



lebronze alloys



ARCAP<sup>®</sup> alloys

Anti-corrosion

Anti-magnetism

Machinability



# ARCAP®: high performance alloys with cutting edge properties



## High corrosion resistance

ARCAP® alloys are highly resistant to most chemical and physico-chemical agents.

LBA can provide you with data about the corrosion behaviour of ARCAP® alloys in various reactive media (corrosion tables available on request).

Note the remarkable resistance of pipes to scaling and clogging due to hard water, and to the accumulation of powdered products such as sodium aluminates and cements.



## Strict magnetism controls

A probe with sensitivity of 1/10 of a nanotesla held 1 mm away from ARCAP® alloys shows no disruptive magnetic effects. This non-magnetism remains at low temperatures (measurements carried out at 4.2 K).



## Very easy to use

Whether they are used for hot stamping, pressing, punching, forming, turning, welding, soldering or electrolytic coating, ARCAP® alloys are easy to work with in the usual conditions.



## High mechanical properties

When in annealed form, ARCAP® alloys, whose elongation may be up to 45%, can be used to produce deep-drawn parts. When in spring form, the breaking load is more than 800 N/mm<sup>2</sup>.

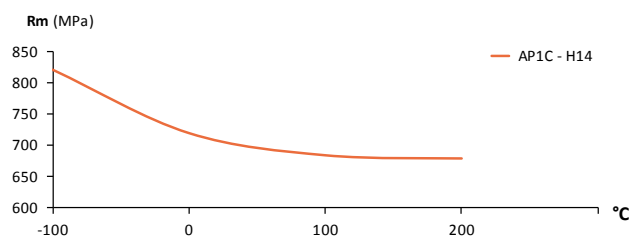


## Stable resistivity

Changes in temperature have virtually no impact on the resistivity of ARCAP® alloys. The temperature coefficient of the AP4 grade is  $\alpha$  (by °C) =  $4 \cdot 10^{-5}$ . For the other grades  $\alpha$  (by °C) =  $25 \cdot 10^{-5}$ .



## Change in the tensile strength at low temperatures



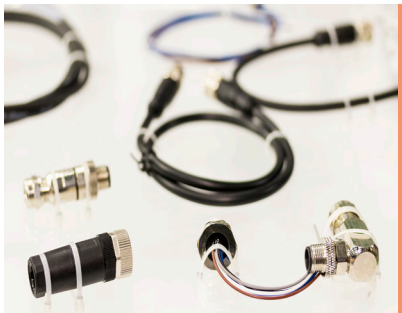
## Four ARCAP® alloy grades

### ARCAP® AP1D: Excellent machinability

The **AP1D** grade has been specially created for all kinds of machining work **with much better machinability than stainless Steel alloys and without chemical compatibility (electrolysis)**. On the contrary than Brass when harsh environment is involved, Arcap AP1D does not need nickel plating.

The ease with which AP1D is machined is reflected in:

- Cutting speeds of up to 150m/minute (depending on parts, tools and machines),
- Excellent surface finishes. Surfaces can be rolled and polished with a diamond tool,
- The absence of burrs on drilling,
- A reduction in sharpening frequencies.



Application: fibre optic connectors

“The machining quality is outstanding with ARCAP® AP1D: the surface finish is similar to grinding!”

Bar turners using ARCAP®

### ARCAP® AP1C and AP1: high elasticity and formability

AP1C (used in strip and bars for parts that will undergo forming through twisting, bending, riveting, crimping, stamping and so on, and for any kind of weld, especially through laser welding) is the spring grade.

AP1 (sheets, strips, wires and tubes) is the deep drawing grade with very good cold forming properties.

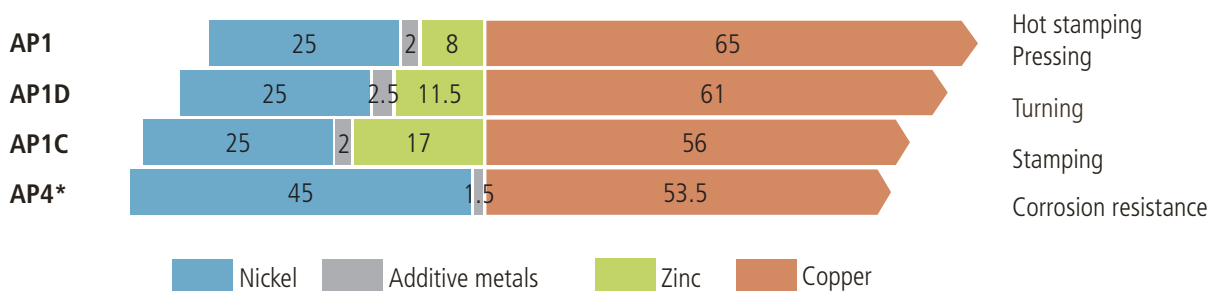
AP1 C is often the best solution when lead free requirement is specified, together with corrosion resistance and amagnetic properties

