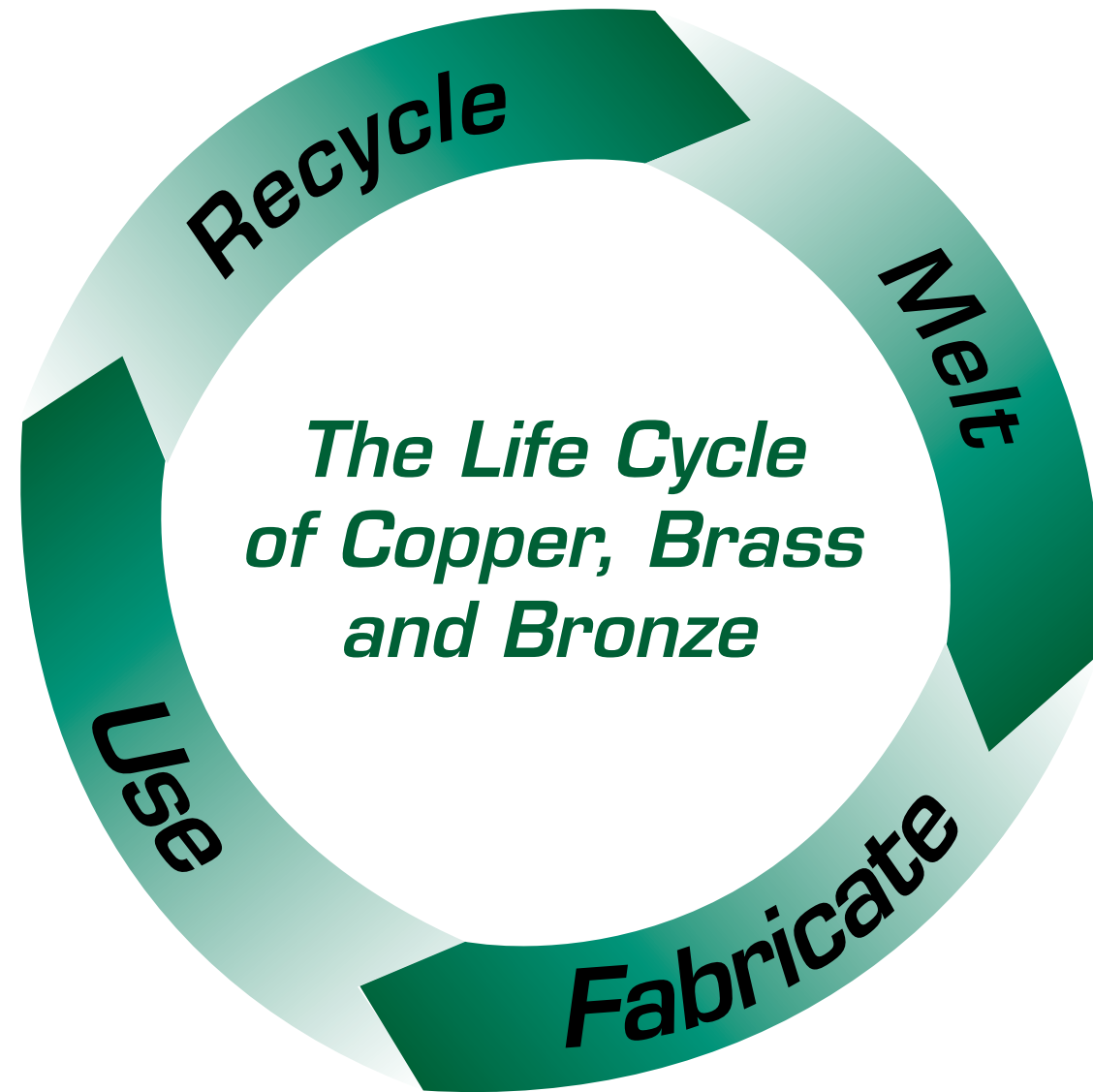


BRASS COPPER AND COPPER ALLOYS CATALOGUE



A complete life cycle material for the Consumer, Industry and the Environment.

To ensure a high quality of life, the materials that we as consumers and manufacturers use should meet not only technical performance standards, but have a long service life, be useable in a greater number of applications and be environmentally friendly. Once their service is complete, they should be 100% recyclable, thereby completing the life cycle to be used once again. Copper, brass and bronze fit the bill perfectly, with a well developed scrap recycling industry that ensures nothing is wasted.

Welcome to

AW Austral Wright Metals



Austral Wright Metals has been a leading metals distributor in Australia for more than 20 years. With non ferrous manufacturing origins for over 70 years prior to this, it means we know metals and the industry better than most.

Service

A comprehensive range of stock; helpful, dedicated and knowledgeable staff; a determination to supply what you need when you need it, at the quality level you require – it adds up to unbeatable service. Our aim is next day delivery for orders for standard stock, and our warehouses around the country are staffed and equipped to achieve this.

With over 5,000 items of copper, brass and bronze, stainless steel, aluminium and even some titanium and nickel alloy products in stock, we are well equipped to meet your requirements. Where customers need non-standard products, special sizes and qualities, or have variable demand, Austral Wright Metals will provide special stocking arrangements. We also source and indent larger quantities of specialized products from mills around the world.

People

Exceptional customer service starts with people. Austral Wright Metals develop and retain high quality personnel with a variety of training courses covering product knowledge and skills training. This is supported by metallurgists and engineers with an unrivalled knowledge of the metals we sell, gained from mill careers in making the metals. In the design phase we're here to help you with product specifications and optimum material selection – economic & technical – and we can help out if you have problems in fabrication or in service.

Quality

Austral Wright Metals sources from selected high quality mills overseas. We choose the best for reliable product quality, price and delivery. Sourcing is our key contribution to the industry – we aim to supply the best combination of quality, delivery and price to make your business more competitive.

LOCATIONS

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AUSTRAL WRIGHT METALS WELCOME YOUR ENQUIRIES FOR ANY OF THE FOLLOWING MATERIALS:

Aluminium	Coil, sheet, bar, tubing, welding wire
Aluminium Bronze	Bar, plate, castings, welding consumables
Aqualoy	Aqualoy boat shafting
Brass	Coil, sheet plate, shim, bar, engraving, tube, wire
Bearing Alloys	Leaded gunmetal, phosphor bronzes, aluminium bronzes
Bimetal	Coil, sheet
Beryllium Copper	Bar, flat, plate, hollow, castings, master alloys, coil
Cobalt	Alloy powder, granules, oxides and salts
Copper	Coil, sheet, plate, shim, busbar, free machining bar, tube, wire
Cupro Nickel	Pipe, tube, fittings, plate, sheet and welding consumables (70/30 & 90/10)
Heat Exchanger Tube	Stainless steel, brass, aluminium brass, copper nickel to AS1569, ASTM, BS and JIS Standards
Incoloy* Alloys	Heat and corrosion resistant material in wrought forms, welding consumables
Incomag*	Material for foundry use for production of SG cast iron
Inconel* Alloys	Heat and corrosion resistant material in wrought forms, welding consumables
Mumetal	Nickel iron alloys for use in the transformer and shielding applications
Molybdenum	Bar, sheet, wire, components and molybdenum compounds
Monel* Alloys	Corrosion resisting nickel alloy in bar, flat, plate, sheet, coil, tube and wire, welding consumables
Nickel	Primary nickel shot, pellets, squares, powder, oxides and salts
Nickel Alloys	Corrosion and heat resisting material in all wrought forms and welding consumables
Nickel Iron	Controlled expansion and electrical alloys in all wrought forms
Nickel Silver	Coil, sheet, bar, wire, in soft, hard, spring hard tempers
Nimonic Alloys	Coil, sheet, rod, wire sections
Nitronic*	Nitronic* grades of stainless steel
Phosphor Bronze	Coil, sheet, rod, wire
Powdered Metals	Nickel, tungsten, cobalt, iron, molybdenum, selenium, tellurium
Silicon Bronze	Sheet, bar, welding consumables
Stainless Steel	Coil, sheet, flats, angles, bar, tube, pipe fittings, welding consumables, all grades
Tantalum	Sheet, tube, rod, wire
Titanium	Sheet, tube, rod, wire, pipe, fittings and fasteners
Tungsten	Sheet, powder, wire, rod
Tungsten-Copper	Sintered bars
Welding Materials	Wire, electrode and fluxes for gas or electric welding nickel alloys, cupro-nickels, aluminium, bronzes, stainless steel, dissimilar metals.

*Registered Trade Names

SECTION 1 BRASS



BRASS ROUND

Metric (mm)	Imperial (Inches)	kg/m (Nominal)	Alloy		
			385 Free Machining Brass	352 D.R. Machining Brass	360 American Free Cutting Brass
3.18	1/8	0.07	50003661		
3.97	5/32	0.11	50003662		
4.76	3/16	0.15	50003663		
5		0.17	50157155		
6	-	0.24	50003656		
6.35	1/4	0.27	50003665		
7.14	9/32	0.34	50003667		
7.94	5/16	0.42	50003668		
8	-	0.43	50157161		
8.73	11/32	0.51	50003669		
9.53	3/8	0.61	50003670	50003679	
10		0.67	50011017		
11.11	7/16	0.82	50003672	50157171	
12		0.96	50003698		
12.7	1/2	1.08	50003410	50003404	
13.49	17/32	1.22	50003456		
14	-	1.30	50120555		
14.1	-	1.32			50125753
14.29	9/16	1.36	50003411	50003448	
14.62 - 14.66	37/64	1.43		50117520	
15.88	5/8	1.68	50003412	50003414	
16	-	1.72	50003466		
17.46	11/16	2.04	50003413	50115318	
19.05	3/4	2.42	50003417	50003415	
20		2.66	50157187		
20.64	13/16	2.84	50003418	50115320	
22	-	3.22	50120557		
22.23	7/8	3.30	50003419	50003420	
23.81	15/16	3.78	50003421	50003416	
25.4	1	4.31	50003422	50003455	
26.99	1 1/16	4.86	50003423	50115033	
28.58	1 1/8	5.45	50003522	50116766	
30	-	5.99	50133770		
30.16	1 3/16	6.07	50003523		
31.75	1 1/4	6.73	50003460	50003601	
32	-	6.79	50157196		
33.34	1 5/16	7.45	50003527		
34.93	1 3/8	8.15	50003528	50115035	
38.1	1 1/2	9.69	50003530	50003615	
41.28	1 5/8	11.38	50003532	50003777	
44.45	1 3/4	13.19	50003533	50003520	
47.63	1 7/8	15.15	50003534		

