritic-pearlitic	140	210
	60<D≤120	250	390	7			
UPON REQUEST	120<D≤400	240	370	11			
EN-GJS-450-12C 5.3128	20<D≤60	310	450	12	Primarily Ferritic	160	210
	60<D≤120	To be agreed					
UPON REQUEST	120<D≤400						

CONTINUOUS CASTING

TECHNICAL CHARACTERISTICS: SPHEROIDAL CAST IRON

MATERIAL DESIGNATION SYMBOL AND NUMBER	DIAMETER OF THE BAR D in mm	0,2 % PROOF STRENGTH Rp0,2 - MPa	TENSILE STRENGTH Rm in MPa	A % min	MATRIX STRUCTURE	BRINELL HARDNESS HBW MIN	BRINELL HARDNESS HBW MAX
EN-GJS-500-14C 5.3129	20<D≤60	400	500	14	ferritic	180	210
	60<D≤120	390	480	12			
UPON REQUEST	120<D≤400	360	470	10			
EN-GJS-500-7C 5.3203	20<D≤60	320	500	7	ferritic-pearlitic	170	240
	60<D≤120	300	450	7			
Normally on stock	120<D≤400	290	420	5			
	D>400	TO BE AGREED					
EN-GJS-550-6C 5.3205	20<D≤60	380	550	6	pearlitic-ferritic	190	255
	60<D≤120	TO BE AGREED					
UPON REQUEST	120<D≤400						
EN-GJS-600-3C 5.3204	20<D≤60	380	600	3	pearlitic-ferritic	200	290
	60<D≤120	360	600	3			
Normally on stock	120<D≤400	340	550	3			
EN-GJS-700-2C 5.3303	20<D≤60	420	700	2	primarily Pearlitic	210	305
	60<D≤120	400	700	2			
UPON REQUEST	120<D≤400	380	650	1			
EN-GJS-800-2C 5.3304	20<D≤60	480	800	2	primarily Pearlitic	240	335
	60<D≤120	TO BE AGREED					
UPON REQUEST	120<D≤400						

MATERIAL DESIGNATION	SYMBOL	0,2 % PROOF STRENGTH Rp0,2 - MPa	TENSILE STRENGTH Rm in Mpa	A % min	BRINELL HARDNESS HBW MIN	BRINELL HARDNESS HBW MAX
AUSTEMPERED DUCTILE IRON A.D.I.	GRADE 1	550	860	10	269	321
	GRADE 2	700	1050	7	302	363
	GRADE 3	860	1200	4	341	444
UPON REQUEST	GRADE 4	1070	1400	1	388	477

The indicated values are measured after the austempering process.

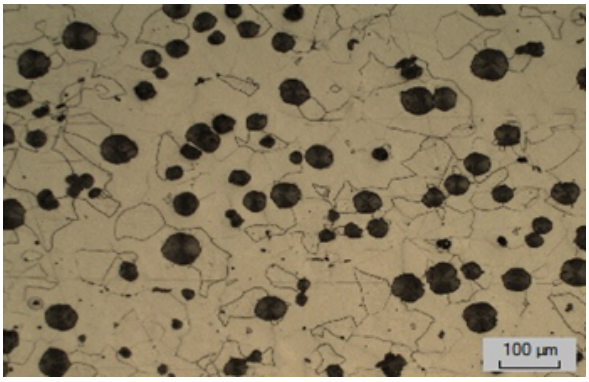
A.D.I. is a spheroidal graphite cast iron alloyed with Cu, Ni, and Mo which, after full austenitizing followed by quenching in a salt bath at 230–450 °C, develops an ausferritic or bainitic structure.
The resulting microstructure provides exceptionally high mechanical properties.