### ARCAP® AP4: Remarkable corrosion resistance at high temperature

AP4 is available in strip, sheets, bars and wire less, easy to turn than the previous two grades. It can nevertheless be machined with no greater difficulty than chrome-nickel-molybdenum steels. The use of lathes with a capacity exceeding the cross-section and use of lubricants for special alloys is recommended. It's showing high mechanical properties and good Marine corrosion resistance.

#### Nominal chemical composition (% / weight)

UNS No. C 79350



\* Specify if for use with electronics/vacuum tubes

# Physical properties

	Colour	Density	Melting range (°C)	Elasticity modulus GPa	Linear expansion coefficient x 10 <sup>-6</sup> /C		Optical reflection coefficient (Ag=100%)	Thermal conductivity W/(m°C)		Resistivity μΩ - cm	Temperature coefficient K-1	Electrical conductivity % IACS	Magnetism (OERSTED**)
					0-300°C	0-600°C		at 20°C	at 200°C				
AP1 AP1C AP1D	Bluish white	8.80	1150-1170	163 to 170	16	17	70%	22	25	35 to 40	0.00025	4.3 to 4.9	10 <sup>6</sup>
AP4	White	8.91	1225-1285	145	16	17	70%	22.5	23	49	0.00004	3.5	10 <sup>6</sup>

Typical values for information purposes.

\*\* The magnetism measurements for the ARCAP grades were carried out by the Institute Physique du Globe in Paris - Geomagnetism and Paleomagnetism Department

# Mechanical properties - Rolled (flat) products

Measurements carried out in the direction of rolling (thicknesses from 0.10 mm to 3 mm)

Grades	Current delivery tempers	AFNOR NFA 02-008 symbol	Vickers Hardness HV	Tensile Strength MPa	Yield Strength E at 0.2% MPa	Elongation A% (Le = 50 mm)	Min. Fb MPa	90° bend		180° bend	
								T	//	T	//
ARCAP® AP1	annealed	0	≤ 120	≤ 420	≤ 300	≥ 30		0*t	0*t	0*t	0*t
	1/4 hard	H11	120-150	370-470	> 300	≥ 20		0*t	0*t	0*t	0*t
	1/2 hard	H12	150-170	450-550	> 370	≥ 10		1*t	1*t	1*t	1*t
	3/4 hard	H13	165-185	520-600	> 470	≈ 3		1*t	2*t	2*t	2*t
	4/4 hard	H14	180-210	≥ 580	≥ 530	≈ 1		2*t	3*t	3*t	4*t
ARCAP® AP1C	annealed	0	≤ 130	≤ 450	≤ 300	≥ 30	150	0*t	0*t	0*t	0*t
	1/4 hard	H11	130-165	450-550	> 300	≥ 15	350	0*t	0*t	0*t	0*t
	1/2 hard	H12	160-190	450-550	> 400	≥ 5	400	1*t	1*t	1*t	1*t
	3/4 hard	H13	180-210	520-600	> 500	≥ 1	550	1.5*t	2.5*t	1.5*t	2.5*t
	4/4 hard	H14	200-230	≥ 580	≥ 550	≥ 1	600	2*t	3*t	2*t	3*t
	spring	H15	≥ 220	≥ 730	≥ 700		600	2*t	3*t	3*t	4*t
		H31	145-180	480-580	≤ 300	≥ 15	450	0*t	0*t	0*t	0*t
		H32	170-200	520-620	≥ 400	≥ 8	550	0.5*t	0.5*t	0.5*t	0.5*t
		H33	210-240	630-730	≥ 590	≥ 3	700	1.5*t	1.5*t	2*t	2*t
		H34	235-265	705-815	≥ 690	≥ 1	750	2*t	2.5*t	3*t	3*t
ARCAP® AP4	annealed	0	≤ 140	≤ 500	≤ 300	≥ 30		0*t	0*t	0*t	0*t
	1/4 hard	H11	140-180	470-600	> 300	≥ 15		0*t	0*t	0*t	0*t
	1/2 hard	H12	150-170	450-550	> 450	≥ 8		1*t	1*t	1*t	1*t
	spring	H15	180-210	≥ 580	≤ 670			1*t	2*t	1*t	2*t

Typical values for information purposes.

