UDC 669.35'24'5'4

WROUGHT MATERIALS

COPPER-NICKEL-ZINC-LEAD ALLOYS
Leaded Nickel Silvers

Cu Ni18 Zn19 Pb1

Common name: Leaded 18% Nickel Silver

A copper-nickel-zinc-lead alloy with an alpha phase structure containing a dispersion of fine lead particles. This silver-white alloy has good corrosion resistance in various environments and good machinability. The most commonly used wrought forms are rod and sections/shapes.

COMPOSITION (weight %)

Cu	59.0–63.0
Ni	17.0–19.0
Pb	0.5–1.5
Mn	0–0.7
Zn	rem.

1 SOME TYPICAL USES

Mechanical
Wide variety of machined items; clock and watch parts; screws.
Miscellaneous
Hinges and screws for spectacle frames; cylinder locks; instrument and camera parts; model construction.

2 PHYSICAL PROPERTIES

		Metric Units	English Units
2.1	Density at 20 °C *68 °F*	8.8 g/cm³	0.320 lb/in³
2.2	Melting range	1 050–1 100 °C	1 920–2 010 °F
2.3	Coefficient of thermal expansion (linear) at: 20 to 200 °C *68 to 392 °F*	0.000 016 per °C	0.000 009 per °F
2.4	Specific heat (thermal capacity) at: 20 °C *68 °F*	0.10 cal/g °C	0.10 Btu/lb °F
2.5	Thermal conductivity at: 20 °C *68 °F*	0.06 cal cm/cm² s °C	15 Btu ft/ft² h °F
2.6	Electrical conductivity (volume) at: 20 °C *68 °F* (annealed or cold worked)	3.5 m/ohm mm²	6% IACS
2.7	Electrical resistivity (volume) at: 20° C *68 °F* (annealed or cold worked)	0.29 ohm mm²/m 29 microhm cm	173 ohms (circ mil/ft) 11 microhm in
2.8	Temperature coefficient of electrical resistance at: 20 °C *68 °F* (annealed or cold worked) applicable over range from 0 to 100 °C *32 to 212 °F*	0.000 3 per °C (6% IACS)	0.000 2 per °F (6% IACS)
2.9	Modulus of elasticity (tension) at 20 °C *68 °F:*		
	annealed	13 000 kg/mm²	18 500 000 lb/in²
	cold worked	13 400 kg/mm²	19 100 000 lb/in²
2.10	Modulus of rigidity (torsion) at 20 °C *68 °F:*		
	annealed	4 800 kg/mm²	6 800 000 lb/in²
	cold worked	5 000 kg/mm²	7 100 000 lb/in²

N.B.: The values shown in Section 2, which have been appropriately rounded in view of the composition range involved, are based on selected literature references. The melting range covers the highest liquidus and lowest solidus temperatures over the composition range quoted.

INDEX NUMBERS RELATE TO LITERATURE REFERENCES (see page 6); INDEX LETTERS RELATE TO FOOTNOTES AT END OF TABLE

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DATA SHEET No. M 2

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3 FABRICATION PROPERTIES

The information given in this table is for general guidance only, since many factors influence fabrication techniques.
The values shown are approximate only, since those used in practice are dependent upon form and size of metal, equipment available, techniques adopted and properties required in the material.

		Metric Units	English Units
3.1	Casting temperature range	1 175–1 250 °C	2 145–2 280 °F
3.2	Annealing temperature range	625– 775 °C	1 155–1 425 °F
	Stress relieving temperature range	300– 400 °C	570– 750 °F
3.3	Hot working temperature range	900– 975 °C	1 650–1 785 °F
3.4	Hot formability	Very limited	
3.5	Cold formability	Fair	
3.6	Cold reduction between anneals	30% max.	
3.7	Machinability:	See General Data Sheet No. 2	
	Machinability rating (free cutting brass = 100)	70	
3.8	Joining methods:	See General Data Sheet No. 3.10	
	Soldering	Very Good	
	Brazing	Good	
	Oxy-acetylene welding	Fair	
	Carbon-arc welding	Not recommended	
	Gas-shielded arc welding	Fair	
	Coated metal-arc welding	Not recommended	
	Resistance welding: spot and seam	Fair	
	butt	Fair	