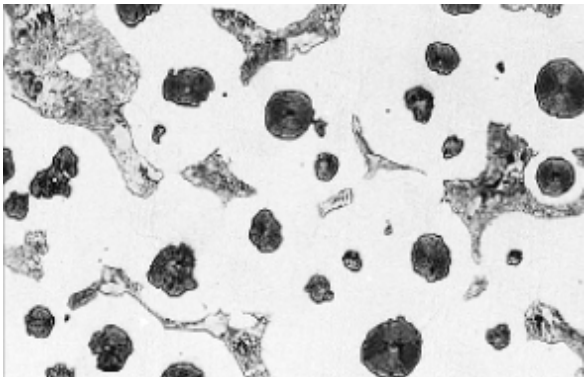
PROPERTIES	Unit	MATERIAL			
		GJS450-12	GJS-500-7C	GJS-600-3C	GJS-700-2C
Shear strength	MPa	405	450	540	630
Torsional strength	MPa	405	450	540	630
Modulus of elasticity E	GN/m²	169	169	174	176
Poisson's ratio v	-	0,275	0,275	0,275	0,275
Compression strength	MPa	700	800	870	1000
Thermal conductivity at 300 °C	W/(K•m)	36,2	35,2	32,5	31,1
Specific heat capacity 20 °C to 500 °C	J/(kg•K)	515	515	515	515
Linear expansion coefficient 20 °C to 400 °C	µm/(m•K)	12,5	12,5	12,5	12,5
Density	kg/dm³	7,1	7,1	7,2	7,2
Maximum permeability	µH/m	2136	1596	866	501
Resistivity	µΩ•m	0,50	0,51	0,53	0,54

CONTINUOUS CASTING

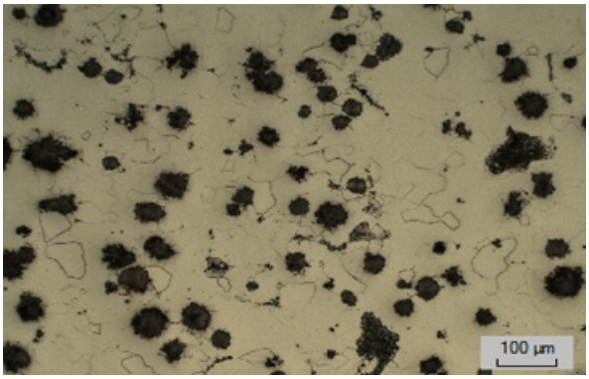
1.10.1 MICROSTRUCTURE OF SPHEROIDAL CAST IRON



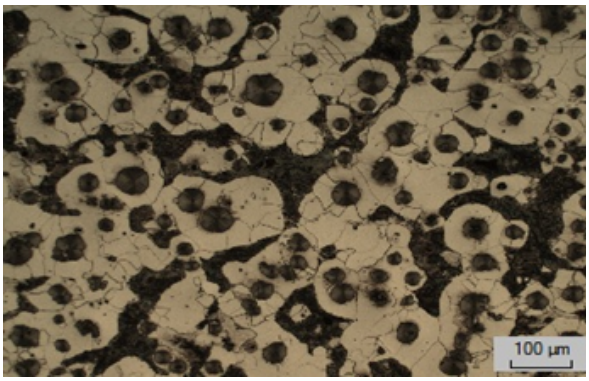
EN-GJS-400-15C



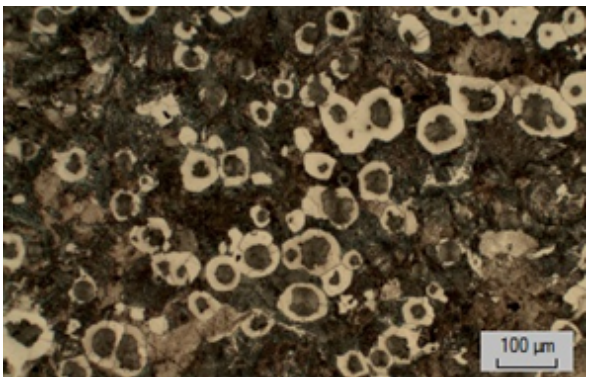
EN-GJS-400-7C



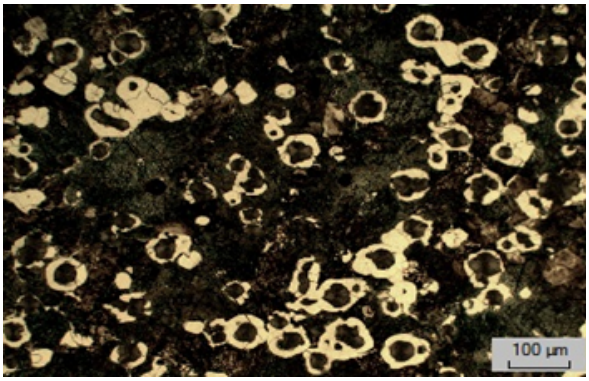
EN-GJS-500-14C



EN-GJS-500-7C



EN-GJS-600-3C



EN-GJS-700-2C

2. CAST IRON PRODUCED BY SHELL CASTING

Shell casting allows obtaining a more compact structure than continuous casting, using steel molds (shells).

This process allows the production of any type of cast iron and is typically employed for manufacturing large-size blocks, taking advantage of the rapid and uniform cooling of the metal, which ensures a homogeneous and dense structure.

