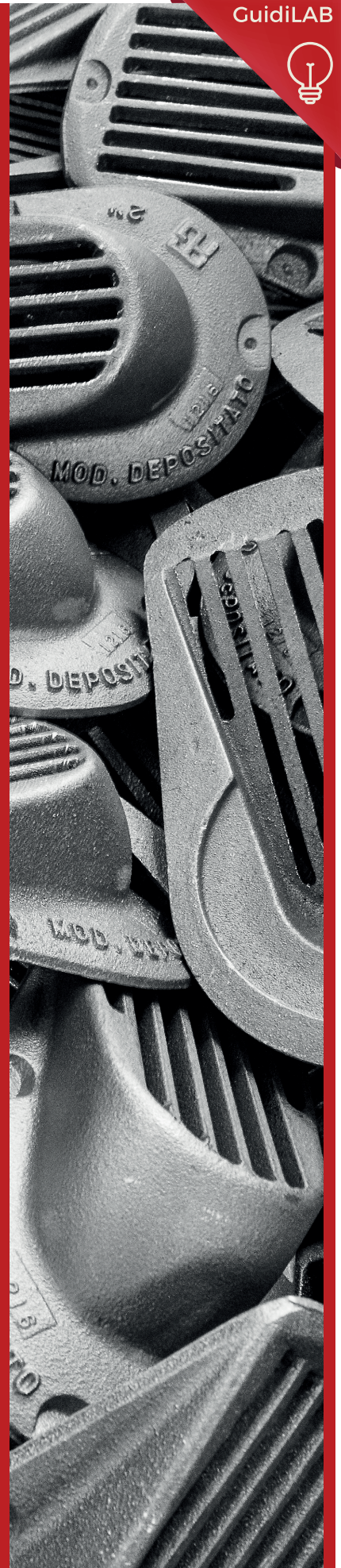




# BRONZE VS BRASS

THE CHALLENGE BETWEEN BRONZE  
AND BRASS AS THE BEST MATERIAL  
FOR NAUTICAL USE.  
AND SOME IN-DEPTH BONUSSES.



# BRONZE VS BRASS

**The challenge between bronze and brass as the best material for nautical use. And some in-depth bonuses.**

On the boats, the hydraulic systems have changed. Today they are much more sophisticated, advanced and technologically perfected, they are connected to electrical and electronic systems, they are much more delicate.

For this reason, the possible corrosion of the accessories used can cause serious damage and, consequently, expensive repairs.

At the time of purchase, accessories are often underestimated. Sometimes to save a handful of euros, sometimes for poor product knowledge. If then also joins a lacking and little careful maintenance, you're done.

Here are the problems: corrosion of the pipes, blocking of the valve handles, leaks that can become harmful, malfunctions in the engine room...

The accessories we are talking about go with the ship owners at sea and are part of the desalination, conditioning and cooling systems of the main and secondary motor units:

- valves
- filters
- water intakes
- thru-hulls
- fittings

Why can we clarify this topic?

...and finally, also give the results of the challenge!

**Because every day we study, verify, check our materials and produce these accessories.**

**Because we at Guidi have been the pioneers in Europe to introduce the use of bronze in the nautical sector.**

The advice is to pay attention to what you buy and prefer bronze. Bronze is the best choice because it is more performing, noble and corrosion resistant than brass.

## The information out there

The information out there leads off the road, or better off course.

There are some alloys marketed as ameliorative of bronze or even without zinc. These alloys are called ADZ, DZR, CR.

The most common are:

### Brass CW602N

standard UNI EN 12164  
drawn bar  
CuZn36Pb2As

### Brass CW602N

standard UNI EN 12165  
moulding bar  
CuZn36Pb2As

### Brass CB752S

standard UNI EN 1982  
ingot for casting  
CuZn35Pb2Al-C

**They are relatively more resistant to corrosion than other alloys, but they are not comparable to the bronze resistance to the various types of corrosion.**

In the bronze, zinc is present in very low quantities with a maximum percentage of 5%. Zinc is an element subject to high levels of corrosion. In the alloys we have listed, it reaches much higher percentages, 35-36%.



## What Guidi uses

Over the years, Guidi technicians have selected different materials preferring and advising the bronze for its resistance to the various types of corrosion.

The choice is the result of careful research and testing.

