

**Unibar**

# **Technical Documentation**

Unibar. Continuous Cast Iron Bar produced by United Cast Bar Limited

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**UNIBAR SPHEROIDAL GRAPHITE (SG)**  
**PRINCIPAL CHARACTERISTICS**

3.2

## **UNIBAR 400-15**

SPHEROIDAL FERRITIC CAST IRON. (GJS-400-15 EN-1563)

### **GENERAL DESCRIPTION**

Its structure is ferritic, obtained via heat treatment (190 HB max), and is therefore used when machinability and a good surface finish are the required characteristics. Because of its ferritic structure it is recommended for uses requiring high heat and/or electric conductivity, as well as good magnetic permeability.

UNIBAR-400-15 possesses high ductility, as illustrated by its high percentage of elongation. It can be manufactured with values of hardness of 180 HB as a maximum and elongation corresponding to the standard GJS-400-18 EN-1563, with or without impact resistance specifications, according to the order specifications.

### **AVAILABILITY**

Available subject to consultation. UNIBAR-400-15 quality is obtained by means of thermal/ annealing treatment of UNIBAR-500-7. See the list of Standard Sizes on page 40

## **UNIBAR-500-7**

### **SPHEROIDAL PEARLITIC-FERRITIC CAST IRON. (GJS-500-7 EN-1563)**

#### **GENERAL DESCRIPTION**

UNIBAR-500-7 (180-230 HB) has a better resistance to wear than UNIBAR-400-15 because of its pearlitic-ferritic structure, and is therefore recommended for applications in which good machinability and surface finish are required, as well as minimal friction with other parts and/or materials.

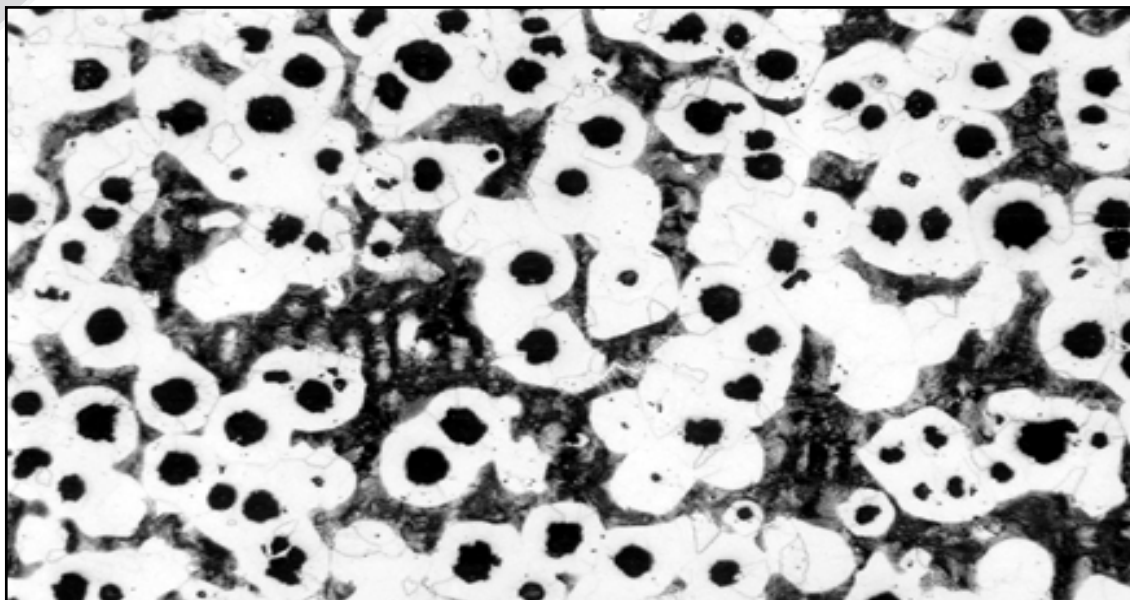
The values of hardness vary according to the dimensions of the bar, producing a maximum of 220-210-200-190 HB (for pearlitic structures of 15/20%). This means that UNIBAR-500-7 also complies with the mechanical characteristics required and the values of hardness, from qualities of UNIBAR-400-15(GJS-400-15) and UNIBAR-500-7(GJS-500-7), as demonstrated in the table, "Mechanical Characteristics, Hardness and Spheroidal Graphite (SG)", on page 48".

