

Cu Al8

Common names: 92/8 Aluminium Bronze
8% Aluminium Bronze
Aluminium Bronze, C

A copper-aluminium alloy with a duplex phase structure and possibly containing a small amount of nickel or manganese at the manufacturer's option. The alloy has good oxidation and corrosion resistance and hot working properties. The most commonly used wrought forms are plate, sheet, strip and rod.

COMPOSITION (weight %)

Al	8.0-9.0
Ni	0 -0.8
Mn	0 -0.5
Cu	rem.

1 SOME TYPICAL USES**Chemical**

Components in contact with acid waters and saline solutions, including concentrated brine; tubes and tubeplates for condensers, evaporators and heat exchangers; papermaking equipment; processing vessels and autoclaves; cryogenic equipment; pickling chains and hooks; fractionating tower parts (bubble caps and risers); sewage-handling equipment; perforated screen plates; diaphragms; waterboxes and storage tanks.

Decorative

Coins, medallions and jewellery.

Marine

Non-magnetic components and instruments (e.g. gyro compasses); protective sheathing; seawater pipework.

Mechanical

Electrode materials for joining and overlaying; fasteners; valve spindles.

2 PHYSICAL PROPERTIES

	Metric Units	English Units
2.1 Density at 20 °C 68 °F	7.8 g/cm ³	0.280 lb/in ³
2.2 Melting range	1 035-1 045 °C	1 895-1 915 °F
2.3 Coefficient of thermal expansion (linear) at:		
—183 °C —297 °F	0.000 009 per °C	0.000 005 per °F
— 93 °C —135 °F	0.000 013 " "	0.000 007 " "
20 to 100 °C 68 to 212 °F	0.000 016 " "	0.000 009 " "
20 to 300 °C 68 to 572 °F	0.000 017 " "	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	0.15-0.17 cal cm/cm ² s °C	36-41 Btu ft/ft ² h °F
200 °C 392 °F	0.20 ^(a) " "	48 ^(a) " "
2.6 Electrical conductivity (volume) at:		
20 °C 68 °F (annealed or cold worked)	7.5-8.7 m/ohm mm ²	13-15% IACS
2.7 Electrical resistivity (volume) at:		
20 °C 68 °F (annealed or cold worked)	0.13-0.11 ohm mm ² /m 13-11 microhm cm	80-69 ohms (circ mil/ft) 5.2-4.5 microhm in
2.8 Temperature coefficient of electrical resistance at:		
20 °C 68 °F (annealed) applicable over range 0 to 100 °C 32 to 212 °F	0.000 8 per °C (13%-15% IACS)	0.000 4 per °F (13%-15% IACS)
2.9 Modulus of elasticity (tension) at 20 °C 68 °F:		
annealed	12 600 kg/mm ²	17 900 000 lb/in ²
cold worked	11 350 kg/mm ²	16 100 000 lb/in ²
2.10 Modulus of rigidity (torsion) at 20 °C 68 °F:		
annealed	4 650 kg/mm ²	6 600 000 lb/in ²
cold worked	4 200 kg/mm ²	6 000 000 lb/in ²

^(a) Approximate value.

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 8); INDEX LETTERS RELATE TO FOOTNOTES AT END OF TABLE

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

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C.I.C.L.A.
Centre d'Information Cuivre, Laitons, Alliages
67, Boulevard Berthier, 75 Paris XVIIe

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3 FABRICATION PROPERTIES

Fabrication characteristics, corrosion resistance and mechanical properties of this copper-aluminium alloy are markedly influenced by composition and by heat treatment which is usually performed by the metal manufacturer. If thermal treatment, including hot forming and joining processes, is to be undertaken by the end user, the advice of the metal supplier should be requested.