The main materials used, which can be used both in the nautical world and in the hydraulics world, are:

### • Bronze

#### Bronze CC491K

standard UNI EN 1982  
ingot for casting  
CuSn5Zn5Pb5-C (\*)

#### Bronze CC498K

standard UNI EN 1982  
ingot for casting  
CuSn6Zn4Pb2-C

#### Bronze CC499K

standard UNI EN 1982  
ingot for casting  
CuSn5Zn5Pb2-C

### • Brass

#### Brass CW617

standard UNI EN 12165  
moulding bar  
CuZn40Pb2

#### Brass CW602N

standard UNI EN 12164  
drawn bar  
CuZn36Pb2As

#### Brass CC770S

standard UNI EN 1982  
ingot for casting  
CuZn36Pb-C

#### Brass CW617N

standard UNI EN 12164  
drawn bar  
CuZn40Pb2

#### Brass CW602N

standard UNI EN 12165  
moulding bar  
CuZn36Pb2As

#### Brass CC753S

standard UNI EN 1982  
ingot for casting  
CuZn37Pb2Ni1AlFe-C

(\*) We are gradually moving up from bronze to 5% to that with a content of 2% and 3%.



## Two words about the bronze

### The tin bronze

Tin added to bronze produces alloys with excellent corrosion resistance and good mechanical properties.

The tin is added in increasing percentage to reach 9-10%. The higher its percentage, the greater its hardness, thus less malleability.

The bronze has a high resistance to corrosion. This explains the use in the nautical field, in contact with liquids or corrosive atmospheres.

### The aluminium bronze

The aluminium bronze is a copper alloy in which aluminium is the main additional element. The most common alloys contain from 5 to 12% of aluminium.

They have excellent mechanical and corrosion resistance. They can replace more expensive alloys, such as tin bronzes.

The aluminium content determines the mechanical strength. The alloy is still ductile and cold workable up to 8%, suitable for the production of tubes, sheets and wires. It is hotly workable between 8 and 10% and, over 10%, special alloys are obtained for applications against corrosion and wear.

## Two words about the brass

Brass is an alloy made up of copper and zinc.

**The zinc content determines properties such as: mechanical strength, colour, tool machinability, ductility, conduction of electricity and heat, resistance to abrasion and corrosion.**

Brass can be binary, made of copper and zinc, or ternaries, made of copper, zinc and another element.

The added elements give different properties to the brass:

- iron increases the breaking load of the metal alloy
- aluminium increases resistance to corrosion and abrasion
- nickel improves mechanical characteristics and corrosion resistance
- lead improves workability with machine tools
- manganese and tin increase corrosion resistance
- antimony and arsenic inhibit dezincification.

The alloys ADZ, DZR, CR are part of a list of materials that can be used for the passing through of drinking water, in compliance with:

- [Decree of the Ministry of Health n. 174 of April, 6th, 2004](#): Regulations concerning materials and objects that can be used in fixed systems for collection, treatment, adduction and distribution of water intended for human consumption. (Official Gazette General Series n. 166 of 17-07-2004).  
Entry into force of the decree: August, 1st, 2004
- [Council Directive 98/83 / EC of November, 3rd, 1998](#) concerning the quality of water intended for human consumption. Establishes drinking water standards. Its purpose is to protect public health from the negative effects deriving from the contamination of water intended for human consumption, guaranteeing its healthiness and cleanliness. (Official Gazette No L 330 of 05-12-1998 P. 0032 - 0054).  
It has been applied since December, 25th, 1998. EU countries had to transpose it into their national legislation by December, 25th, 2000.



## Corrosion

Knowing the corrosion forms is on the basis of prevention, choice of materials and methods of diagnosis.

Galvanic corrosion occurs through a process of an electrochemical nature: it is the contact of two different metals with a different nobility that interact with the corrosion environment. The sea water, the lake water, acts as an electrolyte and any metal that comes into contact behaves as an electrode. The less noble metal will be the one to corrode first.

**Generalized corrosion** affects a large part or all the surface of a metal in contact with an electrolyte. A distinction is made between uniform or non-uniform generalized corrosion. It is uniform when corrosion penetrates the whole surface; non-uniform when the corrosion follows an almost regular profile.

The corrosive process can change according to different factors:

- temperature
- Ph
- electrolyte composition (parameter directly related to the climatic zone)
- presence of other substances
- resistivity
- oxygenation

**Bi-metal corrosion** occurs by coupling two metals with different potentials.

The less noble metal, the one with the lowest electrochemical potential, tends to undergo the corrosive attack more quickly.

