Cu Zn37

Common names: 63/37 Brass
Basis Brass
Common Brass
63/37 Yellow Brass

A copper–zinc alloy with an alpha phase structure possibly also containing a small amount of beta phase, depending upon fabrication history. Service environment must be considered to predict corrosion behaviour. The alloy can be hot or cold worked and its ductility, although lower than that of Cu Zn28, Cu Zn30 and Cu Zn33, permits quite severe deformation, including cold heading of rod and wire. Cu Zn37 is mainly used for simple cold presswork not involving deep-drawing.

COMPOSITION (weight %)

Cu	62.0–65.5
Zn	rem.

1 SOME TYPICAL USES

Electrical
Lamp caps, lampholder and switch components.

Hardware
General coppersmithing work; chain; eyelets, fasteners, hinges, kicking plates, locks, fingerplates and wire brushes.

Mechanical
Miscellaneous cold presswork products, including instrument covers and containers, and blanked articles, such as instrument plates and wheels; cold-headed items including pins, rivets and screws; springs; ink containers for ball-point pens; automobile radiator tanks; torch and flashlight cases; reflectors.

2 PHYSICAL PROPERTIES

	Metric Units	English Units
2.1 Density at 20 °C *68 °F*	8.45 g/cm³	0.305 lb/in³
2.2 Melting range	902–920 °C	1 655–1 690 °F
2.3 Coefficient of thermal expansion (linear) at:		
—243 °C *—459 °F*	0.000 000 5 per °C	0.000 000 3 per °F
—173 °C *—279 °F*	0.000 013 ,, ,,	0.000 007 ,, ,,
— 73 °C *— 99 °F*	0.000 017 ,, ,,	0.000 009 ,, ,,
20 to 100 °C *68 to 212 °F*	0.000 019 ,, ,,	0.000 011 ,, ,,
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
200 °C *392 °F*	0.11 ,,	0.11 ,,
2.5 Thermal conductivity at:		
—200 °C *—328 °F*	0.12 cal cm/cm² s °C	30 Btu ft/ft² h °F
20 °C *68 °F*	0.30 ,,	73 ,,
200 °C *392 °F*	0.34 ,,	82 ,,
2.6 Electrical conductivity (volume) at:		
20 °C *68 °F* (annealed)	15 m/ohm mm²	26 % IACS
200 °C *392 °F* (,,)	12 ,,	21 ,, ,,
2.7 Electrical resistivity (volume) at:		
20 °C *68 °F* (annealed)	0.066 ohm mm²/m 6.6 microhm cm	40 ohms (circ mil/ft) 2.6 microhm in
200 °C *392 °F* (,,)	0.082 ohm mm²/m 8.2 microhm cm	49 ohms (circ mil/ft) 3.2 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 7 per °C (26% IACS)	0.000 9 per °F (26 % IACS)
2.9 Modulus of elasticity (tension) at 20 °C *68 °F*		
annealed	11 100 kg/mm²	15 800 000 lb/in²
cold worked	9 700–11 100 kg/mm²	13 800 000–15 800 000 lb/in²
2.10 Modulus of rigidity (torsion) at 20 °C *68 °F*		
annealed	4 000 kg/mm²	5 700 000 lb/in²
cold worked	3 550–4 000 kg/mm²	5 050 000–5 700 000 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.

INDEX NUMBERS RELATE TO LITERATURE REFERENCES (see page 10); INDEX LETTERS RELATE TO FOOTNOTES AT END OF TABLE

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Cu Zn37
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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	1 040–1 080 °C	1 905–1 975 °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	720– 820 °C	1 330–1 510 °F
3.4 Hot formability	Good	
3.5 Cold formability	Good	
3.6 Cold reduction between anneals	65% max.	
3.7 Machinability:	See General Data Sheet No. 2	
Machinability rating (free-cutting brass = 100)	35	
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	Fair	
Coated metal-arc welding	Not recommended	
Resistance welding: spot and seam	Fair	
butt	Good	