# Mechanical properties - Drawn (round) products

Grades	Current delivery tempers	AFNOR NFA 02-008 symbol	Delivery Ø		Tensile Strength MPa		Elongation A% (Le = 100 mm)
			Wires min. 0.2 max.:	Bars min. 1.5 max.:	Wires	Bars	
ARCAP® AP1	annealed	0	10		≤ 420		≥ 30
	1/4 hard	H11	10	11	420-480	400-450	≥ 10
	1/2 hard	H12	10	"	480-550	450-500	≥ 5
	3/4 hard	H13	10	"	550-610	500-550	≥ 2
	4/4 hard	H14	9	"	590-650	550-600	≥ 1
	spring	H15	6	"	≥ 650	≥ 600	
ARCAP® AP1C	annealed	0	10		≤ 550		≥ 30
	1/4 hard	H11	10	11	550-650	450-500	≥ 5
	1/2 hard	H12	10	"	650-750	500-550	≥ 2
	3/4 hard	H13	10	"	700-800	550-600	≥ 1
	4/4 hard	H14	9	"	800-820	550-700	
	spring	H15		"	≥ 820	≥ 700	
ARCAP® AP4	annealed	0	10		≤ 550		≥ 30
	1/4 hard	H11	10	11	550-650	500-550	≥ 10
	1/2 hard	H12	10	"	650-750	550-600	≥ 5
	3/4 hard	H13	10	"		600-650	≥ 2
	4/4 hard	H14	9	"	750-850	650-800	≥ 1
	spring	H15	6		≥ 800	≥ 800	
ARCAP® AP1D				Ø < 2.5		550-650	≥ 2
				2.5 ≤ Ø < 5		600-750	≥ 2
				5 ≤ Ø ≤ 11*		550-650	≥ 2

Typical values for information purposes.

\* Bars  
 Ø > 11 mm characterisation by hardness HV.  
 11 < Ø ≤ 35 mm minimum guaranteed hardness for H14 temper: HV 160.  
 Ø > 35 mm: contact our technical advisors.





## Bar machining conditions

The table below presents the main machining indications, for grades AP1D, AP1C and AP1, which should be viewed as bases and may be adjusted by users depending on the parts to be produced.

Turning		Cutting speed m/minute		Feed rate mm/rev	
		steel tool	carbide tool	steel tool	carbide tool
	<b>AP1D</b>	125	150/170	0.04	0.06
	<b>AP1C - AP1</b>	65	80	0.04	0.06
Drilling		steel bit	carbide bit with drill bush	steel bit Ø 1.5 to 12	carbide bit with drill bush Ø 6 to 12
		<b>AP1D</b>	120	150	0.012 to 0.080
	<b>AP1C - AP1</b>	60	80	0.012 to 0.080	0.025 to 0.120
Recommended point angle: 160 to 164°.					
Cutting angle	<b>AP1C - AP1D</b>	7 to 8°.			
Sharpening	<b>AP1D</b>	45 times lower sharpening frequency compared with stainless steels.			
	<b>AP1C - AP1</b>	12 times lower sharpening frequency compared with stainless steels.			
Cutting oils	<b>AP1D</b>	Any high quality soluble oil			
	<b>AP1C</b>	Preferably oils for special alloys			

