

Cu Zn20

Common names: 80/20 Brass
80/20 Gilding Metal
Low Brass

A copper-zinc alloy with an alpha phase structure. The alloy has excellent cold-working properties and is generally resistant to dezincification and stress corrosion in most environments. Due to this combination of properties and its attractive colour, the alloy is widely used for decorative purposes and for miscellaneous formed and brazed components.

COMPOSITION (weight %)

Cu 78.5-81.5
Zn rem.

1 SOME TYPICAL USES**Architectural**

Ornamental metalwork; cold-formed angles, channels and trim.

Chemical

Wire for Fourdrinier paper screens; wire cloth.

Decorative

Clock and instrument dials; costume jewellery.

Electrical

Battery caps.

Mechanical

Miscellaneous components required to be brazed; numerous drawn and formed parts; bellows; flexible hose; slide (zip) fasteners.

2 PHYSICAL PROPERTIES

	Metric Units	English Units
2.1 Density at 20 °C 68 °F	8.65 g/cm ³	0.315 lb/in ³
2.2 Melting range	970-1 010 °C	1 780-1 850 °F
2.3 Coefficient of thermal expansion (linear) at:		
20 to 100 °C 68 to 212 °F	0.000 018 per °C	0.000 010 per °F
20 to 300 °C 68 to 572 °F	0.000 019 " "	0.000 011 " "
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:		
-200 °C -328 °F	0.17 cal cm/cm ² s °C	40 Btu ft/ft ² h °F
20 °C 68 °F	0.33 " "	81 " "
200 °C 392 °F	0.40 " "	97 " "
2.6 Electrical conductivity (volume) at:		
-196 °C -321 °F (annealed)	28 m/ohm mm ²	49 % IACS
20 °C 68 °F (")	19 " "	32 " "
200 °C 392 °F (")	14 " "	25 " "
-196 °C -321 °F (fully cold worked)	23 " "	40 " "
20 °C 68 °F (" " ")	16 " "	27 " "

continued overleaf

INDEX NUMBERS RELATE TO LITERATURE REFERENCES (see page 8); INDEX LETTERS RELATE TO FOOTNOTES AT END OF TABLE

2 PHYSICAL PROPERTIES (continued)

	Metric Units	English Units
2.7 Electrical resistivity (volume) at:		
—196 °C —321 °F (annealed)	0.035 ohm mm ² /m 3.5 microhm cm	21 ohms (circ mil/ft) 1.4 microhm in
20 °C 68 °F (")	0.054 ohm mm ² /m 5.4 microhm cm	32 ohms (circ mil/ft) 2.1 microhm in
200 °C 392 °F (")	0.070 ohm mm ² /m 7.0 microhm cm	42 ohms (circ mil/ft) 2.8 microhm in
—196 °C —321 °F (fully cold worked)	0.043 ohm mm ² /m 4.3 microhm cm	26 ohms (circ mil/ft) 1.7 microhm in
20 °C 68 °F (" " ")	0.064 ohm mm ² /m 6.4 microhm cm	38 ohms (circ mil/ft) 2.5 microhm in
2.8 Temperature coefficient of electrical resistance at:		
20 °C 68 °F (annealed) applicable over range from 0 to 100 °C 32 to 212 °F	0.001 5 per °C (32% IACS)	0.000 9 per °F (32% IACS)
20 °C 68 °F (fully cold worked) applicable over range from 0 to 100 °C 32 to 212 °F	0.001 3 " " (27% IACS)	0.000 7 " " (27% IACS)
2.9 Modulus of elasticity (tension) at 20 °C 68 °F		
annealed	12 100 kg/mm ²	17 200 000 lb/in ²
cold worked	10 600–12 100 kg/mm ²	15 100 000–17 200 000 lb/in ²
2.10 Modulus of rigidity (torsion) at 20 °C 68 °F		
annealed	4 400 kg/mm ²	6 250 000 lb/in ²
cold worked	4 150–4 400 kg/mm ²	5 900 000–6 250 000 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.