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 %	Elongation gauge length	Hardness Brinell	Hardness Vickers	Shear Strength kg/mm²	Typical Size Related to Properties Shown[(b)]
Plate Sheet Strip	Annealed grain size 0.035 mm	34	13	56	$5.65\sqrt{S_o}$	65	68	26	0.2–5 mm thick
	grain size 0.025 mm	36	14	53	50 mm	80	84	27	0.2–2.5 mm thick
	grain size 0.015 mm	38	16	50	50 mm	85	89	28	0.2–1.5 mm thick
	Typical Cold Worked Tempers	39	25	35	50 mm	100	105	28	0.2–3 mm thick
		43	33	26	50 mm	120	125	29	"
		49	41	12	50 mm	135	140	31	0.2–2 mm thick
		53	48	5	50 mm	145	150	32	"
		58	55	—	—	155	160	33	0.2–1.5 mm thick
		63	—	—	—	165	170	34	0.2–1 mm thick
Rod	Annealed	34	14	55	$5.65\sqrt{S_o}$	65	68	26	—
	Typical Cold Worked Tempers	38	23	38	$5.65\sqrt{S_o}$	95	100	28	—
		41	32	28	$5.65\sqrt{S_o}$	115	120	29	6–40 mm diam. or equivalent area
		47	41	12	$5.65\sqrt{S_o}$	130	135	31	6–12 mm diam. or equivalent area
Wire	Annealed	37	—	42	100 mm	—	—	27	1.5–6 mm diam.
		39	—	32	100 mm	—	—	28	0.5–1.5 mm diam.
		43	—	18	100 mm	—	—	29	up to 0.5 mm diam.
	Typical Cold Drawn Tempers	41	—	30	100 mm	—	—	28	1.5–6 mm diam.
		56	—	5	100 mm	—	—	31	"
		66	—	—	—	—	—	37	1.5–3 mm diam.
		79	—	—	—	—	—	40	"
		45	—	12	100 mm	—	—	30	0.5–1.5 mm diam.
		59	—	—	—	—	—	33	"
		71	—	—	—	—	—	36	"
		86	—	—	—	—	—	44	"
Tube	Annealed	35	13	52	$5.65\sqrt{S_o}$	80	84	26	—
	Typical Cold Drawn Tempers	42	33	28	$5.65\sqrt{S_o}$	110	115	29	10–50 mm O.D. over 2 mm wall
		49	44	10	$5.65\sqrt{S_o}$	135	140	32	up to 25 mm O.D. up to 2 mm wall
Sections / Shapes	Annealed	34	13	50	$5.65\sqrt{S_o}$	65	68	26	—
	Typical Cold Worked Tempers[(c)]	38	20	33	$5.65\sqrt{S_o}$	90	95	27	—
		40	30	26	$5.65\sqrt{S_o}$	110	115	28	—

(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/in²	Proof Stress 0.1% offset ton/in²	Elongation %	Elongation gauge length	Vickers Hardness	Shear Strength ton/in²	Typical Size Related to Properties Shown[b]
Plate	Hot Rolled	23	9	45	$5.65\sqrt{S_o}$	90	17	0.5–2 in. thick
	Cold Rolled							
	Hard	25	17	35	$5.65\sqrt{S_o}$	100	18	0.625–1 in. thick
		27	20	25	$5.65\sqrt{S_o}$	120	19	0.375–0.625 in. thick
Sheet Strip	Annealed							
	grain size 0.050 mm	22	7	60	2 in.	65	17	—
	grain size 0.035 mm	22	7	58	2 in.	70	17	—
	grain size 0.025 mm	23	8	55	2 in.	80	17	—
	grain size 0.015 mm	24	9	52	2 in.	90	18	0.01–0.125 in. thick
	Cold Worked							
	Quarter Hard	24	16	40	2 in.	100	18	0.01–0.375 in. thick
	Half Hard	27	21	30	2 in.	130	19	0.01–0.25 in. thick
	Hard	32	26	15	2 in.	155	21	0.01–0.1 in. thick
	Extra Hard	38	31	7	2 in.	180	22	"
Rod	Annealed	22	8	50	$5.65\sqrt{S_o}$	75	17	—
	Cold Worked							
	As Manufactured	24	15	35	$5.65\sqrt{S_o}$	100	18	0.25–1 in. diam. or equivalent area
		26	20	30	$5.65\sqrt{S_o}$	120	19	
Wire	Annealed	22	—	60	2 in.	—	17	0.10–0.25 in. diam.
		23	—	55	2 in.	—	17	0.02–0.10 in. diam.
	Cold Drawn							
	Quarter Hard	29	—	20	2 in.	—	19	0.10–0.25 in. diam.
	Half Hard	36	—	10	2 in.	—	26	"
	Hard	44	—	—	—	—	29	"
	Extra Hard	47	—	—	—	—	30	"
	Half Hard	38	—	8	2 in.	—	26	0.02–0.10 in. diam.
	Hard	46	—	—	—	—	29	"
	Extra Hard	50	—	—	—	—	31	"
Tube[c]	Annealed	22	8	50	$5.65\sqrt{S_o}$	75	17	—
	Cold Drawn or Temper Annealed							
	Temper Annealed	24	12	45	$5.65\sqrt{S_o}$	90	18	0.25–2 in. O.D., 0.02–0.08 in. wall
	As Drawn	32	26	15	$5.65\sqrt{S_o}$	160	21	"

[a] The recognised temper designations used in the relevant or nearest British Standards are also given in this table, 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] Intermediate tube tempers are generally obtained by temper annealing. Drawn tubes are usually stress relieved after the final draw.