Subject to special order specifications certain dimensions can be supplied with maximum hardness of 190 HB, it being necessary to anneal smaller dimensions (UNIBAR-400-15) in order to reach this hardness; and given that, due to its partially pearlitic structure (20%), the maximum hardness can reach 220/230 HB.

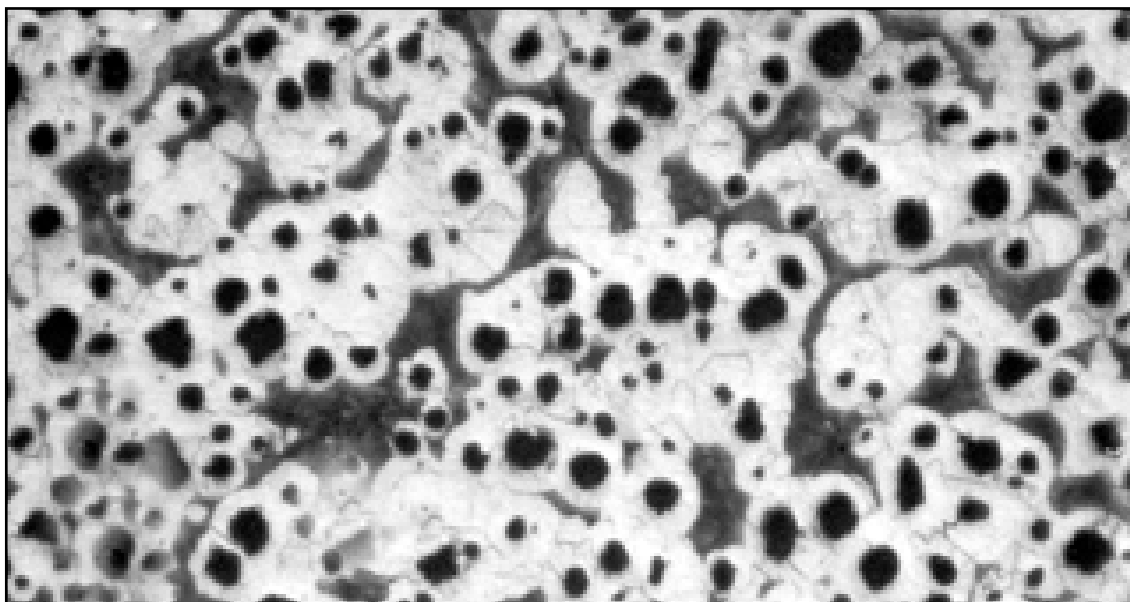
#### **AVAILABILITY**

Available from stock. See list of Standard Sizes on page 40.

However, any other size not included in the list can be produced according to minimum tonnage and after consultation.



UNIBAR-500-7 Core  $\geq 20\%$  Pearlite. HB  $> 200$



UNIBAR-500-7 Core  $\leq 10\%$  Pearlite. HB  $< 200$

## **UNIBAR-600-3**

### SPHEROIDAL PERLITIC CAST IRON (GJS-600-3 EN-1563)

#### **GENERAL DESCRIPTION**

UNIBAR-600-3 has a structure that is predominantly pearlitic (>50%) in the core, which makes it specially recommended for applications requiring high resistance to wear and maximum strength.

The average hardness values fall within the range HB-200-260.

#### **AVAILABILITY**

Available subject to consultation, taking the UNIBAR-500-7 sizes as a basis (see list of Standard Sizes on page 40).

Subject to minimum order.

## **UNIBAR-700-2**

### SPHEROIDAL PEARLITIC CAST IRON (GJS-700-2 EN-1563)

#### **GENERAL DESCRIPTION**

UNIBAR-700-2 possesses a pearlitic structure, including the periphery, with percentages of 20-30% of ferrite in the core. Resistance to wear, tensile stress and elastic limit have maximum values corresponding to hardness 230-290 HB.

#### **AVAILABILITY**

Available subject to consultation, taking the UNIBAR-500-7 sizes as a basis (see the list of Standard Sizes on page 40).

Subject to minimum order.

## UNIBAR-ADI

### (AUSTEMPERING DUCTILE IRON)

#### GENERAL DESCRIPTION

UNIBAR-ADI is an austempered material (isothermic transformation of the austenite), a process that produces a bainitic structure. Therefore UNIBAR-600-3 is alloyed with elements such as Molybdenum, Nickel and Copper. This type of structure increases the strength and particularly the elastic limit, producing a higher resistance to deformation. These values can equal or even exceed those of some steel alloys.