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	1 100–1 150 °C	2 010–2 100 °F
3.2 Annealing temperature range	425– 600 °C	795–1 110 °F
Stress relieving temperature range	200– 300 °C	390– 570 °F
3.3 Hot working temperature range	750– 900 °C	1 380–1 650 °F
3.4 Hot formability		Fair
3.5 Cold formability		Excellent
3.6 Cold reduction between anneals		85% max.
3.7 Machinability:	See General Data Sheet No. 2	
Machinability rating (free-cutting brass = 100)		30
3.8 Joining methods:	See General Data Sheet No. 3.4	
Soldering		Excellent
Brazing		Excellent
Oxy-acetylene welding		Good
Carbon-arc welding		Not recommended
Gas-shielded arc welding		Good
Coated metal-arc welding		Not recommended
Resistance welding: spot and seam		Fair
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	Forgings
								Shapes	
Australia . . .	SAA	—	—	—	—	—	—	—	—
Belgium . . .	NBN	—	—	—	—	—	—	—	—
Canada . . .	CSA	HC.Z20 (or240)	—	HC.4.2	—	HC.5.21	—	—	—
Chile . . .	INDITECNOR	Cu Zn20	247 n./68	—	—	—	—	—	—
France . . .	NF	—	—	—	—	—	—	—	—
Germany . . .	DIN	Cu Zn20 (2.0250)	17 660	17 670	17 672	17 672	17 671	—	—
India . . .	IS	Cu Zn20	—	—	4170	—	—	—	—
Italy . . .	UNI	P-Cu Zn20	4897	4897	4897	4897	4897	—	—
Japan . . .	JIS	RBsP4 RBsW4 RBsR4	—	H 3241 H 3331	—	H 3551	—	—	—
Netherlands . . .	N or NEN ^(b)	—	—	—	—	—	—	—	—
South Africa . . .	SABS	—	—	—	—	—	—	—	—
Spain . . .	UNE	Cu Zn20	37.103	37.103	—	37.103	37.103	—	—
Sweden . . .	SIS	14 51 14	—	14 51 14	—	—	—	—	—
Switzerland . . .	VSM	—	—	—	—	—	—	—	—
United Kingdom . . .	BS	CZ103	—	711 2870	3B 11 2874	2873	—	—	—
United States ^(c)	ASTM	No. 240	—	B 36 B 134	—	B 134	—	—	—
International Organization for Standardization	ISO	Cu Zn20	R 426	—	—	—	—	—	—

^(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 traced
Impact properties	see table 5.2.1

5.3 Mechanical properties at elevated temperature

Short-time tensile properties	see table 5.3.1
Creep properties	no data traced

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^(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 Strip	Annealed grain size 0.025 mm grain size 0.015 mm	31 33	12 14	52 50	50 mm 50 mm	75 85	79 89	23 25	0.2–2.5 mm thick 0.2–1.5 mm thick
	Typical Cold Worked Tempers	42 51 57	30 44 48	28 10 5	50 mm 50 mm 50 mm	115 145 155	120 150 160	29 30 32	0.2–3 mm thick 0.2–2 mm thick 0.2–1.5 mm thick
Rod	Annealed	30	12	58	$5.65\sqrt{S_o}$	65	68	23	—
	Typical Cold Worked Tempers	38 44	29 38	35 20	$5.65\sqrt{S_o}$ $5.65\sqrt{S_o}$	90 125	95 130	27 29	6–40 mm diam. or equivalent area 6–12 mm diam. or equivalent area
Wire	Annealed	33 35	— —	40 38	100 mm 100 mm	— —	— —	25 26	1.5–6 mm diam. 0.2–1.5 mm diam.
	Typical Cold Drawn Tempers	43 54 64	— — —	10 3 —	100 mm 100 mm —	— — —	— — —	29 30 32	1.5–6 mm diam. 1.5–3 mm diam. 0.2–1.5 mm diam.
Tube	Annealed	32	12	52	$5.65\sqrt{S_o}$	70	74	24	—
	Typical Cold Drawn Tempers	38 46	29 39	30 16	$5.65\sqrt{S_o}$ $5.65\sqrt{S_o}$	100 130	105 135	27 30	10–50 mm O.D. over 2 mm wall up to 25 mm O.D. up to 2 mm wall

(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.