Shell-cast iron is identified by the letter “K” instead of “C” (continuous casting), for example: GJL-250K or GJS-500-7K.



2.1 ADVANTAGES OF SHELL CASTING

- Improved mechanical and technological properties
- Better suitability for surface treatments (hardening, chrome plating, nickel plating, polishing)
- Improved machinability thanks to greater casting homogeneity
- Greater compactness and homogeneity, making the castings suitable for use in the hydraulic sector, even at high pressures



2.2 ACHIEVABLE DIMENSIONS

ROUNDS	Ø130 - Ø660 : length 1020 mm Ø680 - Ø1200 : length 550 mm (unless otherwise specifically agreed)
TUBES	Max external Ø 1170 mm - Min internal Ø 250 mm max Length 900 mm min width 40 mm
SQUARE	up to 500 x 500 x 1020 mm
RECTANGULAR	up to 340 x 610 x1020 mm
PLATES	up to 1400 x 1120 x 200 mm

It is also possible to manufacture dimensions different from those listed above. We recommend contacting our sales department to verify the feasibility of the required parts.

All bars or blocks are usually supplied rough-turned or milled on four sides, with a tolerance of +1 / +3 mm, and cut to length (upon specific request, milling or turning of the length is also available).

For bushings, the tolerance on the internal diameter is −1 / −3 mm.

2.3 Production and Delivery Time

Due to the wide range of dimensions produced, only selected round, square, and rectangular sections are normally kept in stock; therefore, availability should always be checked.

If the required material is not in stock, delivery times will be defined at the quotation phase, based on the current workload of the production facilities.

3. DIMENSIONAL TABLES AND THEORETICAL WEIGHTS PER METER

ROUND ●

Ø mm	kg/m	Ø mm	kg/m	Ø mm	kg/m	Ø mm	kg/m	Ø mm	kg/m	Ø mm	kg/m
20	2,3	**75**	32	**125**	89	**200**	228	**300**	514	**400**	914
30	5	**80**	37	**130**	97	**210**	252	**310**	549	**410**	959
35	7	**85**	41	**135**	104	**220**	276	**320**	585	**420**	1007
40	9	**90**	46	**140**	112	**230**	302	**330**	622	**430**	1056
45	12	**95**	52	**145**	120	**240**	329	**340**	660	**450**	1156
50	14	**100**	57	**150**	129	**250**	357	**350**	700	**500**	1428
55	17	**105**	63	**160**	146	**260**	401	**360**	740	**530**	1604
60	21	**110**	69	**170**	165	**270**	416	**370**	782	**550**	1727
65	24	**115**	76	**180**	185	**280**	448	**380**	825	**600**	2056
70	28	**120**	82	**190**	206	**290**	480	**390**	869	**650**	2412

SQUARE ■

mm	kg/m	mm	kg/m	mm	kg/m	mm	kg/m	mm	kg/m	mm	kg/m
30X30	7	**65X65**	31	**95X95**	66	**150X150**	164	**210X210**	321	**280X280**	570
40X40	12	**70X70**	36	**100X100**	73	**160X160**	186	**220X220**	352	**300X300**	654
45X45	15	**75X75**	41	**110X110**	88	**170X170**	210	**230X230**	385	**330X330**	792
50X50	18	**80X80**	47	**120X120**	105	**180X180**	236	**240X240**	419	**360X360**	942
55X55	22	**85X85**	53	**130X130**	123	**190X190**	262	**250X250**	454	**470X470**	1606
60X60	26	**90X90**	60	**140X140**	143	**200X200**	291	**260X260**	492	**500X500**	2199

DIMENSIONAL TABLES AND THEORETICAL WEIGHTS PER METER

RECTANGLES

mm	kg/m	mm	kg/m	mm	kg/m	mm	kg/m	mm	kg/m	mm	kg/m
40X20	6	90X40	26	110X90	72	140X100	102	210X50	76	420X120	366
40X25	7	90X50	33	120X40	35	140X110	112	210X130	199	457X317	207
50X30	11	90X60	39	120X50	44	150X30	33	210X160	244	520X100	378
50X40	15	90X70	46	120X60	52	150X90	98	220X170	272	520X120	453
60X30	13	100X30	22	120X70	61	150X100	109	230X30	50	520X480	1815
60X40	19	100X40	29	120X80	70	160X60	70	245X165	294	551X501	2007
70X30	15	100X50	36	120X90	79	160X80	93	250X190	345	558X355	1440
70X40	20	100X60	44	130X50	47	160X100	116	300X150	327	558X406	1647
70X50	26	100X70	51	130X60	57	170X140	173	320X50	116	560X515	2097
70X60	31	100X80	58	130X70	66	180X60	79	320X60	140	570X530	2196
80X30	18	110X40	32	130X80	76	180X90	118	320X100	233	609X260	1151
80X40	23	110X50	40	130X100	95	180X100	131	387X311	875	610X410	1818
80X50	29	110X60	48	140X50	51	200X100	145	400X50	145	730X95	504
80X60	35	110X70	56	140X60	61	205X60	89	420X80	244	780X180	1021
90X30	20	110X80	64	140X70	71	205X85	127	420X100	305		