4 NATIONAL SPECIFICATIONS FOR MANUFACTURED FORMS

and ISO Recommendation

Country	Designation of Standards	Designation of Material in Standards	Specification for Chemical Composition [a]	Plate Sheet Strip	Rod	Wire	Tube	Sections / Shapes	Forgings
Australia	SAA	NS113	—	—	H 91	—	—	H 91	—
Belgium	NBN	—	—	—	—	—	—	—	—
Canada	CSA	—	—	—	—	—	—	—	—
Chile	NCh (INDITECNOR)	—	NCh 251 of. 68	—	—	—	—	—	—
France	NF	—	—	—	—	—	—	—	—
Germany	DIN	Cu Ni18 Zn19 Pb	17 663	—	17 672	—	—	—	—
India	IS	—	—	—	—	—	—	—	—
Italy	UNI	—	—	—	—	—	—	—	—
Japan	JIS	PbNSB	—	—	H 3712	—	—	—	—
Netherlands	N or NEN [b]	Cu-Ni18 Zn19 Pb	NEN 6030	—	—	—	—	—	—
South Africa	SABS	—	—	—	—	—	—	—	—
Spain	UNE	—	—	—	—	—	—	—	—
Sweden	SIS	—	—	—	—	—	—	—	—
Switzerland	VSM	—	—	—	—	—	—	—	—
United Kingdom	BS	NS113	—	—	2874	—	—	2874	—
United States	ASTM	No. 794	—	—	B 151	B 206	—	—	—
International Organisation for Standardization	ISO	Cu Ni18 Zn19 Pb1	R430	—	—	—	—	—	—

[a] Applicable when the chemical composition is not given in the specifications for wrought forms.
[b] Older specifications bear prefix N; for new specifications the NEN prefix is used.

5 MECHANICAL PROPERTIES

5.1 Mechanical properties at room temperature

Tensile properties	see tables 5.1.1/2/3
Hardness	,, ,, 5.1.1/2/3
Shear strength	,, ,, 5.1.1/2/3
Modulus of elasticity (tension)	see 2.9
Modulus of rigidity (torsion)	,, 2.10

5.2 Mechanical properties at low temperature

Tensile properties	no data
Impact properties	,, ,,

5.3 Mechanical properties at elevated temperature

Short-time tensile properties	see table 5.3.1
Impact properties	,, ,, 5.3.1
Creep properties	no data

5.4 Fatigue properties

Fatigue strength at room temperature	no data

5.1 MECHANICAL PROPERTIES AT ROOM TEMPERATURE [a]

5.1.1 Typical Tensile Properties and Hardness Values—Metric Units

This table is representative of practice in many European countries. For British practice, see table 5.1.2.

The values shown represent reasonable approximations for general engineering use, taking account of variations in composition and manufacturing procedures. For design purposes, national specifications should be consulted.

For a given temper, individual elongation values may show some variation above or below the typical values indicated.

Form	Temper	Tensile Strength kg/mm²	Proof Stress 0.2% offset kg/mm²	Elongation % on $5.65\sqrt{S_o}$	Hardness		Shear Strength kg/mm²	Typical Size Related to Properties Shown [b]
					Brinell	Vickers		
Rod	Typical Cold Worked Tempers	53	40	15	150	155	37	2–10 mm diam. or equivalent area
		60	52	7	170	180	39	2–10 mm diam. or equivalent area
Sections / Shapes	Hot Worked	46	—	—	130	135	33	—
	Typical Cold Drawn Temper	50	—	—	145	150	35	—

(a) It will be noted that tables 5.1.1, 5.1.2 and 5.1.3, giving typical tensile properties and hardness values in Metric, SI and English, and American units respectively are not directly comparable. This is because the properties quoted reflect to some extent the metalworking techniques, specification practices and testing procedures in the countries concerned, and in view of the different sizes of products referred to in these tables. Individual manufacturers of semi-fabricated products can, however, normally meet the requirements of any national standard.