UNIBAR-ADI is manufactured subject to consultation, since it is not a standard item.

Among the advantages of UNIBAR-ADI, are the following:

- ▶ The ability to utilise dimensions very close to the finished size prior to the austempering treatment, thus allowing better dimensional stability in comparison with steels. Through hardening is required to produce similar properties in steels with the attendant risk of distortion.
- ▶ Ease of machining, similar to UNIBAR-600-3, in comparison with various steels, due to the lubricating effect of the graphite. The hardness values prior to the austempering treatment vary between 220-280 HB;
- ▶ UNIBAR-600-3 can also be pre-annealed in order to get a better machinability prior to the austempering process.
- ▶ Vibration damping higher than that of steel;
- ▶ Good ratio of ductility to strength with high values of elastic limit:

<b>From</b>	850MPa(UTS)	550Mpa (PS-0.2%)	10%(EI)
<b>To</b>	1400Mpa(UTS)	1100Mpa (PS-0.2%)	1%(EI)

#### AVAILABILITY

Available subject to consultation, taking the UNIBAR-500-7 measurements as a basis (see the list of Standard Sizes on page 40). Subject to minimum order.

## **COMPARISON BETWEEN UNIBAR-ADI AND STEEL**

Below are some details of the points that must be taken into account when considering replacing steel-made applications with UNIBAR-ADI

1. In the first instance, specify the type of steel that is being used for a given application. That is, we must determine whether this is forged or cast steel, normal steel (F-114/F-115, etc.), or special high resistance steel (F-133/F125. etc.).
2. Determine whether this steel is machined directly, going on to be used in a standard way, namely, without hardening and tempering, or whether it is treated steel. In addition, it is advisable to know whether the steel machining takes place before or after the heat treatment operation, or if a mixed option is chosen which means that certain parts are machined before treatment, followed by minor modifications in dimensions at a later date.
3. Check the required performances on the finished part:
  - ▶ Is High Impact Resistance or the elastic limit the most important characteristic?
  - ▶ Have the design parameters been oversized so that the Mechanical Characteristics of the material can guarantee the satisfaction of service requirements?
  - ▶ Is it possible to study alternatives in order to reduce costs by means of greater accuracy in fixing the parameters of the design (for example, weight of the part)?
4. When establishing a comparison of costs for machining, it is essential to know whether the machining refers to the steel before or after treatment, especially in the case of a forged profile, or a part made of cast steel.
5. It is important to remember that the range of defects (holes, scouring, drawing, etc.) of the steel (especially the cast steel) is higher than that for the Unibar casting process.

## **ADVANTAGES OF UNIBAR-ADI OVER STEEL**

- ▶ Compared with the types of steel most commonly used on the market, such as F-114 and F-115 (hard or semi-hard steel without treatment), UNIBAR-500-7 has an equivalent or higher elastic limit ( $>450\text{MPa}$ ) with similar values of hardness (HB200-230), as well as better machinability. UNIBAR-400-15, (with elastic limit  $>250\text{MPa}$ .) may be used as an alternative to standard steels with lower hardness values such as F-112 or F-111.
- ▶ If the standard steel (F-114/F-115, etc.) is hardened and tempered, the values of tensile strength and yield strength rise. This also occurs in the Unibar spheroidal grades, although our recommendation is for surface hardening and not through hardening.
- ▶ In the field of alloy steels, comparison can be made with UNIBAR-ADI due to its bainitic structure (the austempering treatment must be carried out once the part concerned has been machined). This type of structure gives UNIBAR-ADI values of elastic limit higher than those of certain alloy steels, while offering better machining performance.
- ▶ UNIBAR-ADI with hardnesses of 200/250 HB before austempering treatment, offers machining similar to that of UNIBAR-600-3. In addition, its dimensional stability which is higher than that of steel, means that the dimensions obtained prior to austempering can virtually be the final dimensions.
- ▶ In general, steel exceeds the ductility and tenacity (impact resistance) of the Unibar Spheroidal grades. However, as these properties are rarely necessary, the use of UNIBAR-ADI offers clear advantages in comparison with steel, as has been explained above.
- ▶ Given that, independent of the material used, the majority of parts must retain their shape during use, however demanding this may be, the capacity of the material to be plastically deformed without breaking (ductility) is considered a safety measure. Nevertheless, in applications such as gearing, breakage can be a fail safe mechanism.