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	1 120–1 180 °C	2 050–2 155 °F
3.2 Annealing temperature range	550– 750 °C	1 020–1 380 °F
Stress relieving temperature range	300– 400 °C	570– 750 °F
3.3 Hot working temperature range	800– 900 °C	1 470–1 650 °F
3.4 Hot formability		Good
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)		20
3.8 Joining methods:		See General Data Sheet No. 3.8
Soldering		Not recommended
Brazing (with special fluxes)		Fair
Oxy-acetylene welding		Not recommended
Carbon-arc welding		Not recommended
Gas-shielded arc welding		Good
Coated metal-arc welding		Good
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	—	—	—	—	—	—	—	—
Belgium	NBN	Br Al8	—	266.22	266.22	—	—	—	266.22
Canada	CSA	—	—	—	—	—	—	—	—
Chile	NCh (INDITECNOR)	Cu Al8	—	NCh 249 of. 68	—	—	NCh 249 of. 68	—	—
France	NF	U-A8	—	NF A53-609	—	—	—	—	—
Germany	DIN	Cu Al8	17 665	17 670	17 672	17 672	17 671	—	17 673
India	IS	—	—	—	—	—	—	—	—
Italy	UNI	P Cu Al9	—	2512	2512	2512	2512	—	2512
Japan	JIS	—	—	—	—	—	—	—	—
Netherlands	N or NEN ^(b)	Cu Al8	NEN 6030	NEN 6033	—	—	—	—	—
South Africa	SABS	—	—	—	—	—	—	—	—
Spain	UNE	Cu Al10	—	37 103	—	37 103	37 103	37 103	—
Sweden	SIS	—	—	—	—	—	—	—	—
Switzerland	VSM	Cu Al8	—	10 802	10 802	—	10 802	—	—
United Kingdom	BS	—	—	—	—	—	—	—	—
United States	ASTM	—	—	—	—	—	—	—	—
International Organisation for Standardization	ISO	Cu Al8	R 428	—	—	—	—	—	—

(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
Hardness	„ „ 5.1.1/2
Shear strength	„ „ 5.1.1/2
Modulus of elasticity (tension)	see 2.9
Modulus of rigidity (torsion)	„ 2.10

5.2 Mechanical properties at low temperature

Tensile properties	see table 5.2.1
Impact properties	no data

5.3 Mechanical properties at elevated temperature

Short-time tensile properties	see table 5.3.1
Creep properties	see tables 5.3.2.1/2

5.4 Fatigue properties

Fatigue strength at room temperature	see table 5.4.1
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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 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/mm ²	Proof Stress 0.2% offset kg/mm ²	Elongation		Hardness		Shear Strength kg/mm ²	Typical Size Related to Properties Shown ^(a)
				%	gauge length	Brinell	Vickers		
Plate Sheet Strip	Annealed	42	17	45	$5.65\sqrt{S_o}$	90	95	32	3–20 mm thick
	Typical Cold Worked Tempers	50 57	35 43	20 15	$5.65\sqrt{S_o}$ $5.65\sqrt{S_o}$	130 150	135 160	35 37	3–15 mm thick 3–10 mm thick
Rod ^(b)	Annealed	42	17	45	$5.65\sqrt{S_o}$	90	95	32	10–60 mm diam. or equivalent area
	Hot Worked	45	18	40	$5.65\sqrt{S_o}$	95	100	34	15–80 mm diam. or equivalent area
	Typical Cold Worked Tempers	52 58	37 43	20 15	$5.65\sqrt{S_o}$ $5.65\sqrt{S_o}$	135 160	140 170	36 38	5–30 mm diam. or equivalent area 5–20 mm diam. or equivalent area
Tube	Annealed	45	20	40	$5.65\sqrt{S_o}$	95	100	34	15–30 mm O.D., 1.5–3 mm wall

(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.