(b) It is possible to obtain sizes outside the ranges given in this column, but information on their mechanical properties should be obtained from the metal manufacturers.

5.1.2 Typical Tensile Properties and Hardness Values—SI and English Units

This table is based on British practice. For European practice, see table 5.1.1.

The values shown represent reasonable approximations for general engineering use, taking account of variations in composition and manufacturing procedures. For design purposes, national specifications should be consulted.
For a given temper, individual elongation values may show some variation above or below the typical values indicated.

Form	Temper [a]	Tensile Strength		Proof Stress 0.1% offset		Elongation		Vickers Hardness	Shear Strength		Typical Size Related to Properties Shown [b]
		hbar	ton/in²	hbar	ton/in²	%	gauge length		hbar	ton/in²	
Rod [c]	Cold Worked										
	As Manufactured	51	33	37	24	7	$5.65\sqrt{S_o}$	150	36	23	6–12 mm (0.25–0.5 in.) diam. or equivalent area
		59	38	48	31	~5	$5.65\sqrt{S_o}$	180	40	26	2–6 mm (0.08–0.25 in.) diam. or equivalent area

(a) The recognised temper designation used in the relevant British Standard is also given.

(b) It is possible to obtain sizes outside the ranges given in the column, but information on their mechanical properties should be obtained from the metal manufacturers.

(c) The mechanical properties will be largely dependent upon the size and cross-sectional area or complexity of the product.

5.1.3 Typical Tensile Properties and Hardness Values—American Units

At the date of publication of this sheet, no data relating to this material have been traced.

5.2 MECHANICAL PROPERTIES AT LOW TEMPERATURE

5.2.1 Tensile Properties—Impact Properties

At the date of publication of this sheet, no data relating to this material have been traced.

5.3 MECHANICAL PROPERTIES AT ELEVATED TEMPERATURE

5.3.1 Short-Time Tensile Properties—Impact Properties

Form	Temper	Testing Temperature		Tensile Strength			Elongation		Reduction of Area %	Impact Strength (a)	
		°C	°F	kg/mm²	ton/in²	psi	%	gauge length		kg m/cm²	ft lb
Rod (1) 6 mm diam. 0.24 in. diam.	Annealed	20	68	**44.0**	28	62 500	**40**	30 mm	**65**	**4.0**	21.7
		250	482	**40.5**	25.5	57 500	**36**	30 mm	**52**	**2.7**	14.6
		300	572	**38.5**	24.5	55 000	**39**	30 mm	**48**	**2.1**	11.4
		330	626	—	—	—	—	—	—	**0.4**	2.2
		340	644	**37.0**	23.5	52 500	**30**	30 mm	**30**	—	—
		380	716	—	—	—	—	—	—	**0.6**	3.2
		450	842	**32.0**	20.5	45 500	**45**	30 mm	**54**	—	—

(a) Charpy test, V notch; cross sectional area at the notch 0.75 cm².

N.B.:— Original values are printed in **bold type**; other values are converted.
— All converted values for impact strength are to be taken as indicative only; the impact energy has been converted from kg m/cm² to ft lb by taking into account the cross-sectional area of the specimen at the notch.
— Data not available: Proof stress, 0.1 and 0.2% offset,
Yield strength, 0.5% extension under load.

5.4 FATIGUE PROPERTIES

5.4.1 Fatigue Strength at Room Temperature

At the date of publication of this sheet, no data relating to this material have been traced.

REFERENCE

MECHANICAL PROPERTIES (SECTION 5)

(1) Isler, P. and Form. W. The Mechanism of Fire-Cracking. J. Inst. Metals, Vol. 100 (1972), pp. 107-113.

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