

Cu Zn40 PbCommon names: **60/40 Brass (Leaded)**
Leaded Muntz Metal

A copper-zinc-lead alloy with a duplex alpha-plus-beta phase structure containing a dispersion of fine lead particles. The alloy has excellent hot-working properties and is generally supplied as hot-rolled plate. The material has somewhat inferior cold-working and joining properties, but is more readily machined than the similar non-leaded alloy, Cu Zn40.

COMPOSITION (weight %)

Cu	59.0-62.0
Pb	0.3- 0.8
Zn	rem.

1 SOME TYPICAL USES**Chemical and Marine**

Condenser and heat-exchanger tubeplates; porthole windows and surrounds.

Mechanical and Miscellaneous

Hot forged components and 'upset' products with fair machinability and requiring limited bending or riveting; brake shoe rivets; bending and blanking alloy for decorative brassware trade; extruded sections, including angles, channels and trim.

2 PHYSICAL PROPERTIES

	Metric Units	English Units
2.1 Density at 20 °C 68 °F	8.4 g/cm ³	0.305 lb/in ³
2.2 Melting range	885-900 °C	1 625-1 650 °F
2.3 Coefficient of thermal expansion (linear) at:		
20 to 100 °C 68 to 212 °F	0.000 020 per °C	0.000 011 per °F
20 to 300 °C 68 to 572 °F	0.000 021 " "	0.000 012 " "
2.4 Specific heat (thermal capacity) at:		
20 °C 68 °F	0.09 cal/g °C	0.09 Btu/lb °F
2.5 Thermal conductivity at:		
20 °C 68 °F	0.29 cal cm/cm ² s °C	70 Btu ft/ft ² h °F
2.6 Electrical conductivity (volume) at:		
20 °C 68 °F (annealed)	16 m/ohm mm ²	27% IACS
2.7 Electrical resistivity (volume) at:		
20 °C 68 °F (annealed)	0.064 ohm mm ² /m	38 ohms (circ mil/ft)
	6.4 microhm cm	2.5 microhm in
2.8 Temperature coefficient of electrical resistance at:		
20 °C 68 °F (annealed)	0.001 6 per °C (27% IACS)	0.000 9 per °F (27% 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 or cold worked)	10 000 kg/mm ²	14 200 000 lb/in ²
2.10 Modulus of rigidity (torsion) at 20 °C 68 °F (annealed or cold worked)	3 700 kg/mm ²	5 300 000 lb/in ²

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.

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 (CIDEC)**
100, rue du Rhône - 1204 GENEVE

Distributed by
Copper Development Association
55, South Audley Street—London W1Y 6BJ

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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	1 000-1 050 °C	1 830-1 920 °F
3.2 Annealing temperature range	450- 650 °C	840-1 200 °F
Stress relieving temperature range	250- 350 °C	480- 660 °F
3.3 Hot working temperature range	650- 750 °C	1 200-1 380 °F
3.4 Hot formability		Good
3.5 Cold formability		Limited
3.6 Cold reduction between anneals		35% max
3.7 Machinability:		See General Data Sheet No. 2
Machinability rating (free-cutting brass = 100)		60
3.8 Joining methods:		See General Data Sheet No. 3.5
Soldering		Excellent
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		Not recommended
butt		Fair

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/mm ²	Proof Stress 0.2% offset kg/mm ²	Elongation		Hardness		Shear Strength kg/mm ²	Typical Size Related to Properties Shown ^(b)
				%	gauge length	Brinell	Vickers		
Plate Sheet	Annealed	38	16	35	$5.65\sqrt{S_o}$	85	89	29	—
	Hot Rolled	38	16	30	$5.65\sqrt{S_o}$	85	89	29	20-60 mm thick
	Typical Cold Worked Temper	43	30	20	$5.65\sqrt{S_o}$	125	130	32	5-20 mm thick
Forgings	Hot Worked ^(c)	38	16	30	$5.65\sqrt{S_o}$	85	89	29	—