BRASS ROUND (continued)

Metric (mm)	Imperial (Inches)	kg/m (Nominal)	Alloy		
			385 Free Machining Brass	352 D.R. Machining Brass	360 American Free Cutting Brass
50.8	2	17.23	50003535	50115036	
53.98	2 1/8	19.52	50003479		
57.15	2 1/4	21.80	50003536	50000130	
60.33	2 3/8	24.38	50003587		
63.5	2 1/2	26.92	50003537	50157211	
66.68	2 5/8	29.60	50132908	50157213	
69.85	2 3/4	32.46	50003539		
76.2	3	38.76	50003540		
82.55	3 1/4	45.65	50003526		
88.9	3 1/2	52.76	50003541		
101.6	4	68.91	50003639		
114.3	4 1/2	87.22	50011179		
127	5	107.68	50003634		
152.4	6	155.05	50033768		

Please note: Other sizes available upon request. **Standard lengths:** 3600 mm up to 101.6 mm

BRASS FLAT BAR

Metric (mm)	Imperial (Inches)	kg/m (Nominal)	Alloy
			380
9.53 x 3.18	3/8 x 1/8	0.26	50003864
12.7 x 3.18	1/2 x 1/8	0.34	50003865
12.7 x 4.76	1/2 x 3/16	0.51	50003875
12.7 x 6.35	1/2 x 1/4	0.68	50003884
12.7 x 9.53	1/2 x 3/8	1.03	50003898
19.05 x 3.18	3/4 x 1/8	0.51	50003867
19.05 x 4.76	3/4 x 3/16	0.77	50003876
19.05 x 6.35	3/4 x 1/4	1.02	50003885
19.05 x 9.53	3/4 x 3/8	1.53	50003897
19.05 x 12.7	3/4 x 1/2	2.06	50004009
25.4 x 3.18	1 x 1/8	0.68	50003868
25.4 x 6.35	1 x 1/4	1.36	50003886
25.4 x 9.53	1 x 3/8	2.04	50003901
25.4 x 12.7	1 x 1/2	2.72	50003905
25.4 x 19.05	1 x 3/4	4.13	50003988
31.75 x 3.18	1 1/4 x 1/8	0.85	50003869
31.75 x 9.53	1 1/4 x 3/8	2.55	50004043
38.1 x 3.18	1 1/2 x 1/8	1.02	50003870
38.1 x 6.35	1 1/2 x 1/4	2.04	50003888
38.1 x 12.7	1 1/2 x 1/2	4.09	50004010
38.1 x 19.05	1 1/2 x 3/4	6.19	50004006
50.8 x 3.18	2 x 1/8	1.36	50003871
50.8 x 6.35	2 x 1/4	2.72	50003889
50.8 x 9.53	2 x 3/8	4.09	50003904
50.8 x 12.7	2 x 1/2	5.45	50003907
50.8 x 19.05	2 x 3/4	8.17	50003919
50.8 x 25.4	2 x 1	10.81	50004016
76.2 x 3.18	3 x 1/8	2.04	50003873
76.2 x 9.53	3 x 3/8	6.13	50004019
101.6 x 3.18	4 x 1/8	2.72	50004014
101.6 x 6.35	4 x 1/4	5.45	50003998
152.4 x 6.35	6 x 1/4	8.17	50003893

Please note: Other sizes available upon request. **Standard lengths:** 3600 mm up to 101.6 mm

BRASS HEXAGON BAR

Metric	Imperial	kg/m	Alloy		
			385	352	360
(mm)	(Inches)	(Nominal)	Free Machining Brass	D.R. Machining Brass	American Free Cutting Brass
6.35	1/4	0.30	50003684		
7.14	9/32	0.38	50157121		
7.94	5/16	0.46	50003686		
8		0.47	50155384		
8.23	3/16 Whitworth	0.50	50157125		
9.53	3/8	0.67	50003687		
10		0.73	50003699	60000688	
11.11	7/16	0.91	50003694	50157126	
11.3	1/4 Whitworth	0.94	50157127		
12.7	1/2	1.18	50003435	50003461	
13		1.24	50120134		
13.34		1.25	50003433		
14.29	9/16	1.50	50003436	50136524	
15.24	3/8 Whitworth	1.84	50003434		
15.88	5/8	1.85	50003459	50003462	
16.67		2.04	50120136		
17.00		2.11	50096922		
17.46	11/16	2.24	50003544	50003463	
18.03	7/16 Whitworth	2.36	50033801		
19.05	3/4	2.66	50003589	50003591	
20.64	13/16	3.12	50003550		
20.83	1/2 Whitworth	3.21	50137388		
22.23	7/8	3.62	50003552	50003583	
23.37	9/16 Whitworth	3.68	50003553		
23.81	15/16	4.16	50003554	50115029	
25.4	1	4.73	50003555	50003584	
26.99	1 1/16	5.34	50003546	50033704	
27.94	1 1/10	5.73	50003558		
28.58	1 1/8	5.99	50003547	50003614	
30		6.61	50003610		
30.16	1 3/16	6.69	50003611		
31.75	1 1/4	7.39	50003548	50003585	
33.34	1 5/16	8.17	50003595		
34.93	1 3/8	8.95	50003562	50003617	
38.1	1 1/2	10.61	50003592	50116834	
44.45	1 3/4	16.05	50003596		
47.62	1 7/8	16.68	50003597		
57.15	2 1/4	23.98	50025522		
63.5	2 1/2	29.58	50003635		

Please note: Other sizes available upon request. **Standard lengths:** 3600 mm

BRASS ANGLE BAR

Metric (mm)	Imperial (Inches)	kg/m (Nominal)	Alloy
			380
12.7 x 12.7 x 1.59	1/2 x 1/2 x 1/16	0.34	50003710
19.05 x 19.05 x 1.59	3/4 x 3/4 x 1/16	0.52	50003708
19.05 x 19.05 x 3.18	3/4 x 3/4 x 1/8	0.99	50003713
25.4 x 25.4 x 1.6	1 x 1 x 1/16	0.70	50003709
25.4 x 25.4 x 3.18	1 x 1 x 1/8	1.35	50003711
31.75 x 31.75 x 3.18	1 1/4 x 1 1/4 x 1/8	1.71	50003717
38.1 x 38.1 x 3.18	1 1/2 x 1 1/2 x 1/8	2.08	50003712
50.8 x 50.8 x 3.18	2 x 2 x 1/8	2.65	50003719

Please note: Other sizes available upon request. **Standard lengths:** 3600 mm

BRASS SQUARE BAR

Metric (mm)	Imperial (Inches)	kg/m (Nominal)	Alloy
			385
12.7	1/2	1.37	50003437
15.88	5/8	2.14	50003439
19.05	3/4	3.08	50003567
22.23	7/8	4.22	50003568
25.4	1	5.47	50003570
26.99	1 1/16	6.17	50132896
31.75	1 1/4	8.54	50003571
38.1	1 1/2	12.30	50003572
50.8	2	21.86	50003573

Please note: Other sizes available upon request. **Standard lengths:** 3600 mm

BRASS HOLLOW BAR

Typical Brass Hollow sizes, other sizes may also be available.
Please Note: no stock held, delivery subject to Mill Leadtimes

Size	Type	kg/m (nominal)	Alloy	
			352	385
19.05 X 7.94	HEX	2.01	50003783	
20.64 X 12.7	ROUND	1.77		50003775
20.78 X 15.47	ROUND	1.29		50011343
22.23 X 12.7	ROUND	2.23		50011342
22.23 X 14.5	HEX	1.91		50003797
22.23 X 15.88	ROUND	1.62		50011021
25 X 15	ROUND	2.68		50003784
25.4 X 15.88	ROUND	2.63		50003785
28.58 X 14.29	ROUND	4.10		50003788
28.58 X 20.64	ROUND	2.62		50003795
31.75 X 23.81	ROUND	2.96	50011022	
38.1 X 19.05	ROUND	7.29	50003782	
50.8 X 37.5	OCT	7.87		50003776
50.8 X 38.1	ROUND	7.56		50003791
53.98 X 34.93	ROUND	11.35		50003789
57.15 X 41.28	ROUND	10.46		50003792
61.92 X 38.1	ROUND	15.96		50003787
65.09 X 48	OCT	12.95		50003779
77 X 57	OCT	17.95		50003778
77 X 59	OCT	16.40		50003798
85.73 X 46	OCT	35.06		50003780
85.73 X 58.72	OCT	26.14		50003781
92.08 X 65	OCT	28.49		50003799

BRASS SHEET - 70/30

Size, mm	Temper	Finish	kg/sheet (nominal)	Alloy 260
0.6 X 600 X 1800	SOFT NO.2	MILL	5.53	50002667
0.8 X 900 X 1800	1/2 HARD	MILL	11.06	50002774
1 X 600 X 1800	SOFT NO.2	MILL	9.21	50002670
1 X 900 X 1800	1/2 HARD	MILL	13.82	50002773
1 X 900 X 3600	1/2 HARD	MILL	27.64	50002784
1.2 X 900 X 1800	1/2 HARD	MILL	16.58	50002772
1.2 X 900 X 2400	1/2 HARD	MILL	22.11	50002745
1.6 X 900 X 1800	1/2 HARD	MILL	22.11	50002771
1.6 X 1200 X 2400	SOFT NO.1	MILL	39.31	50002798
2 X 600 X 1800	SOFT NO.2	MILL	18.43	50002673
2 X 900 X 1800	1/4 HARD	MILL	27.64	50002770
2 X 900 X 2400	1/2 HARD	MILL	36.85	50002790
2.5 X 900 X 1800	1/2 HARD	MILL	34.55	50002769
3 X 900 X 1800	SOFT NO.1	MILL	41.46	50002768