5.2 MECHANICAL PROPERTIES AT LOW TEMPERATURE

5.2.1 Tensile Properties—Impact Properties

Form	Temper	Testing Temperature		Tensile Strength			Yield Strength psi	Elongation		Reduction of Area %	Impact Strength[a]	
		°C	°F	kg/mm^2	ton/in^2	psi		%	gauge length		kg m/cm^2	ft lb
Rod[1][b] **12.7 mm diam. 0.5 in. diam.**	Cold Worked[c]	20	68	50.5	32	**72 000**	**54 000**[d]	**23.5**	2 in.	**65**	6.6	**38**
		– 41	– 42	52.5	33.5	**74 500**	**58 000**[d]	**25.5**	2 in.	**65**	6.4	**37**
—[2][e]	Cold Worked[f]	20	68	**38**	24	54 000	—	**41**	$5.65\sqrt{S_o}$	—	—	—
		– 40	– 40	**40**	25.5	57 000	—	**41**	$5.65\sqrt{S_o}$	—	—	—
		– 80	–112	**41**	26	58 500	—	**44**	$5.65\sqrt{S_o}$	—	—	—
		–120	–184	**44**	28	62 500	—	**49**	$5.65\sqrt{S_o}$	—	—	—
		–195	–319	**52**	33	74 000	—	**53**	$5.65\sqrt{S_o}$	—	—	—

[a] Izod specimen; cross-sectional area at the notch 0.8 cm^2. [b] Containing 0.31% Sn. [c] Quoted as "hard drawn" in original document, but amount of cold work not defined. [d] Quoted as "yield strength" in original document, but offset strain not defined. [e] Form not stated in original document. [f] Quoted as "half hard" in original document, but amount of cold work not defined.

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/cm^2 taking into account the actual cross-sectional area of the specimen at the notch.
—The 0.1% and 0.2% offset proof stress values are not available.

5.3 MECHANICAL PROPERTIES AT ELEVATED TEMPERATURE

5.3.1 Short-Time Tensile Properties

Form	Temper	Testing Temperature		Tensile Strength			Proof Stress 0.1% offset ton/in^2	Elongation % on 2 in.
		°C	°F	kg/mm^2	ton/in^2	psi		
Strip[3] **2 mm 0.08 in.**	Annealed (grain size 0.035 mm)	20	68	35.5	**22.5**	50 500	**8.1**	**60**
		100	212	34	**21.5**	48 000	**7.8**	**57**
		200	392	32.5	**20.5**	46 000	**7.8**	**54**
		250	464	30.5	**19.5**	43 500	**7.7**	**50**
		300	572	27	**17.3**	38 500	**7.2**	**39**
Rod[4] **12.8 mm diam. 0.505 in. diam.**	Cold Worked 20%	25	77	43	27	**61 000**	—	**27**
		250	482	37.5	24	**53 700**	—	**20**
		390	734	14.5	9.5	**20 900**	—	**41**
		500	932	5.5	3.5	**7 500**	—	**43**
		550	1 022	4	2.5	**5 800**	—	**32**
		630	1 166	2	1	**2 800**	—	**27**
		725	1 337	0.7	0.5	**1 040**	—	**40**
		800	1 472	0.4	0.2	**530**	—	**139**
		875	1 607	0.1	0.08	**180**	—	**167**

