UDC 669.35'24'5

Cu Ni10 Zn27

Common names: 10% Nickel Silver
Nickel Silver 65–10

A copper-nickel-zinc alloy with an alpha phase structure. The material, which is slightly yellow in colour, has good corrosion resistance to rural and marine atmospheres and to fresh water. The alloy has good cold-working properties. The most commonly used wrought forms are sheet and strip.

COMPOSITION (weight %)

Cu	61.0–65.0
Ni	9.0–11.0
Mn	0– 0.5
Zn	rem.

1 SOME TYPICAL USES

Decorative
Holloware, flatware (spoons and forks), pressed, spun and shallow deep-drawn articles usually silver plated; watch cases; jewellery; "objets d'art".

Electrical
Resistance wire and strip for moderately elevated temperatures; contacts; connectors, connector pins and terminals.

Mechanical
Rivets and clips.

Miscellaneous
Instrument and camera parts; slide fasteners; etching stock, nameplates and dials.

2 PHYSICAL PROPERTIES

		Metric Units	English Units
2.1	Density at 20 °C *68 °F*	8.60 g/cm³	0.310 lb/in³
2.2	Melting range	980–1 035 °C	1 795–1 895 °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*	0.09 cal cm/cm² s °C	22 Btu ft/ft² h °F
	200 °C *392 °F*	0.11 „	27 „
2.6	Electrical conductivity (volume) at:		
	20 °C *68 °F* (annealed or cold worked)	4.9 m/ohm mm²	8.5% IACS
2.7	Electrical resistivity (volume) at:		
	20 °C *68 °F* (annealed or cold worked)	0.20 ohm mm²/m 20 microhm cm	122 ohms (circ mil/ft) 8.0 microhm in
2.8	Temperature coefficient of electrical resistance at:		
	20 °C *68 °F* (annealed or cold worked)	0.000 4 per °C (8.5% IACS)	0.000 2 per °F (8.5% 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	12 000 kg/mm²	17 100 000 lb/in²
2.10	Modulus of rigidity (torsion) at 20 °C *68 °F:*		
	annealed	4 400 kg/mm²	6 300 000 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

Prepared by
CONSEIL INTERNATIONAL POUR LE DEVELOPPEMENT DU CUIVRE (CIDEC)
100, rue du Rhône – 1204 GENEVE

Distributed by
COPPER DEVELOPMENT ASSOCIATION
Orchard House, Mutton Lane,
POTTERS BAR, Herts EN6 3AP

DATA SHEET No. L 1
© Cu Ni10 Zn27
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	1 125–1 200 °C	2 055–2 190 °F
3.2	Annealing temperature range	600– 750 °C	1 110–1 380 °F
	Stress relieving temperature range	250– 350 °C	480– 660 °F
3.3	Hot working temperature range	850– 925 °C	1 560–1 695 °F
3.4	Hot formability	Very limited	
3.5	Cold formability	Good	
3.6	Cold reduction between anneals	70% 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	NS103	—	H 77	—	—	—	—	—
Belgium . . .	NBN	—	—	—	—	—	—	—	—
Canada . . .	CSA	HC. ZN2140 745	—	HC. 4.4	—	—	—	—	—
Chile	NCh (INDITECNOR)	—	NCh 251 of. 68	—	—	—	—	—	—
France. . . .	NF	U-Z28 N9	—	A53-605	—	—	—	—	—
Germany . . .	DIN	—	—	—	—	—	—	—	—
ndia	IS	NS 10	—	2283	—	—	—	—	—
Italy	UNI	—	—	—	—	—	—	—	—
Japan	JIS	NSP 4 NSR 4 NSW 4	—	H3701	—	H3721	—	—	—
Netherlands .	N or NEN [b]	Cu-Ni10 Zn27	NEN 6030	NEN 6033	—	—	—	—	—
South Africa .	SABS	—	—	—	—	—	—	—	—
Spain	UNE	Cu Zn Ni10	37 103	37 103	—	—	—	—	—
Sweden . . .	SIS	—	—	—	—	—	—	—	—
Switzerland . .	VSM	—	—	—	—	—	—	—	—
United Kingdom . .	BS	NS103	—	2870	—	2873	—	—	—
United States [c]	ASTM	No. 745	—	B122 B151	B151	B206	—	—	—
International Organisation for Standardization	ISO	Cu Ni10 Zn27	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.
[c] In the United States, bar and flat wire are covered under the Plate-Sheet-Strip column.

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	no data
Impact properties	,, ,,
Creep properties	,, ,,

5.4 Fatigue properties

Fatigue strength at room temperature	see table 5.4.1

5.1 MECHANICAL PROPERTIES AT ROOM TEMPERATURE*

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 % on 50 mm	Hardness		Shear Strength kg/mm²	Typical Size Related to Properties Shown [a]
					Brinell	Vickers		
Sheet Strip	Annealed (grain size 0.035 mm) (grain size 0.015 mm)	 39 43	 15 20	 52 48	 80 90	 85 95	 29 32	 0.2–2 mm thick 0.2–2 mm thick
	Typical Cold Worked Tempers	46 52 60	32 45 56	25 12 6	120 145 170	125 150 180	32 34 36	0.5–2 mm thick 0.2–2 mm thick 0.2–1 mm thick