Situations of intense galvanic coupling are usually encountered in sea water (salinity, high conductivity, oxygenation).

**Pitting corrosion** is a type of localized attack. From the surface, it penetrates into the metal at a very high speed. The size of the pits vary from a few tens of microns to a few millimetres and have very variable morphologies.

Pitting affects metals in conditions of passivity, where the metal surface is protected by an oxide film. The potentially subject alloys are: stainless steels, copper and its alloys, aluminium.

**Selective corrosion** affects metal alloys. It consists in the corrosion of the less noble metal. The alloy loses its mechanical characteristics. Brasses undergo this type of corrosion: dezincification. Zinc passes into solution and copper remains as a metallic residue.

## Let's see the challenge

We requested a verification of the galvanic coupling of the materials to one of the most important and well-known Italian laboratories, private and independent. Laboratory authorized by the Italian body for accreditation ACCREDIA LAB n. 0003 and LAT N. 090, according to the UNI CEI EN ISO / IEC 17025 standard.

### The tested samples are:

#### A

ADZ

brass sample CW602N

CuZn36Pb2As

#### B

BZ

bronze sample CC491K

CuSn5Zn5Pb5-C

#### P

PTL

brass sample CW617N

CuZn40Pb2

### The procedure:

Recording of the short-circuit potential and the galvanic coupling current between the two metals.

### The standard:

ASTM G199 Standard Guide for Electrochemical Noise Measurement

### Operating conditions:

- From the samples were obtained 30x40x5 mm specimens with surface finishing with paper grain size 120
- Test solution: synthetic sea water
- Test temperature:  $20 \pm 3$  ° C
- Duration of exposure: 9 days with 3 daily tests of electrochemical noise for each sample

### Test activity:

- Comparative evaluation of A - B, B - A couplings: with the exchange between A and B to verify the measurements of both currents and potentials.
- P coupling (PTL) - A (ADZ) and P (PTL) - B (BZ)
- Each test consists in recording the short-circuit potential and the galvanic coupling current between the two metals.

**The tests to which the samples A, B, P were subjected show a significant difference in efficiency.**

The images represent better than descriptions the destructive effects of corrosion on some brass valves.

**Bronze is always nobler.** Brasses do not exhibit sensitive damage.

Many boats are fitted with brass products but, as we have already said, there is a strong increase in electrical and electronic elements on board. **It is certainly better to refer to bronze products for the unparalleled anti-corrosion performance.**

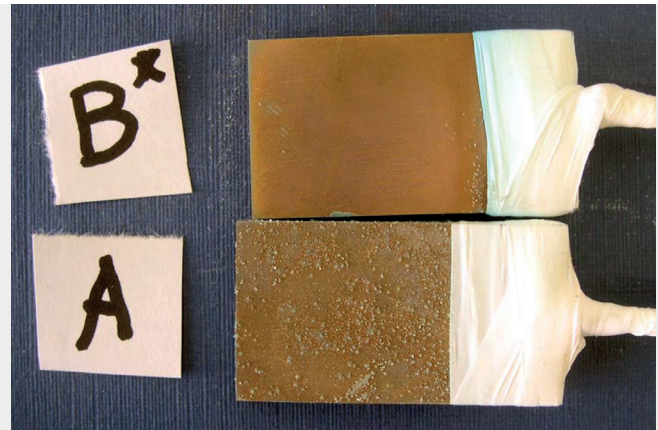


## Visual examination after the test

By observing the images, it is evident that bronze has greater electrochemical nobility.

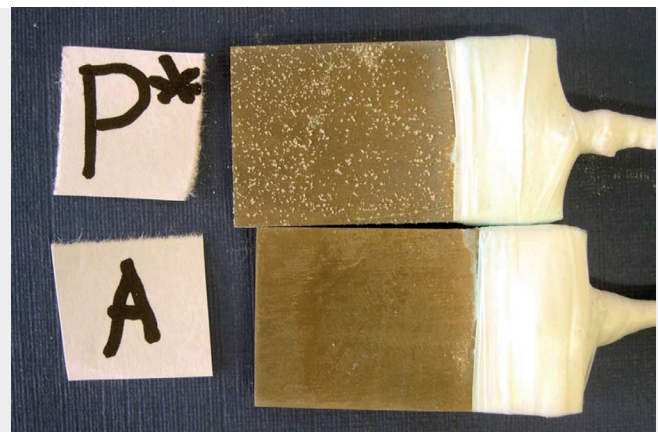
### A-B / B-A coupling

It allows to visually appreciate the galvanic coupling.  
Sample B is nobler of sample A under the test conditions adopted.