N.B.:—Original values are printed in **bold type**; other values are converted.
—Data not available:
Proof stress, 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 ×10⁶	Metric Units kg/mm²		English Units ton/in²		American Units psi	
				Tensile Strength	Fatigue Strength	Tensile Strength	Fatigue Strength	Tensile Strength	Fatigue Strength
Strip[5] 0.51 mm 0.02 in.	Annealed[a]		100	33	10.5[b]	21	6.5[b]	46 600	15 000[b]
	Cold Worked[a]	37.1%	100	54.5	13.5[b]	34.5	8.5[b]	77 200	19 500[b]
		68.7%	100	67	14[b]	42.5	9[b]	95 600	20 000[b]
	Annealed[c]		100	33	9.5[b]	21	6[b]	46 600	13 500[b]
	Cold Worked[c]	37.1%	100	52	12[b]	33	8[b]	73 700	17 500[b]
		60.5%	100	64.5	12[b]	41	8[b]	91 900	17 500[b]
	Hot Rolled[d]		100	—	9.5[b]	—	6[b]	—	13 500[b]
	Cold Worked[d]	37.1%	100	49	10.5[b]	31	6.5[b]	69 600	15 000[b]
		68.7%	100	66	14.5[b]	42	9[b]	93 900	20 500[b]
Strip[6] 0.81 mm 0.032 in.	Annealed (grain size 0.030 mm)		100	36.5	10.5[b]	23	6.5[b]	51 700	15 000[b]
	Cold Worked	21%	100	45.5	13.5[b]	29	8.5[b]	64 800	19 000[b]
		37%	100	56.5	13.5[b]	36	8.5[b]	80 700	19 000[b]
		60%	100	66	13.5[b]	42	8.5[b]	94 000	19 000[b]
Rod[7] 12.7 mm diam. 0.5 in. diam.	Cold Worked	30.1%	300	51	16[e]	32	10[e]	72 200	22 700[e]
Rod[8] 12.7 mm diam. 0.5 in. diam.	Cold Worked	15.2%	0.1	40	31.5[e]	25.5	20[e]	57 200	44 500[e]
		30.1%	0.1	51	38[e]	32	24[e]	72 200	54 000[e]
		50.1%	0.1	64.5	43.5[e]	41	27.5[e]	91 600	62 000[e]
	Cold Worked	15.2%	1	40	23[e]	25.5	14.5[e]	57 200	33 000[e]
		30.1%	1	51	25.5[e]	32	16[e]	72 200	36 000[e]
		50.1%	1	64.5	29[e]	41	18.5[e]	91 600	41 000[e]
	Cold Worked	15.2%	10	40	15[e]	25.5	9.5[e]	57 200	21 500[e]
		30.1%	10	51	17[e]	32	10.5[e]	72 200	24 000[e]
		50.1%	10	64.5	23[e]	41	14.5[e]	91 600	33 000[e]
	Cold Worked	15.2%	100	40	13.5[e]	25.5	8.5[e]	57 200	19 000[e]
		30.1%	100	51	16[e]	32	10.5[e]	72 200	23 000[e]
		50.1%	100	64.5	21[e]	41	13.5[e]	91 600	30 000[e]
	Cold Worked	15.2%	300	40	13[e]	25.5	8.5[e]	57 200	18 500[e]
		30.1%	300	51	16[e]	32	10[e]	72 200	22 500[e]
		50.1%	300	64.5	20.5[e]	41	13[e]	91 600	29 500[e]
	Cold Worked	15.2%	1 000	40	12.5[e]	25.5	8[e]	57 200	18 000[e]
		30.1%	1 000	51	15.5[e]	32	10[e]	72 200	22 000[e]
		50.1%	1 000	64.5	20.5[e]	41	13[e]	91 600	29 000[e]

continued on opposite page

5.4.1. Fatigue Strength at Room Temperature (continued)

Form	Temper	Number of Cycles ×10⁶	Metric Units kg/mm²		English Units ton/in²		American Units psi	
			Tensile Strength	Fatigue Strength	Tensile Strength	Fatigue Strength	Tensile Strength	Fatigue Strength
Rod[9] 25.4 mm diam. 1 in. diam.	Annealed	10 20	33 30.5	12.5[e] 10.5[e]	21 19.5	8[e] 6.5[e]	**47 000** **43 500**	**18 000**[e] **15 000**[e]
	Cold Worked and Stress Relieved[f]	5 20 40	50 38 58	12[e] 9[e] 17.5[e]	31.5 24 37	7.5[e] 6[e] 11[e]	**71 000** **54 000** **82 500**	**17 000**[e] **13 000**[e] **25 000**[e]
Wire[10] 1.8 mm diam. 0.072 in. diam.	Cold Worked 60% 84%	100 100	65.5 83	13.5[e] 15.5[e]	41.5 52.5	8.5[e] 10[e]	**93 000** **118 000**	**19 000**[e] **22 000**[e]

[a] Cu 65.09%. [b] Reversed-bending test. [c] Cu 64.78%. [d] Cu 65.01%. [e] Rotating-beam test. [f] Stress relieved for 3 h at 232 °C (*450 °F*).

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