- ▶ In general, the most valuable property in the majority of designs is tensile strength, not ductility. Most technical calculations are therefore based on the elastic limit, increased by a safety factor, and not on tensile strength. This is why using Unibar Spheroidal Graphite bar offers clear advantages over steel.

	<b>UTS (Mpa)</b>	<b>0.2%PS (Mpa)</b>	<b>% Elongation</b>	<b>H.B.</b>
Ferritic-Pearlitic	400-800	250-500	22-2	140-300
Hardened and Tempered	Up to 1200	Up to 900	2-1	Up to 550
A.D.I.	800-1600	600-1400	10-1	260-480
Austenitic	370-450	190-210	6-20	120-210
Standard Carbon Steel	400-750	450-250	25-11	130-220
Hardened and Tempered Steel (including alloy)	650-1800	450-1400	15-5	200-500

**UNIBAR STANDARD SIZES. UNIBAR 500-7**

**UNIBAR 500-7**

Round ●				Squares ■				Rectangles ▭			
	Standard	Optional	Ingots		Standard	Optional	Ingots		Standard	Optional	Ingots
30 mm.	x			40 x 40 mm.	x			50 x 45 mm.	x		
35 mm.	x			50 x 50 mm.	x			65 x 35 mm.	x		
40 mm.	x			60 x 60 mm.	x			65 x 50 mm.	x		
45 mm.	x			70 x 70 mm.	x			70 x 40 mm.	x		
50 mm.	x			75 x 75 mm.	x			70 x 50 mm.	x		
55 mm.	x			80 x 80 mm.	x			70 x 60 mm.	x		
60 mm.	x			85 x 85 mm.	x			80 x 60 mm.	x		
65 mm.	x			90 x 90 mm.	x			82 x 69 mm.	x		
70 mm.	x			95 x 95 mm.	x			85 x 30 mm.	x		
75 mm.	x			100 x 100 mm.	x			85 x 55 mm.	x		
80 mm.	x			105 x 105 mm.	x			88 x 82 mm.	x		
85 mm.	x			110 x 110 mm.	x			90 x 55 mm.	x		
90 mm.	x			115 x 115 mm.	x			90 x 60 mm.	x		
95 mm.	x			120 x 120 mm.	x			90 x 65 mm.	x		
100 mm.	x			130 x 130 mm.	x			95 x 75 mm.	x		
105 mm.	x			135 x 135 mm.	x			100 x 50 mm.	x		
110 mm.	x			140 x 140 mm.	x			100 x 70 mm.	x		
115 mm.	x			150 x 150 mm.	x			100 x 80 mm.	x		
120 mm.	x			155 x 155 mm.	x			110 x 55 mm.	x		
125 mm.	x			160 x 160 mm.	x			110 x 62 mm.	x		
130 mm.	x			165 x 165 mm.	x			110 x 70 mm.	x		
135 mm.	x			170 x 170 mm.	x			110 x 85 mm.	x		
140 mm.	x			180 x 180 mm.	x			120 x 50 mm.	x		
145 mm.	x			190 x 190 mm.	x			120 x 70 mm.	x		
150 mm.	x			200 x 200 mm.	x			120 x 90 mm.	x		
155 mm.	x			210 x 210 mm.	x			120 x 95 mm.	x		
160 mm.	x			220 x 220 mm.	x			120 x 100 mm.	x		
165 mm.	x			230 x 230 mm.	x			125 x 95 mm.	x		
170 mm.	x			240 x 240 mm.	x			125 x 105 mm.	x		
180 mm.	x			250 x 250 mm.	x			130 x 55 mm.	x		
190 mm.	x			260 x 260 mm.		x		130 x 65 mm.	x		
200 mm.	x			270 x 270 mm.		x		130 x 90 mm.	x		
210 mm.	x			280 x 280 mm.		x		130 x 100 mm.	x		
220 mm.	x			290 x 290 mm.	x			130 x 110 mm.	x		
230 mm.	x			300 x 300 mm.		x		135 x 85 mm.	x		
240 mm.	x			310 x 310 mm.		x		135 x 95 mm.	x		
250 mm.	x			320 x 320 mm.		x		140 x 90 mm.	x		
260 mm.	x			330 x 330 mm.	x			140 x 110 mm.	x		
270 mm.	x			340 x 340 mm.			x	140 x 125 mm.	x		
280 mm.	x			350 x 350 mm.			x	145 x 75 mm.	x		
290 mm.	x			360 x 360 mm.		x		145 x 105 mm.	x		