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				
Sheet Strip	Annealed	19	7	65	2 in.	70	14	0.01–0.125 in. thick " " "	
	grain size 0.035 mm	20	7	63	2 in.	80	15		
	grain size 0.025 mm	21	8	60	2 in.	90	16		
	Cold Worked	Quarter Hard	22	13	50	2 in.	95	16	0.01–0.375 in. thick 0.01–0.25 in. thick 0.01–0.1 in. thick "
		Half Hard	24	18	40	2 in.	115	17	
		Hard	27	22	30	2 in.	135	18	
		Extra Hard	34	29	12	2 in.	160	19	
Rod	Annealed	19	6	55	$5.65\sqrt{S_0}$	70	14	—	
	Cold Worked As Manufactured	21	12	40	$5.65\sqrt{S_0}$	90	16	0.25–1 in. diam. or equivalent area	
		24	17	30	$5.65\sqrt{S_0}$	110	17		
Wire	Annealed	20	—	65	2 in.	—	15	0.10–0.25 in. diam. 0.02–0.10 in. diam.	
		21	—	60	2 in.	—	16		
	Cold Drawn	Half Hard	33	—	15	2 in.	—	23	0.10–0.25 in. diam. " " " " 0.02–0.10 in. diam. "
		Hard	40	—	—	—	—	26	
		Half Hard	35	—	12	2 in.	—	25	
		Hard	42	—	—	—	—	27	

(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.

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 (Plate, Sheet, Strip, Bar and Flat Wire)	Annealed									
	grain size 0.070 mm	42 000	12 000	52	2 in.	57	—	8	32 000	0.040 in. thick
	grain size 0.050 mm	44 000	14 000	50	2 in.	61	—	16	32 000	"
	grain size 0.035 mm	46 000	15 000	48	2 in.	66	—	28	33 000	"
	grain size 0.025 mm	48 000	17 000	47	2 in.	69	—	32	33 000	"
	grain size 0.015 mm	50 000	20 000	46	2 in.	75	—	42	33 000	"
	Cold Worked									
	Quarter Hard	53 000	40 000	30	2 in.	—	55	54	36 000	0.040 in. thick
	Half Hard	61 000	50 000	18	2 in.	—	70	64	39 000	"
	Hard	74 000	59 000	7	2 in.	—	82	71	43 000	"
Spring	91 000	65 000	3	2 in.	—	91	77	48 000	"	
Rod	As Hot Worked	48 000	19 000	58	2 in.	70	24	—	33 000	under 1 in. diam.
	Annealed Soft	44 000	13 000	65	2 in.	60	9	—	32 000	under 1 in. diam.
	Cold Worked Hard (37%)	75 000	56 000	18	2 in.	103	80	—	43 000	under 1 in. diam.
	Hard (40%)	80 000	58 000	15	2 in.	104	81	—	45 000	"
Wire	Annealed									
	grain size 0.050 mm	44 000	—	55	2 in.	—	—	—	32 000	0.080 in. diam.
	grain size 0.035 mm	46 000	—	50	2 in.	—	—	—	33 000	"
	grain size 0.015 mm	50 000	—	47	2 in.	—	—	—	33 000	"
	Cold Worked									
	Eighth Hard	56 000	—	27	2 in.	—	—	—	37 000	0.080 in. diam.
	Quarter Hard	68 000	—	12	2 in.	—	—	—	42 000	"
	Half Hard	82 000	—	8	2 in.	—	—	—	47 000	"
	Hard	107 000	—	5	2 in.	—	—	—	53 000	"
	Extra Hard	116 000	—	4	2 in.	—	—	—	55 000	"
Spring	125 000	—	3	2 in.	—	—	—	60 000	"	
Tube	Annealed Soft	48 000	15 000	43	2 in.	58	—	—	33 000	0.750 in. O.D. × 0.049 in. wall
	Cold Worked Hard (70%)	98 000	60 000	2	2 in.	109	—	—	52 000	0.750 in. O.D. × 0.049 in. wall

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

5.2 MECHANICAL PROPERTIES AT LOW TEMPERATURE

5.2.1 Impact Properties

Form	Temper	Testing Temperature		Impact Strength ^(a)	
		°C	°F	kg m/cm ²	ft lb
—(1)(b)	Annealed	20	68	15.0	54
		-23	-9	15.1	54.5
		-77	-107	15.2	55
		-123	-189	16.6	60
		-173	-279	18.5	67
		-195	-319	19.1	69
	Cold Drawn 27%	20	68	8.8	32
		-23	-9	9.4	34
		-77	-107	10.0	36
		-123	-189	10.2	37
		-173	-279	10.5	38
		-195	-319	10.6	38.5

(a) Charpy specimen, keyhole notch; cross-sectional area at the notch 0.5 cm².

(b) Form not stated in original document.

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 ft lb into kg m/cm² taking into account the actual cross-sectional area of the specimen at the notch.