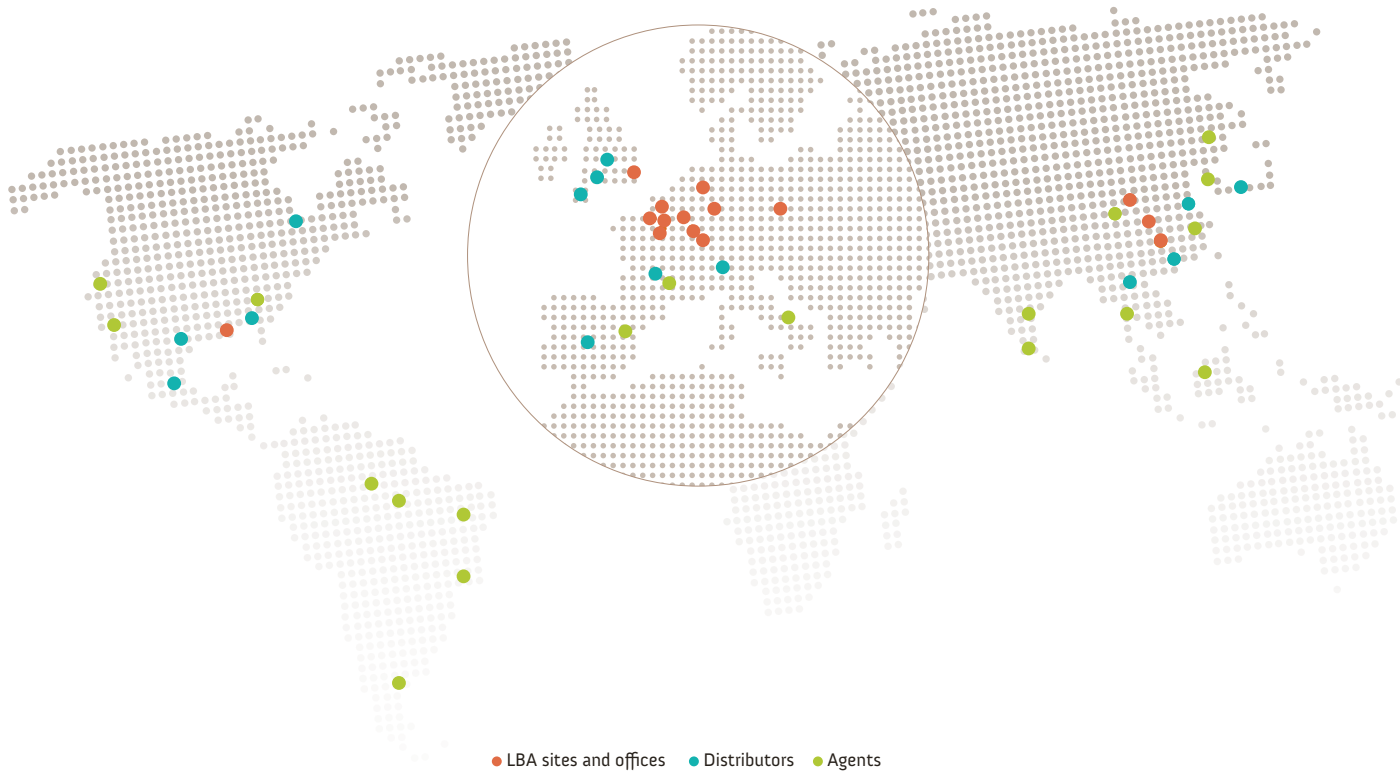
## Application

<b>Boiler making, Sheet metal working, Flow forming, Crimping, etc.</b>	AP1, AP1C and AP4, in annealed form, offer the same forming possibilities as brasses and soft iron.
	AP1 and AP1C must only be cold worked.
	AP4 may be hot worked.
	AP1D is suitable for certain cold forming applications.
<b>Annealing heat treatment</b>	In a neutral or reducing atmosphere - annealing temperature around 750°C, time at temperature 15 minutes to 1 hour depending on the volumes processed.
<b>Stress-relieving heat treatment</b>	Of rolled, drawn, punched parts, etc. - treatment temperature 250°C, preferably in a neutral or reducing atmosphere.
<b>Pickling</b>	After annealing by naked flame, remove the carbon deposits in a 10% sulphuric acid bath with 2% to 3% nitric acid, then pickle in a bath containing 80% water, 9% 66° Be sulphuric acid and 11% sodium dichromate, cold or preferably hot (50 to 60°C).
<b>Welding and soldering, AP1 - AP1C AP4 grades</b>	Brazing and soldering, electrical seam-resistance welding and TIG welding are all possible without difficulty.
<b>AP4 grades</b>	Unconventional welding techniques such as microplasma, plasma, electron beam, capacitive discharge, high frequency and laser welding produce excellent results.
<b>AP1D grades</b>	As these grades are sensitive to temperature rises, welding is not recommended; soldering can be used though.



# lebronze alloys

A global distribution network: stocks available close to final markets



Lebronze alloys was born from the integration of different companies specializing in the development and production of components made from high technical performance alloys, such as copper and nickel alloys, aluminium alloys, speciality steels, stainless steels, titanium and nickel superalloys.

Thanks to its multidisciplinary expertise, the Group provides innovative solutions to major industries such as Aerospace, Energy, Electric Mobility, Oil & Gas, Rail, and also sectors manufacturing smaller equipment and products.

Our 14 production facilities and 1,300 employees manage a unique range of metal processing technologies: continuous and semi-continuous casting, sand casting, die precision chill casting (manual, mechanized and automated), centrifugal casting, extrusion, ring rolling, hot and cold rolling, drawing, open-die forging, hot stamping, closed-die forging, cold forming, machining, non-destructive testing, etc.

The Group's commitment is to find appropriate and optimized solutions for every sector's requirements.

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