PVC coating available upon request

LEADED BRASS ENGRAVING SHEET

Size, mm	Temper	Finish	kg/sheet (nominal)	Alloy
				356
1.2 X 600 X 2000	HARD	MILL	12.20	50002600
1.5 X 600 X 2000	HARD	MILL	15.25	50002601
2 X 600 X 2000	HARD	BRIGHT	20.33	50002635
3 X 600 X 2000	HARD	BRIGHT	30.49	50002697
5 X 600 X 1800	1/4 HARD	BRIGHT	45.74	50002695
6 X 600 X 2000	1/4 HARD	BRIGHT	54.88	50119894

PVC coating available upon request

BRASS PLATE

Size, mm	Temper	kg/plate (nominal)	Alloy
			260
4 X 900 X 1800	1/4 HARD	55.27	50002739
5 X 900 X 1800	1/4 HARD	69.09	50002767
6 X 900 X 1800	1/4 HARD	82.91	50002766
10 X 900 X 1800	1/4 HARD	138.19	50002833

BRASS COIL - 70/30

Size	Temper	Alloy
		260
0.25 X 300	HARD	50002953
0.4 x 300	SOFT NO 2	50106137
0.5 x 300	1/2 HARD	50106139
0.5 x 300	SOFT NO 2	50106141
0.55 x 300	HARD	50106143
0.6 x 300	1/2 HARD	50106145
0.6 x 300	SOFT NO 1	50106146
0.7 x 300	HARD	50106148
0.7 x 300	SOFT NO 2	50106150
0.8 X 300	1/2 HARD	50106151
1.6 X 300	1/2 HARD	50106159
2 x 300	HARD	50106163

* Supplied in alloy 274 - 63/37 For widths below 300mm, see Section 4 - Slitting Centre

BRASS TUBE

Diameter, mm	W/T, mm	Temper	kg/m (nominal)	Alloy
				C26130
9.53	0.91	1/2 Hard	0.21	50007582
9.53	1.22	Hard	0.27	50007620
12.7	1.22	1/2 Hard	0.37	50007593
15.88	1.22	Hard	0.48	50007651
19.05	0.91	1/2 Hard	0.44	50007587
19.05	1.22	Hard	0.58	50007584
19.05	1.22	1/2 Hard	0.58	50007598
19.05	1.22	1/4 Hard	0.58	50007597
19.05	1.63	Hard	0.62	50007647
22.23	1.22	Hard	0.68	50007422*
25.4	1.22	1/2 Hard	0.79	50007588
25.4	1.63	1/2 Hard	1.04	50007589
31.75	1.22	Hard	1.00	50007616
50.8	1.22	1/2 Hard	1.62	50007600
76.2	1.63	1/2 Hard	3.26	50007602

Standard length: 5000 mm

* Alloy C27400

SECTION 2

COPPER



COPPER BAR - FLAT

Square Edge

Radius Corner

Full Radius

Metric (mm)	Imperial (Inches)	kg/m (Nominal)		Alloy C11000 Plain			Alloy C11000 Tinned		
		SE	FR	Square Edge (SE)	Radius Corner (RC)	Full Radius (FR)	Square Edge (SE)	Radius Corner (RC)	Full Radius (FR)
12.7 x 3.18	1/2 x 1/8	0.36	0.34	50003940					
15.88 x 3.18	5/8 x 1/8	0.45	0.43	50003942		50116784	50130369		
19.05 x 3.18	3/4 x 1/8	0.54	0.52	50003928					
19.05 x 4.76	3/4 x 3/16	0.81	0.77	50003944					
19.05 x 6.35	3/4 x 1/2	1.03	0.99			50004036			
20 x 5		0.97	0.9					50157427	
20 x 6.3		1.12	1.05			50003924			50003912
20 x 10		1.79	1.59		50113149			50113152	
25 x 5		1.21	1.11		50121167			50175304	
25 x 6.3		1.40	1.33			50003923			50003909
25 x 10		2.23	2.03		50004026			50066094	
25.4 x 3.18	1 x 1/8	0.72	0.70	50003930		50003992			
25.4 x 4.76	1 x 3/16	1.08	1.03	50003945					
25.4 x 19.05	1 x 3/4	4.32	4.14	50003969					
30 x 10		2.68	2.48		50004025	50157521		50004042	50157415
31.5 x 6.3		1.77	1.70			50003925			50003981
31.75 x 3.18	1 1/4 x 1/8	0.90	0.88			50003973			
31.75 x 6.35	1 1/4 x 1/4	1.80	1.72	50003957					
38.1 x 3.18	1 1/2 x 1/8	1.08	1.06	50003932		50097422			
38.1 x 4.76	1 1/2 x 3/16	1.62	1.58	50003947					
38.1 x 6.35	1 1/2 x 1/4	2.16	2.08	50003958					
38.1 x 19.05	1 1/2 x 3/4	6.48	5.77	50003896					
40 x 5		1.86	1.79					50175305	
40 x 6.3		2.24	2.17			50003926			50004011
40 x 10		3.57	3.38		50003961	50003989		50066102	50004032
44.45 x 6.3	1 3/4 x 1/4	2.53	2.46	50003834					
50 x 5		2.31	2.24					50175303	
50 x 6.3		2.81	2.74			50004053			50004060
50 x 10		4.47	4.27		50003966	50003922		50004040	50157417
50.8 x 3.18	2 x 1/8	1.44	1.42	50003935					
50.8 x 4.76	2 x 3/16	2.16	2.11	50003948					
50.8 x 6.35	2 x 1/4	2.88	2.80	50003937					
50.8 x 12.7	2 x 1/2	5.76	5.43	50003994					
50.8 x 25.4	2 x1	11.52	-	50157561					
60 x 6		3.29	3.22		50157534				

Please note: Other sizes available upon request. Standard length: 4000 mm

COPPER BAR - FLAT (continued)

Metric (mm)	Imperial (Inches)	kg/m (Nominal)		Alloy C11000 Plain			Alloy C11000 Tinned		
		SE	FR	Square Edge (SE)	Radius Corner (RC)	Full Radius (FR)	Square Edge (SE)	Radius Corner (RC)	Full Radius (FR)
60 x 10		5.36	5.17		50003964	50003977		50004024	50157418
63 x 6.3		3.54	3.47			50003956			50003894
75 x 10	-	6.70	6.51					50157434	
80 x 6.3		4.50	4.42			50004047			50003892
80 x 10		7.14	6.95		50004023	50003955		50004012	50117877
88.9 x 6.35	3 1/2 x 1/4	5.03	4.96	50157539					
100 x 6.3		5.63	5.55			50004046			50003906
100 x 10		8.93	8.74		50004049	50115359		50117516	50066103
101.6 x 12.7	4 x 1/2	11.52	11.21	50003844					
101.6 x 25.4	4 x 1	23.05	21.73	50003849					
120 x 10		10.72	10.52		50003835			50116699	50130390
125 x 6.3		7.03	6.96			50004022			50003927
125 x 10		11.25	11.18					50166130	
152.4 x 12.7	6 x 1/2	17.28	16.97			50160331			
152.4 x 25.4	6 x 1	34.57	33.22	50119893					
160 x 6.3		9.00	8.93			50004021			50003874
160 x 10		14.29	14.10		50004027			50003917	

Please note: Other sizes available upon request. **Standard length:** 4000 mm



COPPER BAR - ROUND/ SQUARE

Metric (mm)	Imperial (Inches)	kg/m (Nominal)	Alloy	
			C11000 High Conductivity Copper	C14700 Free Machining Copper
ROUND				
4.76	3/16	0.16	50003649	
6.35	1/4	0.28	50003650	
9.53	3/8	0.64	50003653	
12.7	1/2	1.13	50003392	50003407
15.88	5/8	1.77	50003393	50114703
19.05	3/4	2.55	50003395	
22.23	7/8	3.47	50003396	
25.4	1	4.53	50003397	
31.75	1 1/4	7.08	50003508	
38.1	1 1/2	10.19	50003510	
50.8	2	18.12	50003513	
SQUARE				
10	-	0.89	50135730	

Please note: Other sizes available upon request. **Standard length:** 3600 mm

COPPER PANCAKE COIL



Metric (mm)	Imperial (Inches)	kg/m (Nominal)	kg per coil	Alloy
			(Approximate)	C11000
25.4 x 3.18	1 X 1/8	0.72	36	50003853
38.1 x 3.18	1 1/2 x 1/8	1.08	60	50003855
40 x 2.5		0.89	36	50003801
40 x 4		1.43	36	50003811
40 x 6.3		2.25	36	50004061

Other sizes available subject to minimum mill runs.

COPPER COIL

Size, mm	Temper	Finish	Alloy	
			C11000	C12200
0.1 X 600	SOFT	MILL	50002315	-
0.16 X 600	SOFT	MILL	50002346	-
0.55 x 1220	1/2 HARD	MILL 500 KG	-	50002543
0.6 x 300	1/2 HARD	MILL	50106110	
0.7 X 1200	1/2 HARD	MILL	-	50002532
0.8 x 300	1/2 HARD	MILL	5016112	
0.9 X 1200	1/2 HARD	MILL	-	50002534
1.2 X 300	1/2 HARD	MILL	50106114	-
2.0 X 300	1/2 HARD	MILL	50106130	

For slit coil refer section 4.

