

Knight[®] Precision Wire...

Copper & Copper Alloys

Product Information

Technical Information

Copper and copper alloys form an important group of metals with many excellent properties. They have very good electrical and thermal conductivities, are easy to fabricate and include some alloys of exceptional strength (notably beryllium-coppers) and corrosion resistance. The characteristics of copper and copper alloys have resulted in extensive use of these alloys in a very wide range of applications. They can be formed into the most complex of shapes, by drawing and cold heading.

In general terms the important commercial alloy groups are:

- Commercially pure high conductivity coppers
- Brasses
- Phosphor Bronzes
- Nickel Silvers
- Beryllium Coppers

Commercially Pure High Conductivity Coppers

The various coppers within this group have differing degrees of purity and consequently exhibit different characteristics. For high conductivity requirements oxygen-free coppers are required and this extra purity enhances ductility and gives freedom from hydrogen embrittlement, or blistering during brazing operations.

Brasses

Brasses are copper based alloys with zinc as the essential secondary ingredient. The addition of zinc to copper creates a lower cost alloy with superior cold working strength to copper but at the expense of reduced conductivity. The degree of alloying gives a range of colours for decorative applications.

Phosphor Bronzes

Phosphor bronzes are copper tin alloys containing up to 10% tin and a small quantity of phosphorus, which is a residual from the de-oxidation of the copper melt before the tin is added.

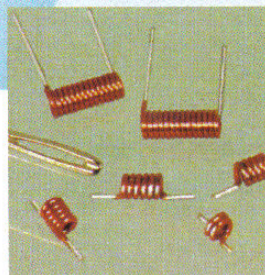
Phosphor bronzes can be significantly hardened by cold working to give excellent spring properties.

Nickel Silvers

These alloys of copper, nickel and zinc contain no silver but take their name from their silvery appearance and ability to be polished to a high lustre. Their mechanical properties are somewhat higher than brasses but not matching phosphor bronze.



Courtesy of Arcoletric Switches plc



Courtesy of Total Frequency Control Ltd

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Beryllium Coppers

Beryllium copper alloys are precipitation hardening alloys of remarkable strength, elasticity and fatigue resistance, making them ideal for spring applications. The principal compositions are based around 1.6% to 2.0% beryllium, with a small addition of cobalt added to refine grain size.

These alloys can be supplied in the following forms:

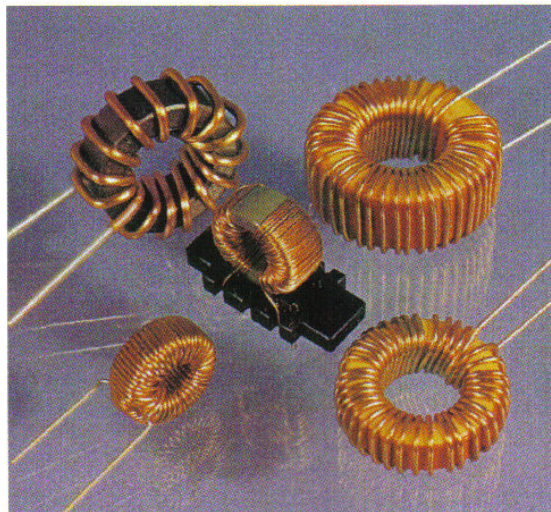
- Solution treated (Annealed), or
- Solution treated and temper drawn, i.e. ...
 - 1/4 Hard,
 - 1/2 Hard,
 - Hard, etc.

Parts requiring severe forming should be manufactured from the softer tempers, those with moderate demands can be made from harder tempers.

After forming, the parts or components should be precipitation hardened in a reducing atmosphere or air circulating furnace at 315 to 335°C for a minimum of 2 hours for temper drawn material or 3 hours for annealed wire.

