UDC 669.35'24'5

Cu Ni15 Zn21

Common names: 15% Nickel Silver
Nickel Silver 65–15

A copper-nickel-zinc alloy with an alpha phase structure. The alloy has good corrosion resistance in many environments, and on account of its pleasing silver-white colour, is selected for many decorative applications. The material has excellent cold formability. The most commonly used wrought forms are sheet, strip, rod and wire.

COMPOSITION (weight %)

Cu	62.0–66.0
Ni	14.0–16.0
Mn	0– 0.5
Zn	rem.

1 SOME TYPICAL USES

Decorative
Holloware, flatware (spoons and forks), pressed, spun and deep-drawn articles usually silver plated; watch cases; medals and medallions; jewellery and fancy buttons; architectural panels and trim; "objets d'art".

Electrical
Contacts, connectors, connector pins and terminals; resistance wire and strip for moderately elevated temperatures.

Mechanical
Springs and clips; rivets.

Miscellaneous
Instrument and camera parts; etching stock, nameplates and dials; musical instruments; slide fasteners; deep-drawn products.

2 PHYSICAL PROPERTIES

		Metric Units	English Units
2.1	Density at 20 °C *68 °F*	8.70 g/cm³	0.315 lb/in³
2.2	Melting range	1 040–1 090 °C	1 905–1 995 °F
2.3	Coefficient of thermal expansion (linear) at:		
	20 to 100 °C *68 to 212 °F*	0.000 015 per °C	0.000 008 per °F
	20 to 300 °C *68 to 572 °F*	0.000 016 „ „	0.000 009 „ „
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*	0.07 cal cm/cm² s °C	17 Btu ft/ft² h °F
	200 °C *392 °F*	0.08 „	19 „
2.6	Electrical conductivity (volume) at:		
	20 °C *68 °F* (annealed or cold worked)	4.1 m/ohm mm²	7% IACS
2.7	Electrical resistivity (volume) at:		
	20 °C *68 °F* (annealed or cold worked)	0.25 ohm mm²/m 25 microhm cm	148 ohms (circ mil/ft) 9.7 microhm in
2.8	Temperature coefficient of electrical resistance at:		
	20 °C *68 °F* (annealed or cold worked)	0.000 3 per °C (7% IACS)	0.000 2 per °F (7% IACS)
	applicable over range from 0 to 100 °C *32 to 212 °F*		
2.9	Modulus of elasticity (tension) at 20 °C *68 °F*:		
	annealed	12 700 kg/mm²	18 100 000 lb/in²
	cold worked	13 200 kg/mm²	18 800 000 lb/in²
2.10	Modulus of rigidity (torsion) at 20 °C *68 °F*:		
	annealed	4 700 kg/mm²	6 700 000 lb/in²
	cold worked	4 900 kg/mm²	7 000 000 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.

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DATA SHEET No. L 3

1973 Edition

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	250– 350 °C	480– 660 °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	Excellent	
3.6	Cold reduction between anneals	80% max.	
3.7	Machinability	See General Data Sheet No. 2	
	Machinability rating (free cutting brass = 100)	25	
3.8	Joining methods:	See General Data Sheet No. 3.10	
	Soldering	Excellent	
	Brazing	Excellent	
	Oxy-acetylene welding	Good	
	Carbon-arc welding	Not recommended	
	Gas-shielded arc welding	Fair	
	Coated metal-arc welding	Not recommended	
	Resistance welding: spot and seam	Good	
	butt	Good	

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	NS105	—	H77	—	—	—	—	—
Belgium	NBN	—	—	—	—	—	—	—	—
Canada	CSA	—	—	—	—	—	—	—	—
Chile	NCh (INDITECNOR)	—	—	—	—	—	—	—	—
France	NF	U-Z22 N15	—	A53-605	—	—	—	—	—
Germany	DIN	—	—	—	—	—	—	—	—
India	IS	NS15	—	2283	—	—	—	—	—
Italy	UNI	—	—	—	—	—	—	—	—
Japan	JIS	NSP 3 NSB 3 NSR 3 NSW 3	—	H3701	H3711	H3721	—	—	—
Netherlands	N or NEN [b]	—	—	—	—	—	—	—	—
South Africa	SABS	—	—	—	—	—	—	—	—
Spain	UNE	Cu Zn Ni15	—	37 103	—	—	—	—	—
Sweden	SIS	—	—	—	—	—	—	—	—
Switzerland	VSM	—	—	—	—	—	—	—	—
United Kingdom	BS	NS105	—	2870	—	2873	—	—	—
United States	ASTM	—	—	—	—	—	—	—	—
International Organisation for Standardization	ISO	Cu Ni15 Zn21	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
Modulis 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	no data
Impact properties	,, ,,
Creep properties	,, ,,

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 and American practices, see tables 5.1.2 and 5.1.3, respectively.