(b) 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 countries, 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/in ²	hbar	ton/in ²	%	gauge length		hbar	ton/in ²	
Plate	Hot Rolled As Manufactured	48	31	20	13	40	$5.65\sqrt{S_o}$	130	36	23	12–50 mm (0.5–2 in.) thick
Sheet Strip	Annealed	43	28	17	11	60	50 mm (2 in.)	100	32	21	—
	Hot Rolled As Manufactured	51	33	25	16	35	50 mm (2 in.)	140	36	23	3–10 mm (0.125–0.375 in.) thick
	Cold Worked Half Hard	56	36	39	25	25	50 mm (2 in.)	160	39	25	1–6 mm (0.04–0.25 in.) thick
	Hard	66	43	51	33	10	50 mm (2 in.)	210	43	28	1–3 mm (0.04–0.125 in.) thick
Tube	Annealed	45	29	17	11	55	$5.65\sqrt{S_o}$	100	34	22	—
	Cold Drawn As Drawn (Half Hard)	57	37	34	22	30	$5.65\sqrt{S_o}$	140	40	26	12–50 mm (0.5–2 in.) O.D.
	As Drawn (Hard)	70	45	57	37	7	$5.65\sqrt{S_o}$	190	45	29	up to 5 mm (0.2 in.) wall

(a) The recognised temper designations used in the nearest 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.

* Copper-aluminium alloys in this composition range (Al: 8.0–9.0%; Cu: rem.) are not included in British Standard specifications for wrought copper-base materials. Plate, sheet, strip and tube products containing 7.5–8% Al are, however, manufactured in British practice, with typical properties as shown above. The properties of plate and tube materials designated CA 102 (Al: 6.0–7.5%; Fe+Ni+Mn: 1.0–2.5% total, optional; Cu: rem.) in British Standards 2875 and 2871 respectively are also similar to those given for these forms in this table.

‡ It will be noted that tables 5.1.1 and 5.1.2, giving typical tensile properties and hardness values in Metric, and SI and English 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

Tensile properties and hardness values in American units are omitted from this data sheet, since alloys within the composition range concerned are not supplied by American manufacturers.

5.2 MECHANICAL PROPERTIES AT LOW TEMPERATURE

5.2.1 Tensile Properties

Form	Temper	Testing Temperature		Tensile Strength			Proof Stress 0.2% offset kg/mm ²	Elongation		Reduction of Area %
		°C	°F	kg/mm ²	ton/in ²	psi		%	gauge length	
(1) (a)	Cold Worked (d)	20	68	54	34.5	77 000	—	33	(b)	—
		—78	—108	57	36	81 000	—	34	(b)	—
		—183	—297	65	41.5	92 500	—	29	(b)	—
Rod (2) 3 mm diam. 0.118 in. diam.	Annealed (grain size 0.190 mm)	20	68	42	27	60 000	9.56 (c)	—	—	79
		—196	—321	54	34	76 500	14.1 (c)	—	—	79
		—269	—452	63.5	40	90 000	15.5 (c)	—	—	80
Rod (3) (e) 76 mm diam. 3 in. diam.	Annealed (grain size 0.016 mm)	25	77	43	27	61 000	11.2 (c)	107	(b)	75
		—196	—321	57	36	81 000	13.7 (c)	77	(b)	60

(a) Form not stated in original document.

(b) Gauge length not stated in original document.

(c) This value was originally reported in psi; in this table it is given in kg/mm² to 3 significant figures.

(d) Amount of cold work not defined in original document.

(e) Alloy containing 7.9% Al.

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

—Data not available:

Proof Stress, 0.1% offset,

Yield Strength, 0.5% extension under load,

Impact Strength.