COPPER & ALLOYS GRADE DESIGNATIONS & CHEMICAL COMPOSITION (% by weight)									
ALLOY	BS 2873 Designation	Cu	Sn	Mn	Ni	Zn	Pb (max)	Be	P
Copper	C101 min	99.9	-	-	-	-	0.005	-	-
Copper, Oxygen free	C103 min	99.5	-	-	-	-	0.005	-	-
Brass Gilding Metal	CZ102	84.0 to 86.0	-	-	-	Balance	-	-	-
Brass (70/30)	CZ106	68.5 to 71.5	-	-	-	Balance	-	-	-
Brass (2/1)	CZ107	64.0 to 71.0	-	-	-	Balance	-	-	-
Brass (Common)	CZ108	62.0 to 65.0	-	-	-	Balance	-	-	-
Phosphor Bronze	PB102	Balance	4.5 to 6.0	-	-	-	-	-	0.02 to 0.40
Phosphor Bronze	PB103	Balance	6.0 to 7.0	-	-	-	-	-	0.02 to 0.40
Nickel Silver	NS103	60.0 to 65.0	-	0.05 to 0.30	9.0 to 11.0	Balance	-	-	-
Nickel Silver	NS107	54.0 to 56.0	-	0.05 to 0.35	17.0 to 19.0	Balance	-	-	-
Beryllium Copper	CB101	Balance	-	-	0.05 to 0.04 + cobalt	-	-	1.7 to 1.9	-

Courtesy of Total Frequency Control Ltd



These alloys are also available in the pre-tempered mill hardened condition, where the wire has been solution treated and precipitation hardened prior to supply. This means no further heat treatment is required but wire in this form should only be used for moderate forming requirements where the maximum mechanical properties of these alloys is not required.

By altering time and temperature during the heat treatment process, pre-tempered wire is available with a range of mechanical properties to suit customers requirements.

**COPPER & COPPER ALLOYS
TYPICAL MECHANICAL PROPERTIES**

ALLOY	TEMPER	TENSILE STRENGTH MIN. (N/mm ²)	ELONGATION % MIN
High Conductivity Coppers			
C101	Annealed	210	10 - 30 depending on diameter
Brasses			
CZ102	Annealed 1/2 Hard Hard	290 430 - 590 590	25
CZ106	Annealed 1/2 Hard Hard	310 460 - 620 620	45
CZ107	Annealed 1/2 Hard Hard Extra Hard	320 460 - 620 620 - 740 740 - 820	35
CZ108	Annealed 1/2 Hard Hard Extra Hard	320 460 - 620 620 - 740 740	35
Phosphor Bronzes			
PB102	Annealed 1/2 Hard Hard Extra Hard	340 540 - 700 700 - 850 850	40
PB103	Annealed 1/2 Hard Hard Extra Hard	370 590 - 740 740 - 900 900	50
Nickel Silvers			
NS103 & NS107	Annealed 1/2 Hard Hard	400 450 - 590 590 - 750	40

**COPPER & COPPER ALLOYS
TYPICAL MECHANICAL PROPERTIES**

ALLOY	TEMPER	TENSILE STRENGTH MIN. (N/mm ²)	TENSILE STRENGTH AFTER AGE HARDENING (N/mm ²)
Beryllium Copper			
CB101	Annealed 1/4 Hard 1/2 Hard 3/4 Hard Hard	390 620 - 795 760 - 930 895 - 1070 965 - 1140	1105 - 1380 1205 - 1405 1275 - 1480 1310 - 1585 1345 - 1600

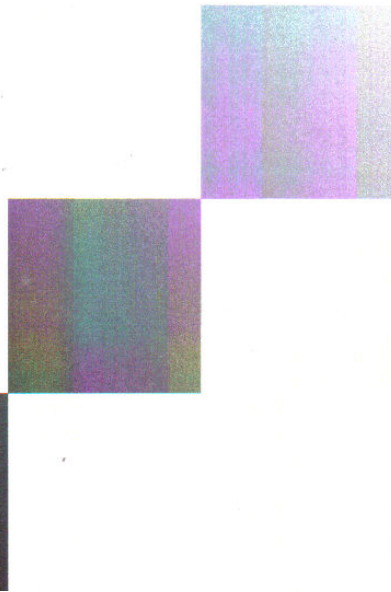
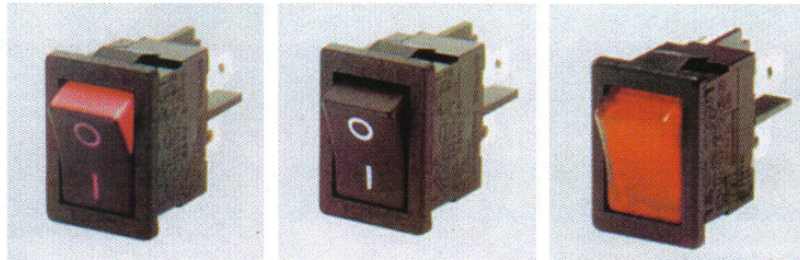
Age hardening treatment: 2 hours at 335°C

**COPPER & COPPER ALLOYS
STOCK RANGE**

	DIAMETER (mm)	
	Min	Max
BRASSES	0.20	4.00
PHOSPHOR BRONZE	0.10	5.00
NICKEL SILVER	0.20	4.00
BERYLLIUM COPPER	0.05	5.00

Other sizes can be made to order. For our full product range and processing capability, please see Section PW01.