(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, 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—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 ton/in ²	Proof Stress 0.1% offset ton/in ²	Elongation		Vickers Hardness	Shear Strength ton/in ²	Typical Size Related to Properties Shown ^(b)
				%	gauge length			
Plate Sheet	Annealed	24	10	45	$5.65\sqrt{S_o}$	95	18	—
	Hot Rolled	25	11	40	$5.65\sqrt{S_o}$	110	19	0.5–2 in. thick
	Cold Rolled	27	16	30 35	$5.65\sqrt{S_o}$ 2 in.	130	19	0.25–0.75 in. thick
Rod	Annealed	23	8	45	$5.65\sqrt{S_o}$	90	17	—
	Hot Worked	24	9	40	$5.65\sqrt{S_o}$	100	18	0.5–2 in. diam. or equivalent area
	Cold Worked As-Manufactured	25	10	40	$5.65\sqrt{S_o}$	110	18	1–2 in. diam. or equivalent area 0.375–1 in. diam. or equivalent area 0.125–0.375 in. diam. or equivalent area
		27	14	35	$5.65\sqrt{S_o}$	125	19	
		30	18	25	$5.65\sqrt{S_o}$	140	21	
Wire	Annealed	23	—	40	2 in.	—	17	0.04–0.25 in. diam.
	Cold Drawn Half Hard Hard	30	—	22	2 in.	—	21	0.125–0.25 in. diam. "
		36	—	—	—	—	23	
	Half Hard Hard	32	—	18	2 in.	—	22	0.04–0.125 in. diam. "
40		—	—	—	—	26		
Sections (extruded)	Hot Worked ^(c)	24	9	40	$5.65\sqrt{S_o}$	100	18	—
	Cold Drawn As-Manufactured ^(c)	26	12	35	$5.65\sqrt{S_o}$	120	19	—
Forgings	Hot Worked ^(c)	24	9	40	$5.65\sqrt{S_o}$	100	18	—

(a) The recognised temper designations used in the relevant or nearest British Standards are also given, to clarify the cold-worked tempers shown.

(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.

5.2 MECHANICAL PROPERTIES AT LOW TEMPERATURE

5.2.1 Tensile Properties—Impact Properties

Form	Temper	Testing Temperature		Tensile Strength ^(a)			Elongation % on $11.3\sqrt{S_0}$	Reduction of Area %	Impact Strength ^(b)	
		°C	°F	kg/mm ²	ton/in ²	psi			kg m/cm ²	ft lb
Rod ^{(1) (c)}	Annealed	20	68	37.1	23.5	53 000	50.2	62.5	4.40	15.9
		-78	-108	38.4	24.5	54 500	49.8	64.0	4.91	17.8
		-183	-297	48.5	31	69 000	50.6	62.1	4.61	16.7
	Cold Worked 12%	20	68	44.8	28.5	63 500	28.2	57.0	2.23	8.1
		-78	-108	49.5	31.5	70 500	27.0	59.0	2.48	9.0
		-183	-297	60.8	38.5	86 500	30.8	57.0	2.19	7.9

(a) 5 mm (0.2 in.) diam. test specimen.

(b) Charpy test, 10 × 8 × 100 mm specimen, 45° V-notch, 3 mm deep; cross-sectional area at the notch 0.5 cm².

(c) Alloy containing Zn 40% Pb 1.3% Cu rem. (i.e. outside the composition range of Cu Zn40 Pb). The results are presented for guidance only, since other information has not been traced.

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 into ft lb taking into account the actual 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.

5.3 MECHANICAL PROPERTIES AT ELEVATED TEMPERATURE

5.3.1 Short-Time Tensile Properties—Impact Properties

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

5.3.2 Creep 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.

REFERENCES

MECHANICAL PROPERTIES (SECTION 5)

(1) Broniewski, W. and Wesolowski, K. L'influence de la température sur les propriétés mécaniques des laitons.—Part 2. Rev. Mét., Vol. 30 (1933), pp. 453-457.