## UNIBAR 500-7

Round ●			Squares ■			Rectangles ▣					
	Standard	Optional	Ingots		Standard	Optional	Ingots		Standard	Optional	Ingots
300 mm.	x			370 x 370 mm.			x	150 x 85 mm.	x		
310 mm.		x		380 x 380 mm.			x	150 x 100 mm.	x		
320 mm.	x			390 x 390 mm.			x	150 x 140 mm.	x		
330 mm.		x		400 x 400 mm.			x	160 x 110 mm.	x		
340 mm.		x		410 x 410 mm.		x	x	160 x 130 mm.	x		
350 mm.	x			420 x 420 mm.			x	165 x 90 mm.	x		
360 mm.		x		430 x 430 mm.			x	165 x 145 mm.	x		
370 mm.	x			440 x 440 mm.			x	168 x 60 mm.	x		
380 mm.		x		450 x 450 mm.			x	175 x 110 mm.	x		
390 mm.		x		460 x 460 mm.			x	175 x 135 mm.	x		
400 mm.	x			470 x 470 mm.			x	175 x 145 mm.	x		
410 mm.		x		480 x 480 mm.			x	180 x 130 mm.	x		
420 mm.		x		490 x 490 mm.			x	185 x 125 mm.	x		
430 mm.		x		500 x 500 mm.			x	190 x 130 mm.	x		
440 mm.		x		510 x 510 mm.			x	190 x 170 mm.	x		
450 mm.		x		520 x 520 mm.			x	200 x 140 mm.	x		
460 mm.				530 x 530 mm.			x	205 x 100 mm.	x		
470 mm.		x		540 x 540 mm.			x	208 x 184 mm.	x		
480 mm.				550 x 550 mm.			x	210 x 160 mm.	x		
490 mm.								220 x 120 mm.	x		
500 mm.		x						235 x 80 mm.	x		
510 mm.								230 x 180 mm.	x		
520 mm.								235 x 185 mm.	x		
530 mm.								235 x 230 mm.	x		
540 mm.								240 x 190 mm.	x		
550 mm.								245 x 155 mm.	x		
560 mm.								245 x 195 mm.	x		
570 mm.								250 x 85 mm.	x		
580 mm.								250 x 245 mm.	x		
590 mm.								255 x 185 mm.	x		
600 mm.								260 x 200 mm.	x		
610 mm.								320 x 80 mm.			x
620 mm.								320 x 100 mm.			x
630 mm.								320 x 120 mm.			x
640 mm.								320 x 220 mm.	x		
650 mm.								380 x 90 mm.	x		
								400 x 80 mm.	x		
								400 x 100 mm.	x		
								400 x 180 mm.	x		
								420 x 80 mm.			x
								420 x 100 mm.			x
								420 x 120 mm.			x
								430 x 330 mm.	x		



**STANDARD LENGTHS FOR UNIBAR SPHEROIDAL GRADES**

	AS-CAST			MACHINED						
	Round	Square	Rectangle	Ingots		Tubes		Peeled	Milled	Turned
				Round	Square	Outside Machined	Outside As-cast			
1000 mm -0/+50 mm	⊙	⊙	⊙	■	■	■	■	⊙	⊙	⊙
2000 mm +50/+150 mm	⊙	⊙	⊙			■	■	⊙	■	■
3000 mm +50/+150 mm	■	■	■					■		■
Others	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙

■ Standard Length  
 ⊙ Possible as special if required both Length and Tolerance.

## SURFACE HARDENINGS (SELECTIVE)

The UNIBAR-600-3 and UNIBAR-700-2 grades are recommended for surface hardening treatments, and especially UNIBAR-700-2 if high post-treatment hardness values are required in areas close to the outside of the bar. In the areas close to the core, lower values may be obtained because of the larger size of the nodules.

Likewise other surface hardening processes are possible, which are normally used in spheroidal cast iron, such as nitriding, etc. It is advisable for the treatment specialist to be aware of the characteristics of the material in terms of its chemical composition, hardness and core-peripheral structure.