5.3 MECHANICAL PROPERTIES AT ELEVATED TEMPERATURE

5.3.1 Short-Time Tensile Properties

Form	Temper	Testing Temperature		Tensile Strength			Proof Stress	Elongation	
		°C	°F	kg/mm ²	ton/in ²	psi	0.2% offset kg/mm ²	%	gauge length
Flat Products ⁽⁴⁾ (Rectangular Rod) 12 mm thick 0.5 in. thick	Hot Rolled	20	68	42	26.5	59 500	—	72	5.65√S ₀
		200	392	35	22	50 000	—	60	5.65√S ₀
		400	752	26	16.5	37 000	—	20	5.65√S ₀
		600	1 112	9	5.5	13 000	—	55	5.65√S ₀
		800	1 472	2	1.5	3 000	—	85	5.65√S ₀
Rod ⁽⁵⁾ 14 mm diam. 0.55 in. diam.	Cold Worked ^(a)	20	68	53.5	34	76 000	36.5	40	5.65√S ₀
		100	212	50	31.5	71 000	36	37	5.65√S ₀
		200	392	49	31	69 500	33	45	5.65√S ₀
		300	572	47.5	30	67 500	29.5	38	5.65√S ₀
		400	752	36	23	51 000	26	15	5.65√S ₀
		500	932	21	13.5	30 000	15	20	5.65√S ₀
		600	1 112	11	7	15 500	10	14	5.65√S ₀
		700	1 292	6	4	8 500	2.5	36	5.65√S ₀
800	1 472	2	1.5	3 000	1	31	5.65√S ₀		
Rod ⁽⁶⁾	Cold Worked 10%	20	68	58.5	37	83 000	38	37	5.65√S ₀
		100	212	58.5	37	83 000	34	38	5.65√S ₀
		200	392	58	37	82 500	32	39	5.65√S ₀
		300	572	56	35.5	79 500	30	38	5.65√S ₀
		400	752	51	32.5	72 500	28	35	5.65√S ₀
		500	932	38	24	54 000	24	35	5.65√S ₀
600	1 112	23	14.5	32 500	13	44	5.65√S ₀		
Rod ⁽⁷⁾	Extruded	20	68	50	31.5	71 000	30	55	5.65√S ₀
		100	212	48	30.5	68 500	26	44	5.65√S ₀
		200	392	45	28.5	64 000	17	48	5.65√S ₀
		300	572	42	26.5	60 000	7	31	5.65√S ₀
		400	752	37	23.5	52 500	2	39	5.65√S ₀
500	932	15	9.5	21 500	1	58	5.65√S ₀		
⁽⁵⁾ (b)	Hot Worked	20	68	47.5	30	67 500	—	59	11.3√S ₀
		100	212	45	28.5	64 000	—	64	11.3√S ₀
		200	392	44	28	62 500	—	64	11.3√S ₀
		300	572	42.5	27	60 500	—	58	11.3√S ₀
		400	752	32	20.5	45 500	—	33	11.3√S ₀
		500	932	14	9	20 000	—	28	11.3√S ₀
		600	1 112	7	4.5	10 000	—	28	11.3√S ₀
		700	1 292	4	2.5	5 500	—	31	11.3√S ₀
800	1 472	2.5	1.5	3 500	—	19	11.3√S ₀		

(a) Quoted as "1/4 hard" in original document, but amount of cold work not defined.

(b) Form not stated in original document.

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

—Data not available:

Proof stress, 0.1% offset,
Yield strength, 0.5% extension under load.

—Further data can be obtained from the following paper:

■ Köster, W. and Speidel, M. O. Der Einfluss der Temperatur und der Korngröße auf die ausgeprägte Streckgrenze von Kupferlegierungen. Z. Metallkunde. Vol. 56 (1965), pp. 585-598.