COPPER PLATE

Size, mm	Temper	Finish	Nominal, kg/plate	Alloy
				C10200
4 X 900 X 1800	65 MAX SOFT	MILL	57.93	50001908
5 X 900 X 1800	1/2 HARD	MILL	72.41	50002060
6 X 900 X 2400	1/2 HARD	MILL	115.86	50002027
10 X 900 X 1800	1/2 HARD	MILL	144.83	50002035
25 X 900 X 1800	1/2 HARD	MILL	362.07	50002065

Alloy C10200 is suitable for welding and brazing applications, plus it exhibits superior electrical conductivity to that of 110

COPPER SHEET

Size, mm	Temper	Finish	kg	Alloy		
				C10200	C11000	C12200
0.55 X 900 X 1800	1/2 HARD	MILL	9.96	-	-	50001936
0.55 X 1200 X 2400	1/2 HARD	MILL	14.16	-	-	50001987
0.55 X 1200 X 2400	1/2 HARD	PVC	14.16	-	-	50001962
0.7 X 900 X 1800	1/2 HARD	MILL	10.14	-	-	50001938
0.7 X 1200 X 2400	1/2 HARD	MILL	18.02	-	-	50001992
0.9 X 900 X 1800	65 MAX SOFT	MILL	13.03	-	50001957	-
0.9 X 900 X 1800	1/2 HARD	MILL	13.03	-	-	50001939
0.9 X 1200 X 2400	1/2 HARD	MILL	23.17	-	-	50002003
1.2 X 900 X 1800	65 MAX SOFT	MILL	17.38	-	50001917	-
1.2 X 900 X 1800	1/2 HARD	MILL	17.38	-		50001905
1.2 X 1200 X 2400	1/2 HARD	MILL	30.90	-	-	50001996
1.6 X 900 X 1800	65 MAX SOFT	MILL	23.17	-	50001932	-
1.6 X 900 X 1800	1/2 HARD	MILL	23.17	-	50001942	50001916
1.6 X 1200 X 2400	1/2 HARD	MILL	41.20	-	-	50001997
2 X 900 X 1800	65 MAX SOFT	MILL	28.97	50001949	-	-
2 X 900 X 1800	1/2 HARD	MILL	28.97		-	50001925
2 X 1200 X 2400	1/2 HARD	MILL	51.49	-	-	50001998
2.5 X 900 X 1800	1/2 HARD	MILL	36.21	-	-	50001918
3 X 900 X 1800	50 MAX SOFT	MILL	43.45	50001922	-	-
3 X 900 X 1800	1/2 HARD	MILL	43.45	-	50001946	50001907
3 X 1200 X 2400	1/2 HARD	MILL	77.24	-		50002000

PVC coating available upon request.

Alloy C10200 is suitable for welding and brazing applications, plus it exhibits superior electrical conductivity to that of C11000.

Comparison of Coppers

Copper		Typical Conductivity % IACS	Welding and Brazing Performance
C10200	Oxygen Free	101-103%	Good
C11000	ETP	100%	Fair
C12200	Phosphorus Deoxidised	70-90%	Good

COPPER TUBE

AWM supplies Inner Groove and Smooth bore Layer wound coil.		
Material		
Standards	Chemical Composition, %	
	Cu	P
C12200 or JIS C1220	99.90min	0.015-0.040

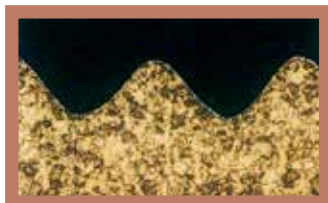
Mechanical Properties				
Temper	Tensile, MPa	Elongation, %	HR15T	Grain Size, mm
Light Annealed	275	40 min	65 max	0.04 max

Standard Dimensions - Inner Groove Tube					
Groove Type	Outer Dia, mm	Av. Wall Thickness, mm	No. of Grooves	Helix Angle	Groove Depth, mm
A	9.52	0.35	65	25	0.15
	9.52	0.41	65	25	0.15
B	9.52	0.35	60	25	0.12
C	7.94	0.36	50	18	0.2
	9.52	0.35	60	18	0.2
	9.52	0.36	60	18	0.2
	9.52	0.41	60	18	0.2
	12.70	0.51	65	18	0.25

For other dimensions please consult with our Sales office.

Groove Shapes

Type A



Type B



Type C



SECTION 3 ALLOYS



PHOSPHORUS BRONZE SHEET/COIL

				Phos Bronze
Size, mm	Temper	Finish	kg/sheet (nominal)	Alloy 510/518/519
0.6 x 300	HALF HARD	MILL	-	50106169
0.7 x 300	HALF HARD	MILL	-	50106170
0.8 x 300	HALF HARD	MILL	-	50106172
1.6 X 600 X 2000	EXTRA HARD	MILL	15.45	50002685
	HARD	MILL	19.31	50002682
3 X 600 X 1800	EXTRA HARD	MILL	28.97	50002714

ALLOY STRIP

Please contact your local AWM Sales Office for availability of Gilding Metal, Phos Bronze and Nickel Silver Strip.

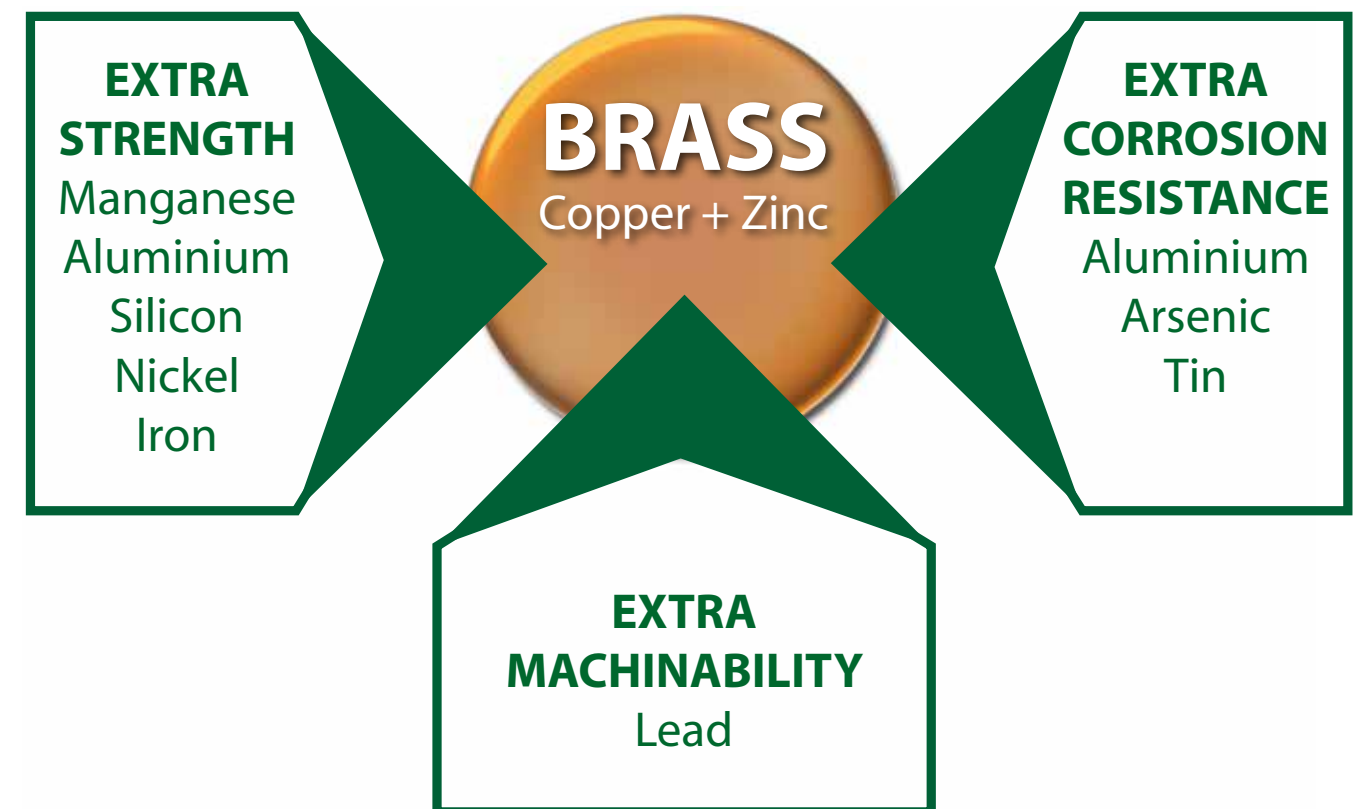
BERYLLIUM COPPER

Please contact your local AWM Sales Office for details on availability of coil, bar and non-sparking tools.

BRONZE BAR

Please contact your local AWM Sales Office for details of your closest approved distributor.

SECTION 4 TECHNICAL INFORMATION



QUICK REFERENCE GUIDE TO COMMON COPPER AND COPPER ALLOYS

Alloy Group	Alloy	Nom. Composition	Available forms		Also called	Defining Characteristics	Typical applications
			Sheet, Coil, Plate	Bar, Tube			
Copper	102	>99.95Cu	*	*	Oxygen Free H.C. Copper	High Conductivity	Busbar, terminals, contacts, and other electrical applications.
	110	>99.90Cu	*	*	High Conductivity Copper		
	122	>99.90Cu + P	*	*	Phos Deoxidised Copper		
	147	>99.90Cu + S		*	Free Cutting copper		
Gilding Metal Brasses	220	90Cu, 10Zn	*		90/10 Gilding Metal, Red Brass	Good formability, corrosion resistance and colour	Architectural applications, jewellery, munitions, badges, door hardware.
	230	85Cu, 15Zn	*		85/15 Gilding Metal, Commercial Bronze		
Brasses	260	70Cu, 30Zn	*	*	70/30 Brass, Cartridge Brass	Ductility and good strength	Automotive radiators, spun components, electrical terminals, locks, fasteners, drawn products.
	26130	70Cu, 30Zn, As	*		Arsenical Brass	Ductility, strength, and corrosion resistance	Dezincification resistant alloy, Automotive radiators, plumbing applications.
	268	65Cu, 35Zn	*		65/35 Brass, Yellow Brass	Ductility and good strength	Automotive radiators, spun components, electrical terminals, locks, fasteners.
	270	65Cu, 35Zn	*	*	Wire Brass, Unleaded Brass	Cold formability	Severely cold formed components, bolts, screws, rivets.
	356	60Cu, 38Zn, 2.5Pb	*		Engraving Brass	Machining and engraving	Name plates, plaques, architectural applications.
	380	58Cu, 40Zn, 2Pb, 0.5Al		*	Section Brass	Bright golden colour	Locks, sections, channels, flats, angles, Bright finish brass.
	360	61Cu, 36Zn, 3Pb		*	American Free Cutting Brass	Good machineability & ductility	High speed repetition machining, electrical terminals, riveting, threads.
	385	58Cu, 39Zn, 3Pb		*	C3604, Free Cutting Brass, Superkut	Excellent machineability	Excellent high speed repetition machining, threaded components. No cold forming.
	352	63Cu, 37Zn, As		*	Dezincification Resistant (DR) Brass	Machinability and corrosion resistance	Dezincification resistant alloy, Good machining properties, tap spindles
	353	62Cu, 36Zn, 2Pb		*	Riveting Brass	Bending and machining	Fasteners, rivets, cistern balls, handles, electrical terminals.
Bronzes	377	58Cu, 38Zn, 2Pb		*	Forging Brass	Hot forging	Hot forging/stamped and machined components valves.
	464	62Cu, 37Zn, 1Sn		*	Naval Bronze / Naval Brass	High corrosion resistance High corrosion resistance & hot forging	Good corrosion resistance, bolts, marine fittings, hot forgings.
	486	61Cu, 37Zn, 1Sn, 1Pb, As		*	Arsenical Leaded Naval Brass, DR Brass		
	510	95Cu, 5Sn	*		5% Phosphor Bronze		
	519	94Cu, 6Sn	*		6% Phosphor Bronze		
Nickel Silver	655	96Cu, 1Mn, 3Si	*		Silicon Bronze, Cusiman, Everdur	High strength, formability, and corrosion resistance	Cold formed components for marine and chemical applications.
	678	59Cu, 37Zn, Fe, Mn, Al, Sn		*	Manganese Bronze	Hot forging and corrosion resistance	High tensile corrosion resistant sections, shafts, fittings.
	686	59Cu, 37Zn, Pb, Mn, Fe, Sn, Al		*	Leaded Manganese Bronze, Leaded High Tensile Brass	Corrosion and machining properties	High strength, fasteners, valve spindles, nuts and bolts for marine.
	757	65Cu, 23Zn, 12Ni	*		12% Nickel Silver, Nickel Brass	Corrosion and spring properties	Electrical terminals, springs and contacts, jewellery, medallions, silverware.
Nickel Silver	798	47Cu, 49Zn, 2Pb, 2Mn		*	Leaded Nickel Silver	High strength and colour attractiveness	Machined components for telecommunications, medical and architectural applications.

