

## BRASS ALLOY CW603N

Free-cutting brass of American type in the form of rod. The alloy can be an alternative to CW614N and CW607N if better cold workability than provided from CW614N and better machinability than CW607N is required.

### Composition

CW603N	Cu	Zn	Pb	Al	Fe	Ni	Sn	Other
Limits	60.0-62.0	Rem	2.5-3.0%	<0.05%	<0.3%	<0.3%	<0.2%	<0.2%

### Standardization

The alloy is, according to international standards, equivalent in composition to

CW603N	CuZn36Pb3
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SS-EN 12164, rod for free machining purposes

SS-EN 12166, wire for general purposes

SS-EN 12167, profiles and rectangular bars for general purposes

### Structure type

( $\alpha$ + $\beta$ )-phase together with lead phase.

### Application example

Rod. Bent handles, details for crimping.

### Residual stress level

Rod must show no evidence of cracking after testing according to SS-ISO 6957 Copper Alloys – “Ammonia test for determining resistance to stress corrosion”. Moderate stress according to the standard must be applied.

### Dezincification resistance

The alloy CW603N is not dezincification resistant.

### Heat treatment

**Stress-relief annealing.** Temperature 330-350°C. Time 1-2 hours (max). Stress-relief annealing should be carried out after all cold working which gives high residual tensile stresses in the material. It may also be justified after machining. This eliminates the risk of stress corrosion cracking caused by internal stresses.

**DZR Heat Treatment.** Temperature 500-550°C. Time 1-2 hours.

### Physical properties

Property	Value	Unit
Density	8500	kg/m <sup>3</sup>
Melting temperature	885-890	°C
Heat capacity at 20°C	0.38	kJ/(kg°C)
Resistivity at 20°C	64	nΩm
Temperature coefficient for resistance at 20°C, 0-100°C	0.0016	°C
Conductivity at 20°C	14 28%	MS/m IACS <sup>1</sup>
Thermal conductivity at 20°C	120	W/m°C
Thermal expansivity, 20-300°C	21*10 <sup>-6</sup>	°C
Modulus of elasticity	110	GPa
Modulus of shearing	36	GPa

1) IACS = International Annealed Copper Standard. 100% IACS is equivalent to a resistivity of 17.241 nΩm and a conductivity of 58 MS/m.

### Workability

**Hot workability** is good. Suitable temperature 650-775°C. One should, when heating before forging, ensure that the temperature does not exceed the specified range and that time at elevated temperature is as short as possible. Otherwise, the material can have significant grain growth that can easily lead to cracks during forging.

**Cold workability** in the hot worked and annealed condition is fairly good. The workability decreases as hardness increases. For stress-relief annealing after cold working see Heat treatment.

### Corrosion resistance

Copper is a relatively noble metal. Copper and its alloys therefore show little tendency to react with the environment. As a result of this, the copper materials generally have good corrosion resistance. However, corrosion may occur under disadvantageous unfavorable conditions. The type of corrosion which may occur depends on both the environment and the composition of the alloy.

The corrosion resistance of CW603N is

Corrosion types	Corrosion resistance	Comment
Stress Corrosion Cracking, SCC	Satisfactory	This type of corrosion only occurs in the simultaneous presence of high stresses in the material and a corrosive medium containing ammonia and moisture. (See Heat treatment.)
Dezincification, DZR	Poor	This type of corrosion only occurs when the material is exposed to water or a moist atmosphere, preferentially at elevated temperature and at the presence of chlorides.
Erosion corrosion	Quite good	

### Machinability

The alloy is very easy to machine and high surface quality is easy to achieve. The chips are short. The alloy is suitable for machining in automated machines.

Tool and cutting data. Tungsten carbide according to ISO-group K 10.

Cutting data	Tungsten carbide	High speed steel
Rake angle	2-6°	0-3°
Back rake angle	0°	0°
Clearance angle	4-6°	0-6°
Cutting speed	Approx. 300 m/min or faster	Approx. 150 m/min or faster
Cutting fluid	Dry or cutting oil	Emulsion or cutting oil

### Welding and brazing

The high lead content means that in welding, the material becomes hot brittle and the weld is porous. The following applies to the different welding methods:

Welding method	Suitability	Comment
Fuse welding and resistance welding	Poor	Cannot be carried out with good results.
Braze welding	Poor	Cannot be carried out with good results because of the minimal difference between the melting temperature of the base metal and the working temperature of the solder.
Brazing (hard soldering)	Satisfactory, can be carried out with a silver solder and silver-phosphorus-copper solder	Difficult to carry out with a phosphorus-copper solder and cannot be carried out with satisfactory results with a brass solder (see Braze welding).
Soldering	Excellent	Very easy to carry out.

### Surface treatment

**Mechanical surface treatment** such as grinding, brushing, blasting and polishing is carried out by conventional methods.

**Pickling** (non-oxidizing pickling) is suitably carried out with diluted sulphuric acid at room temperature.

**Pickling** to a metallically clean surface (oxidizing pickling) is suitably carried out in a pickling bath containing oxidants such as peroxide, nitric acid or dichromate. For pickling to a high gloss, baths containing nitric acid are mainly used.

**Chemical and electrolytic polishing** is easy to carry out with mixtures of concentrated acids, e.g. phosphoric acid, nitric acid and acetic acid.

**Polishing** is suitably carried out with commercial cleaning products for copper.

**Dark dyeing** is easy to carry out by wet chemical methods, dark sulphide or oxide layers being obtained.

**Varnishing** with clear varnish means that the appearance obtained after cleaning or dyeing, for example, is retained for a long time. Clear varnishes containing a discoloring inhibitor are available for demanding applications.

**Metallization** (metallic surface coating) is easy to carry out.

### Mechanical properties

CW603 N from Nordic Brass Gusum meets and exceeds the quality demands defined in the standards. To give an idea of the mechanical properties some empirical values, according to the material grade "M" in the EN standard, are listed below. These values are to be considered as guideline values for the delivered material.

Property	Value	Unit
Rm, Tensile strength	>350	MPa
Rp02, Yield strength	~300	MPa
A5, Fracture elongation	>20	%
Brinell hardness	~110	HB