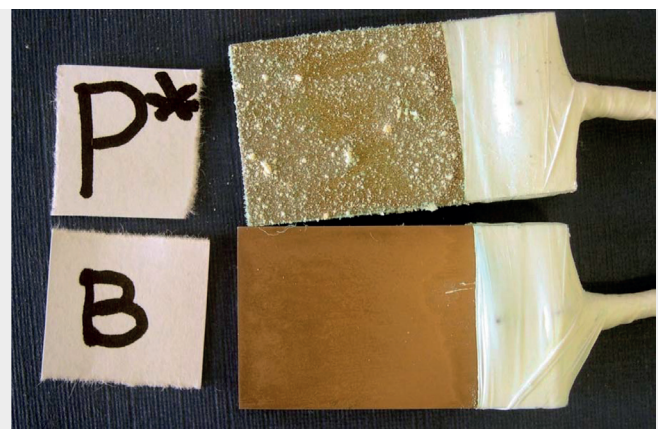
### P-A coupling

In this case, P turns out to be less noble of A under test conditions adopted.



### P-B coupling

The coupling obviously detects as B it is nobler than P in these test conditions.



**The rating of electrochemical nobility detected is therefore: BZ (bronze) > ADZ and PTL (brass).**

**So be wary of the offerings of alloys marketed as ameliorative of bronze, even without zinc! The panaceas of every problem in the on-board systems are not these. Bronze and appropriate maintenance are a far better choice!**

## Low quality brass and alloys

Unfortunately, there is another problem on the market: the presence of unsuitable material, or low quality brass and alloys.

Also in this regard, we have asked the same laboratory for checks on 5 samples taken from the accessories market, 2 of which manufactured by us.

### The tested samples are:

5 brass parts declared in alloy:

- **CuZn37Pb2Ni1AlFe-C (UNI EN 1982)**
- **CW617N (UNI EN 12165)**
  1. elbow 90° ø50mm
  2. elbow 90° ø30mm GUIDI
  3. ball valve ø50mm
  4. water intakes ø32mm GUIDI
  5. water intakes ø20mm



### The procedure and the standard:

Optical Emission Spectrometry. UNI EN 15079:2007 test standard.

## Determinations results

1. leaded Brass of complex identification: for example, Fe% and Si% too high for CuZn35Pb2AlFe.
2. assimilable to bronze UNS C38000 (ASTM B455)
3. assimilable to brass CuZn33Pb2SiC (CC75153)
4. ~ brass CuZn33Pb2-C
5. it was not possible to determine this alloy

CHEMICAL ANALYSIS (Analysis N. 360÷364)												
Identification	Cu%	Pb%	Sn%	P%	Mn%	Fe%	Ni%	Si%	As%	Al%	Zn%	Sb%
1	62.2*	2.5	0.98	0.026	0.08	0.82	0.09	0.09	0.008	0.61	Balance	0.052
2	60.0*	1.7	0.26	0.009	0.01	0.29	0.15	0.01	0.007	0.021	Balance	0.016
3	65.9*	1.6	0.12	0.024	0.01	0.26	0.13	0.83	0.007	0.025	Balance	0.003
4	63.3*	2.6	0.77	0.017	0.09	0.62	0.41	0.056	0.009	0.57	Balance	0.047
5	56.2*	5.0	0.80	0.029	0.03	0.60	0.34	0.045	0.009	0.23	Balance	0.075

\* By difference

**We need to take care with our purchases: sometimes there are bad surprises behind too competitive prices!**

## Prevention

Besides preferring bronze and ensuring excellent maintenance, corrosion must be prevented.

**Cathodic protection electrochemically guarantees corrosion protection to metal structures exposed to a potentially aggressive electrolyte environment.**

The protection by galvanic coupling or sacrificial anode is essential to preserve the boat and the systems.

This type of protection occurs by connecting the metal to be protected (cathode) to a less noble metal (anode).

**The sacrificial anode is destined to consume itself progressively preserving the qualities of the noblest metal.**

The anodes can be made of aluminium, zinc or magnesium and must be chosen according to use.

These materials have very low electronegativity. In the case of galvanic current, it will be the sacrificial anode, composed of one of these materials, to act as an electrode, to progressively lose electrons and then corrode. The other noblest metal parts remain so protected.





Don't forget to share your ideas with us!

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