5.3.2 Creep Properties
5.3.2.1 Original Creep Data*

Form	Temper	Testing Temperature		Stress			Duration h	Total Extension % ^(a)	Intercept %	Min. Creep Rate % per 1 000 h
		°C	°F	kg/mm ²	ton/in ²	psi				
Square Tube ^(b) (c) 38 mm side 1.625 mm wall 1.5 in. side 0.064 in. wall	Annealed grain size 0.037 mm	500	932	7.0	4.5	10 000	7 ^(b)	17	—	—
				5.6	3.6	8 000	25 ^(b)	13	—	—
				4.2	2.7	6 000	92 ^(b)	9	—	—
				2.8	1.8	4 000	376	6.5	0.08	4.0
				2.5	1.6	3 500	624	6.5	0.05	2.8
				2.1	1.3	3 000	1 400	5	0.06	0.9
				1.8	1.1	2 500	3 072	6	0.11	0.4
				1.4	0.89	2 000	7 420	11	0.07	0.2
	Cold Worked 25%	500	932	7.0	4.5	10 000	18 ^(b)	1	—	—
				5.6	3.6	8 000	80 ^(b)	2	—	—
				4.2	2.7	6 000	268 ^(b)	2	—	—
				3.5	2.2	5 000	691	2	0.12	1.1
				3.2	2.0	4 500	1 173	2.5	0.10	0.6
				2.8	1.8	4 000	1 636 ^(b)	2	—	—
2.5	1.6	3 500	3 432	1.23 ^(d)	0.08	0.3				
2.1	1.3	3 000	7 776	3	0.07	0.3				

(a) Total elongation (rupture).

(b) Rupture test.

(c) The chemical composition of this material is: Al 7.07; Fe0.83; Ni0.80; Mn0.30; Cu: rem (%).

(d) Total extension (creep).

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

5.3.2.2 Stress for Designated Creep Rate*

Form	Temper	Testing Temperature		Stress for Designated Creep Rate								
		°C	°F	0.001 % per 1 000 h			0.01 % per 1 000 h			0.1 % per 1 000 h		
				kg/mm ²	ton/in ²	psi	kg/mm ²	ton/in ²	psi	kg/mm ²	ton/in ²	psi
Square Tube ^(b) (a) 38 mm side 1.625 mm wall 1.5 in. side 0.064 in. wall	Annealed grain size 0.037 mm	500	932	0.47	0.30	670	0.70	0.45	1 000	1.3	0.80	1 800
	Cold Worked 25%	500	932	—	—	—	—	—	—	1.7	1.1	2 400

(a) The chemical composition of this material is: Al 7.07; Fe0.83; Ni0.80; Mn0.30; Cu: rem (%).

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

* This data has been included for information only, since none has been traced for alloys within the exact composition range of Cu Al8.

5.4 FATIGUE PROPERTIES
5.4.1 Fatigue Strength at Room Temperature

Form	Temper	Number of Cycles $\times 10^6$	Metric Units kg/mm ²		English Units ton/in ²		American Units psi	
			Tensile Strength	Fatigue Strength	Tensile Strength	Fatigue Strength	Tensile Strength	Fatigue Strength
Rod ⁽⁹⁾ (a) 19 mm diam. 0.75 in. diam.	Extruded Light Drawn	52.52 ^(b)	56	22 ^(c)	35.7	14 ^(c)	80 000	31 500 ^(c)
Rod ⁽¹⁰⁾ (f) 25 mm diam. 1 in. diam.	Rolled	100	61	17 ^(d)	39	11 ^(d)	86 800	24 500 ^(d)
Rod ⁽⁶⁾ 42 mm diam. 1.7 in. diam.	Forged	50	52.5	18.5 ^(d)	33.5	11.5 ^(d)	74 500	26 500 ^(d)
Rod ⁽¹¹⁾ (j)	Cold Worked 11.5%	300	68.5	15.5 ^(c)	43.5	10 ^(c)	97 500	22 000 ^(c)
Wire ⁽³⁾ (g)	Annealed (grain size 0.16 mm)	10 ^(b)	43	16 ^(h)	27	10 ^(h)	61 000	22 700 ^(h)

(a) Alloy containing 1.4% Zn.

(b) Unbroken specimen.

(c) Rotating beam test.

(d) Rotating cantilever test.

(f) Alloy containing 9.10% Al.

(g) Alloy containing 7.9% Al.

(h) Push-pull test.

(j) Alloy containing 0.64% Fe; 0.51% Ni; 0.38% Sn.

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

REFERENCES

MECHANICAL PROPERTIES (SECTION 5)

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