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		Hardness		Shear Strength kg/mm²	Typical Size Related to Properties Shown [b]
				%	gauge length	Brinell	Vickers		
Sheet Strip	Annealed (grain size 0.035 mm) (grain size 0.015 mm)	 41 45	 16 22	 45 38	 50 mm 50 mm	 85 100	 90 105	 31 34	 0.2–2 mm thick 0.2–2 mm thick
	Typical Cold Worked Tempers	47 53 61	36 47 57	25 15 8	50 mm 50 mm 50 mm	125 150 170	130 155 180	33 34 36	0.5–2 mm thick 0.2–2 mm thick 0.1–1 mm thick
Rod [c]	Annealed	40	16	45	$5.65\sqrt{S_o}$	85	90	30	5–25 mm diam. or equivalent area
	Typical Cold Worked Temper	52	43	16	$5.65\sqrt{S_o}$	145	150	34	5–15 mm diam. or equivalent area
Wire	Annealed	41	—	40	100 mm	—	—	31	0.5–3 mm diam.
	Typical Cold Drawn Temper	63	—	6	100 mm	—	—	38	0.2–2 mm diam.

(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.

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

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

This table is based on British practice. For other European and American practices, see tables 5.1.1 and 5.1.3, respectively.

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	
Sheet Strip	Annealed										
	(grain size 0.040 mm)	40	26	15	10	45	50 mm (2 in.)	90	29	19	0.2–3 mm (0.008–0.12 in.) thick
	(grain size 0.025 mm)	42	27	20	13	42	50 mm (2 in.)	100	31	20	0.2–3 mm (0.008–0.12 in.) thick
	Cold Worked										
	Half Hard	49	32	37	24	15	50 mm (2 in.)	150	34	22	0.2–3 mm (0.008–0.12 in.) thick
	Hard	57	37	48	31	6	50 mm (2 in.)	175	37	24	0.2–3 mm (0.008–0.12 in.) thick
	Extra Hard	68	44	59	38	~2	50 mm (2 in.)	200	40	26	0.2–3 mm (0.008–0.12 in.) thick
Rod [c]	Annealed	39	25	14	9	45	$5.65\sqrt{S_o}$	90	29	19	—
	Typical Cold Worked Temper	53	34	42	27	10	$5.65\sqrt{S_o}$	160	37	24	4–12 mm (0.16–0.5 in.) diam. or equivalent area
Wire	Annealed	39	25	—	—	40	100 mm (4 in.)	—	29	19	0.5–2.5 mm (0.02–0.10 in.) diam.
	Cold Drawn										
	Half Hard	62	40	—	—	<5	100 mm (4 in.)	—	—	—	0.5–2.5 mm (0.02–0.10 in.) diam.
	Hard	76	49	—	—	—	—	—	—	—	0.5–2.5 mm (0.02–0.10 in.) diam.

(a) The recognised temper designations used in the relevant British Standards are also given.

(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.

(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

This table is based on American practice and the temper designations shown are those referred to in ASTM and other American Standards. For British and other European countries' practices, see tables 5.1.2 and 5.1.1, respectively.

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 psi	Yield Strength 0.5% extension under load psi	Elongation		Rockwell Hardness			Shear Strength psi	Typical Size Related to Properties Shown [a]
				%	gauge length	F	B	30 T		
Flat Products (Sheet, Strip)	Annealed									
	(grain size 0.070 mm)	53 000	18 000	43	2 in.	69	22	27	40 000	0.040 in. thick
	(grain size 0.050 mm)	55 000	19 000	42	2 in.	73	31	33	42 000	0.040 in. thick
	(grain size 0.035 mm)	57 000	21 000	40	2 in.	79	39	41	43 000	0.040 in. thick
	(grain size 0.025 mm)	59 000	24 000	37	2 in.	82	46	46	44 000	0.040 in. thick
	(grain size 0.015 mm)	61 000	28 000	34	2 in.	89	55	53	45 000	0.040 in. thick
	Cold Worked									
	Eighth Hard	60 000	35 000	30	2 in.	—	60	55	42 000	0.040 in. thick
	Quarter Hard	65 000	49 000	21	2 in.	—	70	63	43 000	0.040 in. thick
	Half Hard	74 000	62 000	10	2 in.	—	80	70	44 000	0.040 in. thick
	Hard	85 000	75 000	3	2 in.	—	87	75	51 000	0.040 in. thick
	Extra Hard	92 000	79 000	2	2 in.	—	90	77	53 000	0.040 in. thick
	Spring	97 000	—	—	—	—	92	—	58 000	0.040 in. thick

[a] It is possible to obtain sizes different from those given in this column, but information on their mechanical properties should be obtained from metal manufacturers.

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

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

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.

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