Brass & Copper Rod and Bar Tolerances

Drawn Round and Square Bars		Brass Machining Rod	
Size range	Tol, mm	Tol, mm	
3mm and under	+/-0.04	+0/-0.04	
3.1mm to 10 mm	+/-0.05	+ 0/-0.05	
10.1mm to 20mm	+/-0.08	+ 0/-0.08	
20.1mm to 30mm	+/-0.10	+ 0/-0.10	
30.1mm to 50mm	+/-0.15	+ 0/-0.15	
over 50mm	by agreement	by agreement	

Drawn Hexagon and Octagon Bars	
Size range	Tol, mm
10mm and under	+0/-0.10
10.1mm to 20mm	+0/-0.20
20.1mm to 30mm	+0/-0.25
30.1mm to 40mm	+0/-0.30
40.1mm to 50mm	+0/-0.40
50.1mm to 70mm	+0/-0.50
over 70mm	by agreement

Extruded Only Rounds, Squares, and Flats	
Size range	Tol, mm
20mm and under	+/-0.25
20.1mm to 40mm	+/-0.40
40.1mm to 50mm	+/-0.50
over 50mm	by agreement

Sheet, Coil, and Plate Tolerances

Thickness Tolerance	Thickness tolerance, +/-mm				
	<200mm wide	200mm to 300mm wide	300mm to 600mm wide	600mm to 900mm wide	900mm to 1200mm wide
0.20 to 0.30 mm	0.01	0.02	0.03		
0.31mm to 0.40mm	0.02	0.03	0.04	0.08	0.09
0.41mm to 0.50mm	0.02	0.03	0.05	0.08	0.09
0.51mm to 0.60mm	0.03	0.04	0.05	0.09	0.10
0.61mm to 0.70mm	0.03	0.05	0.06	0.09	0.10
0.71mm to 1.00mm	0.04	0.05	0.06	0.10	0.12
1.01mm to 1.3mm	0.05	0.06	0.07	0.12	0.15
1.31mm to 2.00mm	0.06	0.07	0.08	0.15	0.17
2.01mm to 3.50mm	0.07	0.08	0.10	0.17	0.20
3.51mm to 5.00mm	0.08	0.10	0.11	0.20	0.25
5.01mm to 8.00mm	0.10	0.11	0.12	0.25	0.30
8.01mm to13.00mm	0.11	0.12	0.15	0.35	0.40
13.01mm to 20.00mm	0.13	0.17	0.22	0.45	0.50
20.01mm to 30.00mm	0.17	0.22	0.27	0.55	0.60

Width Tolerance - Sheet, Coil, and Strip	Width tolerance, +/-mm			
	0.102mm to 0.80mm thick	0.81mm to 3.2mm thick	3.3mm to 5.0mm thick	5.1mm to 12.0mm thick
below 50.8mm	0.13	0.25	0.3	0.38
50.8mm to 200mm	0.2	0.33	0.38	0.38
200.1mm to 600mm	0.4	0.4	0.4	0.79
600.1mm to 1020mm	0.79	0.79	79	1.19

BUSBAR CURRENT RATING INFORMATION

Busbar current rating information
Current ratings, moments of inertia and section moduli - strips and bars

Busbar Size	X-Sect- ional area	Weight	Approx d.c. resistance 20°C	Approx d.c. rating (1)		Approx a.c. rating		Moment of Inertia		Modulus of Section Z	
				Still air (3)	Free air (3)	Still air	Free air	Edge-wise	Flat	Edge-wise	Flat
mm	mm ²	kg/m	mW/m	A	A	A	A	mm ⁴	mm ⁴	mm ³	mm ³
10 x 1.60	16.0	0.143	1077	105	115	105	115	133.3	3.413	26.66	4.266
12.5 x 1.60	20.0	0.179	862	125	135	125	135	260.4	4.266	41.66	5.333
16 x 1.60	25.6	0.229	673	155	170	155	170	546.1	5.461	68.26	6.826
20 x 1.60	32.0	0.286	538	185	205	185	205	1,066	6.826	106.6	8.533
25 x 1.60	40.0	0.357	431	225	250	225	250	2,083	8.533	166.6	10.67
30 x 1.60	48.0	0.429	359	265	290	265	290	3,600	10.24	240.0	12.80
10 x 2.00	20.0	0.179	862	115	130	115	130	166.6	6.666	33.32	6.666
12.5 x 2.00	25.0	0.223	689	140	155	140	155	325.5	8.333	52.08	8.333
16 x 2.00	32.0	0.286	538	175	190	175	190	682.6	10.66	85.33	10.66
20 x 2.00	40.0	0.357	431	210	230	210	230	1,333	13.33	133.3	13.33
25 x 2.00	50.0	0.446	344	255	280	255	280	2,604	16.66	208.3	16.66
30 x 2.00	60.0	0.536	287	295	330	295	330	4,500	20.00	300	20.00
40 x 2.00	80.0	0.714	215	380	420	380	420	10,660	26.66	533	26.66
10 x 2.50	25.0	0.223	689	130	145	130	145	208.3	13.02	41.66	10.42
12.5 x 2.50	31.25	0.279	557	160	175	160	175	406.9	16.27	65.60	13.02
16 x 2.50	40.0	0.357	431	195	215	195	215	853.3	20.83	106.70	16.66
20 x 2.50	50.0	0.446	344	235	260	235	260	1,666	26.04	166.6	20.83
25 x 2.50	62.5	0.558	275	285	315	285	315	3,255	32.55	260.4	26.04
30 x 2.50	75.0	0.670	229	330	370	330	370	5,625	39.06	375.0	31.25
40 x 2.50	100	0.893	172	425	475	425	475	13,330	52.08	666.5	41.66
50 x 2.50	125	1.115	137	520	575	520	575	26,040	65.10	1041	52.08
60 x 2.50	150	1.339	114	605	675	605	675	45,000	78.13	1500	62.50
10 x 2.75	31.5	0.281	547	150	170	150	170	262.5	26.05	52.5	16.54
12.5 x 2.75	39.4	0.352	437	180	200	180	200	512.7	32.56	82.03	20.67
16 x 2.75	50.4	0.450	342	220	245	220	245	1075	41.67	134.4	26.46
20 x 3.0	60.0	0.536	287	260	290	260	290	2,000	45.00	200.0	30.00
25 x 3.0	75	0.670	229	315	350	314	350	3,906	56.25	312.4	37.5
30 x 3.0	90	0.803	191	365	405	365	405	6,750	67.50	450.0	45.0
40 x 3.0	120	1.071	143	470	520	470	520	16,000	90.00	800.0	60.0
50 x 3.0	150	1.339	114	570	635	570	635	31,250	112.50	1,250	75.0
60 x 3.0	180	1.607	95.7	665	740	665	740	54,000	135.00	1,800	90.0
80 x 3.0	240	2.142	71.8	860	955	860	955	128 x 103	180.00	3,200	120.0
10 x 4.0	40	0.357	431	175	195	175	195	333.3	53.33	66.66	26.67
12.5 x 4.0	50	0.446	344	210	230	210	230	651.0	66.67	104.2	33.34
16 x 4.0	64	0.571	269	255	285	255	285	1,365	85.33	170.6	42.67