## MACHINING ALLOWANCE FOR SG IRON BARS

DIMENSION (mm)	ROUND	SQUARE AND RECTANGULAR
	Minimum Machining Allowance	Minimum Machining Allowance
25-50	2 mm	2.5 mm
55-75	2.5 mm	3 mm
80-100	3 mm	4 mm
105-150	4 mm	5 mm
155-200	5 mm	6 mm
210-280	6 mm	7 mm
290-350	8 mm	9 mm
360-430	10 mm	12 mm

## NOTE:

This machining allowance refers to the radius of the round bar or to each face of the square or rectangular bar. For example, in order to obtain a  $\pm 40$  mm as a final dimension, we must start with a  $\pm 44$  mm as a minimum. In the case of square and rectangular sections, we have to machine a dimension 108x108 mm or over in order to obtain a final dimension of 100x100 mm.

**DIMENSIONAL TOLERANCE OF SG IRON BARS**

<b>DIAMETER (mm)</b>	<b>TOLERANCE in comparison with the nominal measurement</b>	<b>Maximum Ovality <math>\emptyset-\emptyset</math></b>
20-100	- 0.5 / +2 mm	2 mm
105-200	- 0.5 / +3 mm	3 mm
> 200	- 3/ +3 mm	4 mm

SHAPE	In comparison with the nominal measurement SQUARE C x C	TOLERANCE SQUARE C < 100 mm	TOLERANCE SQUARE 100 ≤ C-Width ≤ 200	TOLERANCE SQUARE 200mm < C
<b>SQUARE</b>	C -	C(- 0.5,+2)	C(- 0.5,+3)	C(- 3,+3)
	In comparison with the nominal measurement RATIO C / c C- Widt...c- Height	TOLERANCE RECTANGLE c-Height C-Width < 100 mm	TOLERANCE RECTANGLE c-Height 100 < = C-Width ≤ 200	TOLERANCE RECTANGLE c-Height 200mm < C-Width
<b>RECTANGLE</b>	1 < C/c < 1,5	c(0,+2) C(- 0.5,+2)	c(0,+3) C(- 0.5,+3)	c(0,+4) C(- 3,+3)
	1,5 = < C/c < 2	c(0,+3) C(- 0.5,+2)	c(0,+4) C(- 0.5,+3)	c(0,+5) C(- 3,+3)
	2 = < C/c < 3	c(0,+4) C(- 0.5,+2)	c(0,+5) C(- 0.5,+3)	c(0,+6) C(- 3,+3)
	3 = < C/c < 4	c(0,+5) C(- 0.5,+2)	c(0,+6) C(- 0.5,+3)	c(0,+7) C(- 3,+3)
	4 < C/c	c(0,+6) C(- 0.5,+2)	c(0,+7) C(- 0.5,+3)	c(0,+8) C(- 3,+3)

## CHEMICAL COMPOSITION

Unibar guarantees the physical characteristics particular to its various grades, with the chemical composition subject to the discretion of its Technical Department. Required variations to the mechanical or compositional characteristics must be discussed in advance and specified on the order (for example, percentage of elements which influence austempering for Unibar-ADI).

The following table shows the chemical composition of the various Unibar spheroidal grades for information purposes only. The percentages of C and Si vary according to the dimensions of the bar.

<b>ELEMENT</b>	<b>%</b>
<b>Carbon</b>	3.4 - 3.85
<b>Silicon</b>	2.3 - 3.1
<b>Manganese</b>	0.1 - 0.3
<b>Sulphur</b>	0.020 max.
<b>Phosphorus</b>	0.1 max.

## MECHANICAL CHARACTERISTICS, HARDNESS AND SPHEROIDAL GRAPHITE (SG) STRUCTURE.

UNIBAR GRADE	DIAMETER COOLING MODULUS	HARDNESS RANGE H.B. 2.5/187.5	% PEARLITE	0.2 % PS (N/mm <sup>2</sup> ) or (Mpa) -Min.-	UTS (N/mm <sup>2</sup> ) or (Mpa) -Min.-	% TEL -Min.-
<b>UNIBAR 400-15</b>	< 50 mm	190 MAX	10 MAX	250	390	15
	> 50 mm	180 MAX	10 MAX	240	370	12
<b>UNIBAR 500-7</b>	< 50 mm	180-230	15-50	300	450	7
	> 50 mm			290	420	5
<b>UNIBAR 600-3</b>	< 50 mm	200-260	50-80	360	600	3
	> 50 mm			340	550	1
<b>UNIBAR 700-2</b>	< 50 mm	230-290	70-100	400	700	2
	> 50 mm			380	660	1

The table above shows details of the minimum values.