GMI

D x H (mm)	kg/m
90X48	25
94X52,5	29
108X58	36
115X63	42

Supplied in Half-Round Section

The sections listed above are the most common, but other sections may also be available in stock.

For more detailed information, please contact our sales department. Larger dimensions can be produced using the shell-casting method.

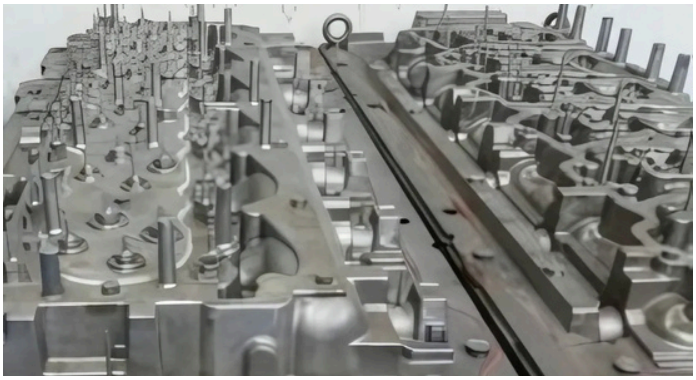
CONTINUOUS CASTING

4. PEARLITIC SPHEROIDAL CAST IRON "WRI-100"

Special cast irons, available exclusively on request, subject to minimum order quantities.

The WRI-100 spheroidal cast iron is a "non-standard" material, specifically designed and produced for the construction of core boxes, plates, and models used in high-production green sand molding lines, as well as for model production.

WRI-100 is essentially a modified GJS-700-2C spheroidal cast iron, engineered to make it interchangeable with 40CrMnMo7 steel (AISI P20) in certain applications.



4.1 MICROSTRUCTURE

- **Matrix:** predominantly pearlitic (over 80% pearlite)
- **Carbides:** <5%, well dispersed
- **Graphite shape:** Type I and II (80%)
- **Graphite size:** 5–8

AVERAGE CHEMICAL ANALYSIS

C%	Si%	Mn%	P%	S%	Cu%	Ni%	Mo%	Mg%
3,3 - 3,8	2,5 - 3,1	0,3 max	0,08 max	0,02 max	0,1 max	0,10 max	0,1 max	0,03 - 0,05

4.2 Main Technical Characteristics

High surface density and integrity
(resulting from the combination of spheroidal graphite and pearlite)

High wear resistance (exceeding P.20 steel)
(due to the properties of spheroidal cast iron)

Good corrosion resistance and thermal fatigue strength
(due to the properties of GJS cast iron)

Excellent machinability, leading to reduced production costs

Guaranteed absence of internal defects
(thanks to continuous casting production)

Suitable for quenching heat treatment, with achievable hardness up to 55–60 HRC.



4.3 GENERAL MECHANICAL PROPERTIES

Density	kg/dm³ 7,2	**Compression strength**	MPa 1000
Brinell Hardness HBW	230- 300	**Thermal conductivity at 300 °C**	W/(K•m) 31,1
Shear strength	MPa 620	**Linear expansion coefficient 20 °C to 400 °C**	µm/ (m•K) 12,5
Tensile Strength	MPa 700 min	**Modulus of elasticity E (tension and compression)**	GN/m² 176
Torsional Strength	MPa 620	**Fatigue limit without notch (Ø10.6 mm)**	MPa 280
Elongation (%)	da 2% a 5%	**Fatigue limit with notch (Ø10.6 mm)**	MPa 168

4.4 Sections Available on Request

The information in this table is for general guidance only.

380x260x2300 mm	**500x100x2000 mm**	**650x100x2250mm**	**650x200x2250 mm**
575x90x2000 mm	**610x410x2250 mm**	**650x140x2250 mm**	**Other sections to be defined**