Busbar Size	X-Sect- ional area	Weight	Approx d.c. resistance 20°C	Approx d.c. rating (1)		Approx a.c. rating		Moment of Inertia		Modulus of Section Z	
				Still air (3)	Free air (3)	Still air	Free air	Edge-wise	Flat	Edge-wise	Flat
mm	mm ²	kg/m	mW/m	A	A	A	A	mm ⁴	mm ⁴	mm ³	mm ³
20 x 4.0	80	0.714	215	305	340	305	340	2,666	106.7	266.6	53.35
25 x 4.0	100	0.893	172	365	410	365	410	5,208	133.3	416.6	66.65
30 x 4.0	120	1.071	143	430	475	430	475	8,999	1600	599.6	80.00
40 x 4.0	160	1.428	107	545	610	540	605	21,330	213.3	1,066.5	106.7
50 x 4.0	200	1.785	86.2	665	740	660	735	41,660	266.7	1,666	133.4
60 x 4.0	240	2.142	71.8	775	860	770	855	72,000	320.0	2,400	160.0
80 x 4.0	320	2.856	53.8	995	1,120	980	1,105	170 x 103	426.7	4,268	213.4
100 x 4.0	400	3.571	43.1	1,210	1,365	1,185	1,340	333 x 103	533.3	6,666	266.7
10 x 5.0	50	0.446	344	200	225	200	225	416.7	104.2	83.34	41.68
12.5 x 5.0	62.5	0.558	275	240	265	240	265	813.4	130.2	130.1	52.08
16 x 5.0	80	0.714	215	290	325	290	325	1,707	166.7	213.4	66.68
20 x 5.0	100	0.893	172	345	385	345	385	3,333	208	333.3	83.20
25 x 5.0	125	1.116	137	415	465	415	465	6,560	260.4	520.8	104.2
30 x 5.0	150	1.339	114	485	540	480	540	11,250	312.5	750.0	125.0
40 x 5.0	200	1.785	86.2	615	685	610	680	26,670	416.7	1334	166.7
50 x 5.0	250	2.232	68.9	745	830	740	820	52,080	520.8	2,083	208.3
60 x 5.0	300	2.678	57.4	870	970	865	960	90,000	625.0	3,000	250.0
80 x 50	400	3571	431	1,120	1,260	1,110	1,250	213 x 103	833.3	5,333	333.3
100 x 50	500	4464	344	1,355	1,530	1,345	1,520	417 x 103	1,042	8,334	416.8
10 x 6.3	63	0.562	273	235	260	235	260	525	208.4	105.0	66.16
12.5 x 6.3	78.75	0.703	218	275	305	275	305	1,025	260.5	164.0	82.70
16 x 6.3	100.8	0.899	171	335	370	335	370	2,150	333.4	268.8	105.8
20 x 6.0	120	1.071	143	385	430	385	430	4,000	360.0	400.0	120.0
25 x 6.0	150	1.339	114	460	515	460	515	7,813	450.0	625.0	150.0
30 x 6.0	180	1.607	95.7	535	600	535	595	13,500	540.0	900.0	180.0
40 x 6.0	240	2.142	71.8	680	760	675	755	32,000	720.0	1,600	240.0
50 x 6.0	300	2.678	57.4	825	915	815	910	62,500	900.0	2,500	300.0
60 x 6.0	360	3.214	47.8	965	1,075	955	1,065	108 x 103	1,080	3,600	360.0
80 x 6.0	480	4.285	35.9	1,230	1,370	1,220	1,355	256 x103	1,440	6,400	480.0
100 x 6.0	600	5.356	28.7	1,490	1,680	1,480	1,670	500 x103	1,800	10,000	600.0
120 x 6.0	720	6.428	23.9	1,750	1,970	1,700	1,915	864 x103	2,160	14,400	720.0
160 x 6.0	960	8.570	17.9	2,250	2,535	2,130	2,400	2.05 x106	2,880	25,600	960.0
20 x 8.0	160	1.428	107	460	510	455	510	5,333	853.3	533.0	213.3
25 x 8.0	200	1.785	86.2	545	610	545	605	10,420	1,067	833.6	266.7
30 x 8.0	240	2.142	71.8	630	705	630	700	18,000	1,280	1,200	320.0
40 x 8.0	320	2.856	53.8	800	890	795	885	42,670	1,707	2,134	426.8
50 x 8.0	400	3.571	43.1	965	1,070	950	1,055	83,300	2,133	3,333	533.3
60 x 8.0	480	4.285	35.9	1,120	1,250	1,110	1,235	144 x 103	2,560	4,800	640.0
80 x 8.0	640	5.713	26.9	1,435	1,595	1,420	1,580	341 x 103	3,413	8,533	853.3
100 x 8.0	800	7.142	21.5	1,735	1,955	1,595	1,800	667 x 103	4,267	13,330	1067
120 x 8.0	960	8.570	17.9	2,032	2,290	1,760	1,985	1.15 x 106	5,120	19,200	1280
160 x 8.0	1280	11.43	13.4	2,610	2,935	2,230	2,510	2.73 x 106	6,827	34,140	1707

COPPER AND COPPER ALLOYS

Copper and copper alloys are one of the major groups of commercial metals. They offer a wide range of properties, including excellent electrical and thermal conductivity, outstanding corrosion resistance, good strength and fatigue resistance, and appearance. They can be readily worked, brazed and welded.

- Primary selection criteria include:
- **Electrical conductivity:** copper has the highest conductivity of the engineering metals. Silver or other elements may be added to increase strength, softening resistance or other properties without major loss of conductivity.
 - **Thermal conductivity:** this property is similar to electrical conductivity. Alloys of copper may be used for this property, where good corrosion resistance compensates for loss of conductivity with increased alloying.
 - **Colour and appearance:** many of the copper alloys have a distinctive colour, which may change as the object weathers. For most of alloys it is easy to prepare and maintain the surface to a high standard, even in adverse corrosion conditions. Many of the alloys are used in decorative applications, either in their native form or after metal plating. The alloys have specific colours, ranging from the salmon pink of copper through yellow, gold and green to dark bronze in the weathered condition. Atmospheric exposure can produce a green or bronze surface, and prepatinated alloys are available in some product forms.
 - **Ease of fabrication:** most of the alloys can be easily cast, hot or cold formed, machined, joined etc. These alloys are often the standard against which other metals are compared.

Many of the alloys are solid solution strengthened, but are based on the copper crystal structure and have good ductility. Most alloys can be further strengthened by cold work, which improves tensile and fatigue strength while retaining useful ductility. Some alloys can be dispersion strengthened, and a few can be age hardened to very high strength levels.

The metals are commonly divided into six families: coppers, high copper alloys, brasses, bronzes copper nickels, and nickel silvers. Most alloys are available in the wrought or the cast condition, with different UNS numbers.

1. Coppers are essentially commercially pure copper, which ordinarily is very soft and ductile, containing up to about 0.7% total impurities. These materials are used for their electrical and thermal conductivity, corrosion resistance, appearance and colour, and ease of working. They have the highest conductivity of the engineering metals and are very ductile and easy to braze, and generally to weld. Typical applications include electrical wiring and fittings, busbars, heat exchangers, roofs, wall cladding, tubes for water, air and process equipment.

2. High copper alloys contain small amounts of various alloying elements such as beryllium, chromium, zirconium, tin, silver, sulphur or iron. These elements modify one or more of the basic properties of copper, such as strength, creep resistance, machinability or weldability. Most of the uses are similar to those given above for coppers, but the conditions of application are more extreme.

3. Brasses are copper zinc alloys containing up to about 45% zinc, with possibly small additions of lead for machinability, and tin for strength. Copper zinc alloys are single phase up to about 37% zinc in the wrought condition. The single phase alloys have excellent ductility, and are often used in the cold worked condition for better strength. Alloys with more than about 37% zinc are dual phase, and have even higher strength, but limited ductility at room temperature compared to the single phase alloys. The dual phase brasses are usually cast or hot worked. Typical uses for brasses are architecture, drawn & spun containers and components, radiator cores and tanks, electrical terminals, plugs and lamp fittings, locks, door handles, name plates, plumbers hardware, fasteners, cartridge cases, cylinder liners for pumps.

4. Bronzes are alloys of copper with tin, plus at least one of phosphorus, aluminium, silicon, manganese and nickel. These alloys can achieve high strengths, combined with good corrosion resistance. They are used for springs and fixtures, metal forming dies, bearings, bushes, terminals, contacts and connectors, architectural fittings and features. The use of cast bronze for statuary is well known.

Busbar Size	X-Sectional area	Weight	Approx d.c. resistance 20°C	Approx d.c. rating (1)		Approx a.c. rating		Moment of Inertia		Modulus of Section Z	
				Still air (3)	Free air (3)	Still air	Free air	Edge-wise	Flat	Edge-wise	Flat
mm	mm ²	kg/m	mW/m	A	A	A	A	mm ⁴	mm ⁴	mm ³	mm ³
200 x 8.0	1600	14.27	10.8	3,170	3,570	2,760	3,110	5.33 x 106	8,533	53,330	2133
20 x 10	200	1.785	86.2	525	585	480	535	6,670	1,667	667	333.4
25 x 10	250	2.232	68.9	625	695	580	645	13,020	2,083	1,042	416.6
30 x 10	300	2.678	57.4	720	825	700	795	22,500	2,500	1,500	500.0
40 x 10	400	3.571	43.1	910	1,030	880	995	53330	3,333	2,667	666.6
50 x 10	500	4.464	34.4	1,090	1,235	1,060	1,200	104 x 103	4,167	4,168	833.4
60 x 10	600	5.356	28.7	1,270	1,435	1,200	1,355	180 x 103	5,000	6,000	1,000
80 x 10	800	7.142	21.5	1,615	1,840	1,525	1,735	427 x 103	6,667	10,670	1,333
100 x 10	1,000	8.928	17.2	1,950	2,225	1,800	2,065	833 x 103	8,333	16,670	1,667
120 x 10	1,200	10.71	14.3	2,285	2,610	2,100	2,395	144 x 103	10,000	23,980	2,000
160 x 10	1,600	14.28	10.7	2,930	3,380	2,620	3,040	341 x 103	13,330	42,660	2,666
200 x 10	2,000	17.84	8.62	3,550	4,150	3,140	3,630	6.67 x 106	16,670	66,670	3,334
250 x 10	2,500	22.30	6.89	4,320	5,030	3,710	4,310	13.0 x 106	20,830	104 x 103	4,166
25 x 12	300	2.678	57.4	700	710	640	650	15,630	3,599	1,250	599.8
30 x 12	360	3.214	47.8	805	820	750	765	27,000	4,319	1,800	719.8
40 x 12	480	4.285	35.9	1,010	1,100	950	1,030	64,000	5,759	3,200	959.8
50 x 12	600	5.356	28.7	1,210	1,330	1,160	1,275	125 x 103	7,199	5,000	1,199
60 x 12	720	6.428	23.9	1,405	1,550	1,320	1,455	216 x 103	8,639	7,200	1,439
80 x 12	960	8.570	17.9	1,785	2,000	1,670	1,870	512 x 103	11,519	12,800	1,919
100 x 12	1,200	10.71	14.3	2,155	2,420	2,010	2,255	1.00 x 106	14,390	20,000	2,398
120 x 12	1,440	12.85	11.9	2,520	2,880	2,310	2,640	1.73 x 106	17,280	28,800	2,880
160 x 12	1,920	17.14	8.97	3,225	3,650	2,860	3,235	4.10 x 106	23,040	51,200	3,840
200 x 12	2,400	21.43	7.18	3,910	4,480	3,380	3,870	8.00 x 106	28,790	80,000	4,798
250 x 12	3,000	26.78	5.74	4,750	5,440	4,060	4,650	15.6 x 106	35,990	125 x 103	5,998
25 x 16	400	3.571	43.1	840	960	740	855	20,830	8,533	16.7 x 103	1,067
30 x 16	480	4.285	35.9	960	1,095	845	975	35,990	10,240	24.0 x 103	1,280
40 x 16	640	5.713	26.9	1,200	1,370	1,055	1,220	85330	13,650	42.7 x 103	1,706
50 x 16	800	7.142	21.5	1,430	1,635	1,260	1,450	167 x 103	17,070	66.7 x 103	2,134
60 x 16	960	8.570	17.9	1,660	1,895	1,460	1,685	288 x 103	20,480	96.0 x 103	2,560
80 x 16	1,280	11.43	13.4	2,100	2,400	1,850	2,130	683 x 103	27,310	171 x 103	3,414
100 x 16	1,600	14.28	10.7	2,530	2,880	2,220	2,560	1.33 x 106	34,130	267 x 103	4,266
120 x 16	1,920	17.14	8.97	2,940	3,360	2,590	2,990	2.30 x 106	40,960	384 x 103	5,120
160 x 16	2,560	22.85	6.73	3,750	4,360	3,180	3,700	5.46 x 106	54,610	683 x 103	6,826
200 x 16	3,200	28.57	5.38	4,540	5,725	3,760	4,370	10.7 x 106	68,270	1.07 x 106	8,534
250 x 16	4,000	35.71	4.31	5,520	6,425	4,500	5,250	20.8 x 106	85,330	1.67 x 106	10,670
300 x 16	4,800	42.84	3.59	6,460	7,525	5,270	6,150	36.0 x 106	102 x 103	2.40 x 106	12,800