(a) 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 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) (grain size 0.025 mm)	 37 40	 24 26	 14 19	 9 12	 50 47	 50 mm (2 in.) 50 mm (2 in.)	 80 90	 28 29	 18 19	 0.2–3 mm (0.008–0.12 in.) thick 0.2–3 mm (0.008–0.12 in.) thick
	Cold Worked Half Hard Hard Extra Hard	 46 54 65	 30 35 42	 31 43 56	 20 28 36	 22 10 ~3	 50 mm (2 in.) 50 mm (2 in.) 50 mm (2 in.)	 140 170 190	 29 32 32	 19 21 21	 0.2–3 mm (0.008–0.12 in.) thick 0.2–3 mm (0.008–0.12 in.) thick 0.2–3 mm (0.008–0.12 in.) thick
Rod [c]	Annealed	36	23	12	8	50	$5.65\sqrt{S_o}$	80	26	17	—
	Typical Cold Worked Temper	49	32	36	23	15	$5.65\sqrt{S_o}$	150	32	21	4–12 mm (0.16–0.5 in.) diam. or equivalent area
Wire	Annealed	37	24	—	—	45	100 mm (4 in.)	—	28	18	0.5–2.5 mm (0.02–0.10 in.) diam
	Cold Drawn Half Hard Hard	 57 73	 37 47	 — —	 — —	 ~5 —	 100 mm (4 in.) —	 — —	 — —	 — —	 0.5–2.5 mm (0.02–0.10 in.) diam. 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 meta manufacturers.

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

* 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.

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, Bar Flat Wire)	Annealed									
	(grain size 0.070 mm)	49 000	18 000	49	2 in.	67	22	30	37 000	0.040 in. thick
	(grain size 0.050 mm)	51 000	19 000	46	2 in.	71	28	34	38 000	0.040 in. thick
	(grain size 0.035 mm)	53 000	20 000	43	2 in.	76	35	38	40 000	0.040 in. thick
	(grain size 0.025 mm)	56 000	23 000	40	2 in.	80	42	44	42 000	0.040 in. thick
	(grain size 0.015 mm)	60 000	28 000	36	2 in.	85	52	51	45 000	0.040 in. thick
	Cold Worked									
	Eighth Hard	60 000	35 000	34	2 in.	—	60	55	42 000	0.040 in. thick
	Quarter Hard	65 000	45 000	25	2 in.	—	70	63	43 000	0.040 in. thick
	Half Hard	73 000	60 000	12	2 in.	—	80	70	44 000	0.040 in. thick
	Hard	86 000	75 000	4	2 in.	—	89	76	51 000	0.040 in. thick
	Extra Hard	95 000	76 000	3	2 in.	—	92	78	53 000	0.040 in. thick
Wire	Annealed									
	(grain size 0.070 mm)	50 000	—	50	10 in.	—	—	—	38 000	0.080 in. diam.
	(grain size 0.050 mm)	52 000	—	48	10 in.	—	—	—	39 000	0.080 in. diam.
	(grain size 0.035 mm)	56 000	—	45	10 in.	—	—	—	42 000	0.080 in. diam.
	(grain size 0.025 mm)	58 000	—	40	10 in.	—	—	—	43 000	0.080 in. diam.
	(grain size 0.015 mm)	63 000	—	35	10 in.	—	—	—	47 000	0.080 in. diam.
	Cold Worked									
	Eighth Hard (10%)	65 000	—	25	10 in.	—	—	—	45 000	0.080 in. diam.
	Quarter Hard (20%)	72 000	—	10	10 in.	—	—	—	50 000	0.080 in. diam.
	Half Hard (37%)	85 000	—	7	10 in.	—	—	—	55 000	0.080 in. diam.
	Hard (60%)	105 000	—	5	10 in.	—	—	—	63 000	0.080 in. diam.
	Extra Hard (75%)	120 000	—	3	10 in.	—	—	—	66 000	0.080 in. diam.
	Spring (84%)	130 000	—	1	10 in.	—	—	—	71 000	0.080 in. diam.

[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

Form	Temper	Number of Cycles $\times 10^6$	Metric Units kg/mm²		English Units ton/in²		American Units psi	
			Tensile Strength	Fatigue Strength	Tensile Strength	Fatigue Strength	Tensile Strength	Fatigue Strength
Strip [f] [1] **0.56 mm 0.022 in.**	Cold Worked 30.9%	100	62	19.5 [a]	39.5	12.5 [a]	**88 000**	**28 000** [a]
Strip [f] [1] **0.64 mm 0.025 in.**	Cold Worked 17.2%	100	53.5	17 [a]	34	10.5 [a]	**76 000**	**24 000** [a]
Strip [f] [1] **0.71 mm 0.028 in.**	Cold Worked 10.9%	100	48.5	19 [a]	31	12 [a]	**69 000**	**27 000** [a]
Strip [f] [1] **0.81 mm 0.032 in.**	Annealed	100	43	14 [a]	27	9 [a]	**61 000**	**20 000** [a]
—[b] [c] [2]	Cold Drawn	100 [d]	41.5	12 [e]	26	7.5 [e]	**58 700**	**17 000** [e]

[a] Reversed-bending test.
[b] Alloy composition: Cu 60.08%; Ni 10.89%; Zn 29.05%; Fe 0.20%.
[c] Form not stated in original document, but probably rod.
[d] Estimated.
[e] Rotating-cantilever test.
[f] Alloy composition: Cu 60.7%; Ni 9.5%; Mn 0.07% Fe 0.10%; Pb 0.02%; Zn rem.

N.B.: Original values are printed in **bold type**; other values are converted.

REFERENCES

MECHANICAL PROPERTIES (SECTION 5)

[1] Gohn, G.R., Guerard, J.P. and Herbert, G.J. The Mechanical Properties of Some Nickel Silver Alloy Strips. Proc. ASTM Vol. 54, (1954). pp. 229-256.
[2] McAdam, D.J., Jr. Fatigue and Corrosion-Fatigue of Spring Material. Trans. ASME., No. 51, (1929), pp. 45-58.

Printed by James Upton Ltd., Birmingham and London