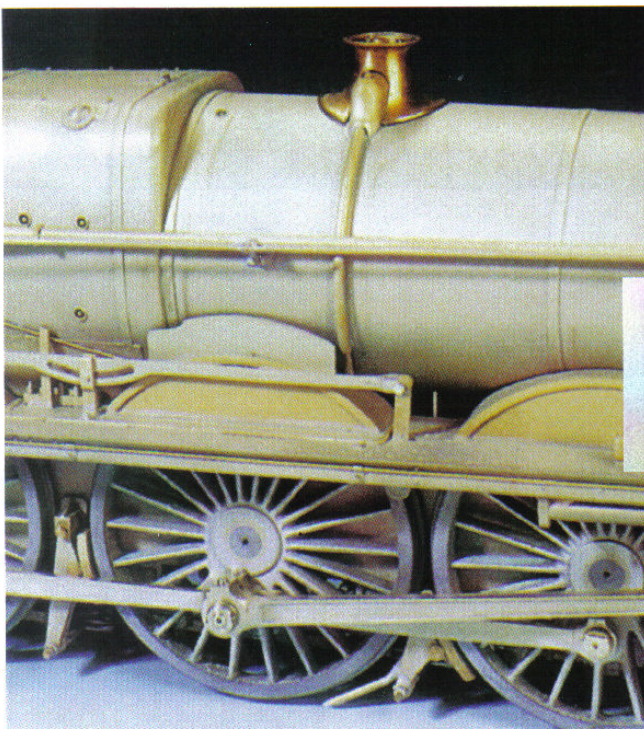
Courtesy of Arcoelectric Switches plc



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PW04

	GRADE (BS 2873)	SERVICE PROPERTIES	APPLICATIONS
COPPER	C101	Excellent formability and conductivity, but can be embrittled in reducing atmospheres.	KNITTING, BRAIDING, WEAVING, WIRE SHAPES, FUSES, CONDUCTORS
COPPER (Oxygen free)	C103	Reduced oxygen to prevent embrittlement. Excellent formability	ELECTRONIC INDUSTRIES
BRASS (Gilding metal)	CZ102	Popular for architectural metalwork and imitation jewellery due to its golden colour and ability to be brazed and enamelled	WIRE SHAPES, SPRINGS, CONTACTS, JEWELLERY
BRASS (70/30)	CZ106	Maximum ductility of the CuZn alloys. Good deep drawing properties.	MODEL MAKING, FERRULES
BRASS (2/1)	CZ107	A good cold working alloy.	SPRINGS, CONNECTOR PINS, HINGE PINS
BRASS (common)	CZ108	General purpose alloy for simple forming operations.	SPRINGS, CONNECTOR PINS, KNITTING, WEAVING
PHOSPHOR BRONZE	PB102	Good formability, combined with good corrosion resistance.	SPRINGS, CONTACTS, WIRE SHAPES, LOCK LEVERS, SWITCHES
PHOSPHOR BRONZE	PB103	Extra tin improves wear properties, corrosion resistance and tensile strength.	SPRINGS, CONTACTS, SWITCHES, BRUSHES
NICKEL SILVER	NS103	Good formability, readily soldered or brazed.	MODEL MAKING, JEWELLERY
NICKEL SILVER	NS107	"Whiter" alloy than NS103.	BRUSH ANCHOR WIRE, PINS
BERYLLIUM COPPER	CB101	Precipitation hardening alloy with remarkable strength, elasticity and fatigue resistance.	SPRINGS, CONTACTS, SWITCHES, CONNECTOR PINS



Courtesy of British railway modelling

The data printed in the above sections is based on information from our own and other organisations; although every effort has been made to ensure its accuracy, no guarantee or warranty is given or implied as to fitness for specific applications. Those suggested are for the purpose of illustration only and it is the responsibility of the user to decide on the most suitable product for any use or purpose whatsoever.

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