NOTES:

1. Ratings apply for single bars on edge operating in a 40°C ambient temperature with 50°C temperature rise.

2. a.c. ratings are for frequencies up to 60 Hz.

3. 'Free air' conditions assume some air movement other than convection currents, and may be applicable for outside installations. 'Still' and 'free' air conditions both assume no enclosure.

4. Source data: www.cda.org.uk

5. Copper nickels are alloys of copper with nickel, with a small amount of iron and sometimes other minor alloying additions such as chromium or tin. The alloys have outstanding corrosion resistance in waters, and are used extensively in sea water applications such as heat exchangers, condensers, pumps and piping systems, sheathing for boat hulls.

6. Nickel silvers contain 55 – 65% copper alloyed with nickel and zinc, and sometimes an addition of lead to promote machinability. These alloys get their misleading name from their appearance, which is similar to pure silver, although they contain no addition of silver. They are used for jewellery and name plates and as a base for silver plate (EPNS), as springs, fasteners, coins, keys and camera parts.

Classification of wrought copper alloys

Class Name	UNS numbers	Composition	Typical Uses
1. Coppers	C10100 - C15760	>99% Copper	Electrical conductors & connectors, water supply, heat exchangers, tanks, chemical equipment.
2. High-copper alloys	C16200 - C19600	>96% Copper	Electrical conductors & connectors, springs, fasteners.
3. Brasses	C20500 - C28580	Cu – Zn	Deep drawn containers, tanks, heat exchangers, architectural panels, coins.
Leaded brasses	C31200 - C38590	Cu - Zn – Pb	Cylinders, builders hardware, wear plates, fasteners.
Tin brasses	C40400 - C49080	Cu - Zn – Sn – (Pb)	Electrical switches, springs, terminals, bearings.
Other copper - zinc alloys	C66400 - C69900		Valve stems.
4. Phosphor bronzes	C50100 - C52400	Cu - Sn – P	Fasteners, springs, chemical hardware, wear plates.
Leaded phosphor bronzes	C53200 - C54800	Cu - Sn – Pb - P	Bearings, bushings, gears, valves.
Aluminum bronzes	C60600 - C64400	Cu - Al - Ni - Fe - Si - Sn	Heat exchangers, pump parts, machine parts, structural members.
Silicon bronzes	C64700 - C66100	Cu - Si – Sn	Fasteners, springs, electrical connectors.
5. Copper – nickels	C70000 - C79900	Cu - Ni – Fe	Condensers, heat exchangers, brake lines, salt water pipes.
6. Nickel silvers	C73200 - C79900	Cu - Ni – Zn	Sliver plate (EPNS), nameplates, hollow ware

Classification of cast copper alloys

Class Name	UNS numbers	Composition	Typical Uses
1. Coppers	C80100 - C81100	>99% Copper	Electrical & thermal conductors
2. High – copper alloys	C81300 - C82800	>94% Copper	High strength electrical conductors, including spot welding electrodes
3. Red brasses	C83300 - C85800	Cu - Zn - Sn –(Pb) (75 - 89% Cu)	Valves, pump parts, plumbing hardware
Yellow brasses	C85200 - C85800	Cu - Zn - Sn – (Pb) (57 - 74% Cu)	Fittings, trim, builders hardware
4. Manganese bronzes	C86100 - C86800	Cu - Zn - Mn - Fe – (Pb)	Gears, bearings, bushings, marine fittings
Silicon bronzes, silicon brasses	C87300 - C87900	Cu - Zn – Si	Gears, bearings, bushings, marine fittings
Tin bronzes	C90200 - C94500	Cu - Sn - Zn – (Pb)	Gears, bearings, bushings, pump parts
Nickel – tin bronzes	C94700 - C94900	Cu - Ni - Sn - Zn – (Pb)	Wear parts, low speed bearings
Aluminum bronzes	C95200 - C95810	Cu - Al - Fe - Ni	Gears, bearings, bushings, pump parts, pickling equipment, non sparking tools
5. Copper – nickels	C96200 - C96800	Cu - Ni - Fe	Valves, pumps etc resistant to seawater
6. Nickel silvers	C97300 - C97800	Cu - Ni - Zn – (Pb) - Sn	Builders hardware, valves, pumps
Miscellaneous alloys	C99300 - C99750	-	Various

Alloy designations: Alloys are available according to several numbering systems, including AS, UNS, BS, JIS and others as required. Individual alloy data sheets give alloy equivalents.



— *at the cutting edge*

BRASSES

Brasses are copper zinc alloys with a wide range of engineering uses. The addition of zinc to copper raises the strength and gives a range of properties, and the brasses are a very versatile range of materials. They are used for their strength, corrosion resistance, appearance and colour, and ease of working and joining. The single phase alpha brasses, containing up to about 37% zinc, are very ductile and easy to cold work, weld and braze. The dual phase alpha-beta brasses are usually hot worked.

There are many brasses, with properties tailored for specific applications by the level of addition of zinc. Minor amounts of other alloying elements may also be added.

COMPOSITION, AS2738.2 (Other specifications approximately equivalent)

UNS No	AS No	Common Name	BSI No	ISO No	JIS No	Copper %	Zinc %	Lead %	Others %
C21000	210	95/5 Gilding metal	-	CuZn5	C2100	94.0-96.0	~ 5	< 0.03	
C22000	220	90/10 Gilding metal	CZ101	CuZn10	C2200	89.0-91.0	~ 10	< 0.05	
C23000	230	85/15 Gilding metal	CZ102	CuZn15	C2300	84.0-86.0	~ 15	< 0.05	
C24000	240	80/20 Gilding metal	CZ103	CuZn20	C2400	78.5-81.5	~ 20	< 0.05	
C26130	259	70/30 Arsenical brass	CZ126	CuZn30As	~C4430	69.0-71.0	~ 30	< 0.07	Arsenic 0.02-0.06
C26000	260	70/30 Brass	CZ106	CuZn30	C2600	68.5-71.5	~ 30	< 0.05	
C26800	268	Yellow brass (65/35)	CZ107	CuZn33	C2680	64.0-68.5	~ 33	< 0.15	
C27000	270	65/35 Wire brass	CZ107	CuZn35	-	63.0-68.5	~ 35	< 0.10	
C27200	272	63/37 Common brass	CZ108	CuZn37	C2720	62.0-65.0	~ 37	< 0.07	
C35600	356	Engraving brass, 2% lead	-	CuZn39Pb2	C3560	59.0-64.5	~ 39	2.0-3.0	
C37000	370	Engraving brass, 1% lead	-	CuZn39Pb1	~C3710	59.0-62.0	~ 39	0.9-1.4	
C38000	380	Section brass	CZ121	CuZn43Pb3	-	55.0-60.0	~ 43	1.5-3.0	Aluminium 0.10-0.6
C38500	385	Free cutting brass	CZ121	CuZn39Pb3	-	56.0-60.0	~ 39	2.5-4.5	

UNS No	Common Name	Colour	The brasses are often used for their appearance. As the zinc content is increased, the colour changes.
C11000	ETP Copper	Soft pink	
C21000	95/5 Gilding metal	Red-brown	
C22000	90/10 Gilding metal	Bronze-gold	
C23000	85/15 Gilding metal	Tan-gold	
C26000	70/30 Brass	Green-gold	

C22000, 90/10 Gilding metal, combines a rich golden colour with the best combination of strength, ductility and corrosion resistance of the plain copper-zinc alloys. It weathers to a rich bronze colour. It has excellent deep drawing capability, and resistance to pitting corrosion in severe weather and water environments. It is used in architectural fascias, jewellery, ornamental trim, door handles, escutcheons, marine hardware.

C26000, 70/30 Brass and C26130, Arsenical brass, have excellent ductility and strength, and are the most widely used brasses. Arsenical brass contains a small addition of arsenic, which greatly improves corrosion resistance in waters, but is otherwise effectively identical. These alloys have the distinctive bright yellow colour normally associated with brass. They have the optimum combination of strength and ductility in the copper-zinc alloys, coupled with good corrosion resistance. C26000 is used for architecture, drawn and spun containers and shapes, electrical terminals and connectors, door handles, plumbers hardware. C26130 is used for tube and fittings in contact with water, including potable water.