—Data not available:

Tensile strength

Proof stress, 0.1% and 0.2% offset

Yield strength, 0.5% extension under load

Elongation

Reduction of Area

5.3 MECHANICAL PROPERTIES AT ELEVATED TEMPERATURE

5.3.1 Short-Time Tensile Properties

Form	Temper	Testing Temperature		Tensile Strength			Elongation % on 2 in.
		°C	°F	kg/mm ²	ton/in ²	psi	
Rod⁽²⁾ 12.8 mm diam. 0.505 in. diam.	Cold Worked 30%	23	73	57	36	80 800	13
		250	482	34	21.5	48 700	0
		400	752	14.5	9.5	20 800	7
		500	932	4.5	3	6 600	16
		625	1 157	2.5	1.5	3 800	19
		750	1 382	2	1	2 700	29
		850	1 562	1	0.6	1 400	30
		900	1 652	0.7	0.4	1 000	36

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

—Data not available:

Proof stress, 0.1% and 0.2% offset

Yield strength, 0.5% extension under load.

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

Form	Temper	Number of Cycles × 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	
Strip ⁽³⁾ 0.81 mm 0.032 in.	Annealed (grain size 0.035 mm)	100	32.5	10 ^(a)	20.5	6.5 ^(a)	46 200	14 000 ^(a)	
	Cold Worked	21%	100	44.5	13.5 ^(a)	8.5 ^(a)	63 600	19 000 ^(a)	
		37%	100	54	16 ^(a)	10 ^(a)	76 900	22 500 ^(a)	
60%	100	62	15.5 ^(a)	39.5	10 ^(a)	88 000	22 000 ^(a)		
Flat Products ⁽⁴⁾ 1 mm 0.04 in.	Cold Worked ^(b)	20	64	17 ^(a)	40.5	10.5 ^(a)	91 000	24 000 ^(a)	
Sheet ⁽⁵⁾ 2.54 mm 0.10 in.	Annealed (grain size 0.04 mm)	2	—	14 ^(a)	—	9 ^(a)	—	20 000 ^(a)	
Rod ⁽⁶⁾ 19 mm diam. 0.75 in. diam.	Annealed	50	32	15.5 ^(c)	20	10 ^(c)	45 300	22 400 ^(c)	
	Cold Worked	27%	50	51	15 ^(c)	32.5	9.5 ^(c)	72 700	21 500 ^(c)
		27% and Stress Relieved ^(d)	50	49	17.5 ^(c)	31.5	11 ^(c)	70 300	25 000 ^(c)
Rod ⁽⁷⁾ 25.4 mm diam. 1 in. diam.	Annealed	90	31	12.5 ^(c)	19.5	8 ^(c)	44 000	17 500 ^(c)	
	Cold Worked	100	54	16 ^(c)	34	10.5 ^(c)	76 500	23 000 ^(c)	
		Cold Worked and Stress Relieved ^(e)	40	56.5	18.5 ^(c)	36	11.5 ^(c)	80 500	26 000 ^(c)
Rod ⁽⁸⁾ 25.4 mm diam. 1 in. diam.	Cold Worked and Stress Relieved ^(f)	100	41	15 ^(c)	26	9.5 ^(c)	58 000	21 000 ^(c)	
	Cold Worked and Annealed ^(g)	40	32	12 ^(c)	20.5	7.5 ^(c)	45 500	17 000 ^(c)	
Wire ⁽⁹⁾ 1.8 mm diam. 0.072 in. diam.	Cold Worked	60%	100	62.5	18 ^(c)	39.5	39 000	23 000 ^(c)	
		84%	100	76	18.5 ^(c)	48	108 000	26 500 ^(c)	
Wire ⁽⁴⁾ 2 mm diam. 0.08 in. diam.	Cold Worked ^(h)	100	75	16 ^(c)	48	10.5 ^(c)	107 000	23 000 ^(c)	
	Cold Worked ^(b)	100	88	18.5 ^(c)	56	11.5 ^(c)	125 000	26 000 ^(c)	

(a) Reversed-bending test. (b) Quoted as "spring" in original document, but amount of cold work not defined. (c) Rotating-beam test. (d) Stress relieved for 1 h at 275 °C (527 °F). (e) Stress relieved for 1 h at 232 °C (450 °F). (f) Stress relieved for 2 h at 232 °C (450 °F). (g) Annealed for 2 h at 482 °C (900 °F). (h) Quoted as "hard" in original document, but amount of cold work not defined.

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

REFERENCES

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