### NOTE:

- 1 UNIBAR-400-15 can be supplied, subject to consultation, with specific values relating to elongation and/or minimum impact resistance, as well as maximum values of hardness (according to dimensions).
- 2 UNIBAR-500-7 can be supplied, subject to consultation, with specific maximum values of hardness and percentage of pearlite (depending on dimensions). The EN-1563 (Spheroidal) and EN-1561 (Laminar) standards provide for casting requests in accordance with specific HB hardness values. In this case, these values will determine the Unibar grade, while the mechanical characteristics (UTS, PS, EL) will be provided for information only.
- 3 Spheroidal Unibar has a rim on the periphery with approximately 200/250 nod/mm<sup>2</sup>. The structure is predominantly ferritic in the grades UNIBAR-400-15 and UNIBAR-500-7 and predominantly pearlitic in UNIBAR-600-3 and UNIBAR-700-2. With regard to the core, the number of nodules is approximately 80/150 nod/mm<sup>2</sup>, depending on the dimensions involved.
- 4 The graphite comes in forms V and VI (EN ISO 945), or Types I and II (ASTM A-247).
5. UNIBAR-500-7, 600-3 and 700-2 can have a maximum percentage of 5% Fe<sub>3</sub>C in a form dispersed in the outside rim.

**UNIBAR NI-RESIST**

3.3

## **UNIBAR NI-RESIST**

### **UNIBAR-NR-F (FLAKE GRAPHITE) AND UNIBAR-NR-S (SPHEROIDAL GRAPHITE)**

#### **GENERAL DESCRIPTION**

UNIBAR Ni-Resist is characterised by having an austenitic structured matrix produced by means of alloying with Ni, in the presence of carbides. UNIBAR Ni-Resist offers excellent resistance to heat, corrosion and wear, without being magnetic. In addition, it has high values of resistance to wear without this affecting machinability. It is non-magnetic at any temperature, making it especially suitable for electrical applications and navigational components.

UNIBAR Ni-Resist guarantees dimensional stability since austenite is a stable phase even at high temperatures.

The more common applications however are corrosion-resisting parts particularly in seawater, sulphuric acid, hydrochloric acid, and petroleum refining. Heat-resistance is another area where Ni-Resist is commonly used (furnace parts etc.). A recent application, which combines both these properties, is in an exhaust brake for commercial vehicles. It possesses the same coefficient of expansion as aluminium, making it suitable for wear-resisting inserts in aluminium components such as valve guides in cylinder heads and ring carriers in aluminium pistons.

As with the Unibar pearlitic-ferritic grades, graphite can be offered in this austenitic casting in lamellar (ASTM A-436) or spheroidal (ASTM A-439) form. For particular uses requiring higher mechanical characteristics, spheroidal austenitic casting is advisable. The compositional properties of both types of Ni-Resist are detailed in the following table:

Chemical Composition	UNIBAR NR-F	ASTM A436 Type 1	UNIBAR NR-N	ASTM A439 Type D2
% Carbon	3.00 Max	3,0 Max	3.00 Max	3,00 Max
% Silicon	1,5 – 2,8	1,00 - 2,8	1.5 - 3.0	1,5 - 3,0
% Manganese	0,5 - 1.5	0,5 - 1,5	0.5 - 1.5	0,7 - 1,25
% Phosphorus			0.08 Max	0,08 Max
% Nickel	13.5 - 17.5	13,5 - 17,5	18,00 – 22,00	18,00 - 22,00
% Copper	5.5 - 7.5	5,5/7,5	0,5 Max.	N/A
% Chromium	1.00 - 2.50	1,00 - 2,50	1.00 - 2.50	1,75 - 2,75
% Sulphur		0,12 Max		
Mechanical Characteristics				
0.2%PS-ksi(Mpa)	N/A	N/A	30.5(210)	30 (207) Min
UTS-ksi (Mpa)	24,6/170 Min.	25/172 Min	53,7(370)	58 (400) Min
% Elongation	N/A	N/A	7 Min.	8 Min
Brinell Hardness	140 - 202	131 - 183	140 - 200	139 - 202

### AVAILABILITY

UNIBAR Ni-Resist is not a grade that is normally held on stock; its availability is subject to consultation.