C26800, Yellow brass, is the single phase alpha brass with the lowest content of copper. It is used where its deep drawing properties and lower cost give an advantage. When welded, particles of beta phase may form, reducing ductility and corrosion resistance.

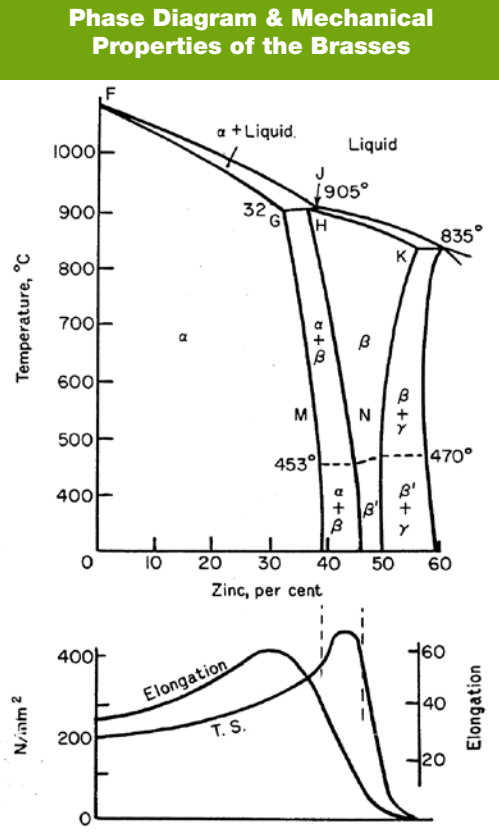
C35600 and C37000, Engraving brass, are 60/40 alpha-beta brasses with different levels of lead added to give free machining properties. They are widely used for engraved plates and plaques, builders hardware, gears. They should not be used for acid etched work, for which the single phase alpha brasses should be used.

C38000, Section brass, is a readily extrudable leaded alpha/beta brass with a small aluminium addition, which gives a bright golden colour. The lead gives free cutting properties. C38000 is available as extruded rods, channels, flats and angles, which are typically used in builders hardware.

C38500, Free cutting brass, is a significantly improved form of 60/40 brass, with excellent free cutting properties. It is used in the mass production of brass components where maximum output and longest tool life are required, and where no further cold forming after machining is required.

Australian Product Specifications

Specification	Product Form
AS1566	Rolled flat products
AS1567	Wrought rods, bars & sections
AS1568	Forging stock & forgings
AS1569	Seamless tubes for heat exchangers
AS1571	Seamless tubes for air conditioning & refrigeration
AS1572	Seamless tubes for engineering purposes
AS1573	Wire for engineering purposes
AS1574	Wire for electrical purposes



Corrosion Resistance

Brasses are resistant to corrosion in many media. Please consult Austral Wright Metals for detailed advice on your application.

Brasses are particularly susceptible to corrosion by solutions containing ammonia or amines. Alloys with more than about 15% of zinc may suffer dezincification, which leaves a weak, porous corrosion deposit of copper. Resistance to dezincification is greatly reduced by the addition of a small amount of arsenic to the alloy.

Stress corrosion cracking, particularly by ammonia and amines, is also a problem with the brasses. Alloys containing more than about 15% zinc are most susceptible. Use of the annealed temper, and annealing or stress relieving after forming, reduces susceptibility to stress corrosion cracking.



— at the cutting edge

BEARING BRONZES

Austral Wright Metals stock three copper alloys suitable for sleeve bearings. These alloys give a range of service performance, depending on the application. They are used for many other applications, where their high strength and wear resistance are valuable.

Leaded Gunmetal (LG2) is the most commonly used general purpose bearing bronze. It is used for lightly stressed bearings. It is stocked as solid bar, hollow bar and machined bushes in a range of metric and imperial sizes, up to 12” (305 mm) OD.

Phosphor Bronze (PB1) provides better strength and resistance to wear and corrosion than LG2. It is stocked as solid and hollow bar in a range of imperial sizes up to 6” (152 mm) OD.

Aluminium Bronze (AB) gives the best performance of the three alloys. Resistance to fatigue, wear, corrosion and temperature are outstanding. It is stocked as solid and hollow bar in a range of imperial sizes up to 6” OD.

Table 1: Composition (weight %) of the alloys

Alloy	UNS	Copper	Tin	Zinc	Lead	Phosphorus	Aluminium	Iron
Leaded Gunmetal	LG2	C83600	85%	5%	5%	5%		
Phosphor Bronze	PB1	C90710	89%	10.5%			0.7%	
Aluminium Bronze	AB	C95400	85%				10.5%	4.0%

Table 2: Mechanical properties of the alloys (solid bar)

Alloy		Yield MPa	Tensile MPa	Elongation %	Hardness Brinell	Machinability Rating	Maximum Operating Temperature
Leaded Gunmetal	LG2	130 Typ	300 Typ	20% Typ	75 Typ	84	230°C
Phosphor Bronze	PB1	170 Typ	360 Typ	10% Typ	100-150 Typ	30	250°C
Aluminium Bronze	AB	220 Min	585 Min	15% Min	180 Typ	60	260°C

Table 3: Properties of the alloys (solid bar)

	Load Capacity and Fatigue	Maximum Operating Temperature	Conformability and Embeddability	Resistance to Seizure	Hardness and Wear Resistance	Corrosion resistance
Leaded Gunmetal	Moderate / high	High	Good	Moderate	High	Dezincification resistant
Phosphor Bronze	Very high	High	Poor	Moderate	Very high	Good
Aluminium Bronze	Very high	Very high	Poor	Moderate	Very high	Reasonable

These products are supplied in the cast condition. Austral Wright Metals’ supplier uses an improved casting process to obtain a uniform, extremely fine grain structure for Micrograin® performance – better strength, fatigue resistance and longer life.

Alloy Selection

The selection of a suitable bearing bronze depends on many factors, such as

- loading conditions
- running speed
- operating environment
- lubrication conditions

Austral Wright Metals can provide handbooks with detailed information to aid bearing design.

Bearing alloy selection is usually guided by experience: an existing bearing is not performing satisfactorily. To solve wear problems, it may be most economical to improve the lubrication of the bearing (these alloys are not self lubricating, the lead is present in LG2 mainly to assist machinability), rather than move to a harder alloy.

BEARING BRONZES (continued)

The strength and wear characteristics of the shaft material must also be considered. Bronze bearings are intended to wear preferentially, with reasonable life, to protect the shaft. Properties such as conformability (ability to conform to non-uniformities in the shaft surface and to shaft misalignment) and embeddability (ability to enclose dirt and wear particles without damage) can be very important, and the forging nature of LG2 is often critical in this respect.

Heavy Duty Service

Where the service conditions are too onerous for the stocked bronze alloys, Austral Wright Metals can supply alloys of even higher strength and wear resistance, such as manganese bronze and nickel aluminium bronzes. These high strength alloys can be obtained quickly by Austral Wright Metals.

Nominal Composition (weight %) of higher strength alloys

Alloy	UNS	Type	Copper	Aluminium	Iron	Nickel	Manganese	Zinc
Ampco M4	AMS 4590	Nickel aluminium bronze	78%	10.5%	4.8%	5.0%	1.5%	
Ampco 45	C63000	Nickel aluminium bronze	81%	10%	3.0%	5.0%	1.0%	
Ampco 863	C86300	Manganese bronze	62%	6.0%	3.0%		3.0%	26.0%

Typical mechanical properties of the higher strength alloys

Alloy	Yield MPa	Tensile MPa	Elongation %	Hardness Brinell	Hardness HRB	Condition
Ampco M4	750	980	8%	285	29 (HRC)	Extruded, drawn and heat treated
Ampco 45	520	815	15%	225	98	Extruded and drawn
Ampco 863	365	725	18%	225	95	Continuous cast

Handbooks available from Austral Wright Metals (as pdf files):

1. Cast copper alloy sleeve bearings. Copper Development Association (USA) Catalogue A1063, 2006.
2. Copper alloy bearings. Copper Development Association (UK) Technical Note 45, 1992.
3. Selecting Bronze Bearing Materials Copper Development Association (USA) Catalogue 702/6a

The technical advice and recommendations made in this Product Data Sheet should not be relied or acted upon without conducting your own further investigations, including corrosion exposure tests where needed.

Please consult current editions of standards for design properties.

Austral Wright Metals assumes no liability in connection with the information in this Product Data Sheet

HIGH CONDUCTIVITY COPPER (ETP COPPER) ALLOY 110 UNS C11000

Composition, AS2738.2 Copper 99.90+%, oxygen by agreement, usually 0.04%

Equivalent Alloy Specifications	Specification	Designation
	UNS	C11000
	BS/EN	C101/CW004A
	JIS	C 1100
	ISO	Cu-ETP

Australian Standard Product Specifications (Other product specifications available on enquiry)	Specification	Product Form
	AS1566	Rolled flat products
	AS1567	Wrought rods, bars & sections
	AS1568	Forging stock & forgings
	AS1569	Seamless tubes for heat exchangers
	AS1571	Seamless tubes for air conditioning & refrigeration
	AS1572	Seamless tubes for engineering purposes

ASTM Product Specifications	Specification	Title
	B5	High Conductivity Tough Pitch Copper Refinery Shapes
	B124	Copper and Copper Alloy Forging Rod, Bar, and Shapes
	B152	Copper Sheet, Strip, Plate, and Rolled Bar
	B187	Copper Bar, Bus Bar, Rod and Shapes
	B188	Seamless Copper Bus Pipe and Tube
	B283	Copper and Copper Alloy Die Forgings (Hot Pressed)
	B447	Welded Copper Tube
	B577	Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper
	B694	Clad Alloy Steel (CAS) Sheet and Strip for Electrical Cable Shielding

Mechanical Properties (AS1566, Sheet & Strip)	Property	Temper			
		Units	Annealed* (soft)	Half hard	Hard
	Tensile Strength, min	MPa	210*	245	310
	Elongation, min	%	40*	10	7
	Hardness	HV	55 max*	75 – 90	90 – 115

Notes: 1. Properties marked * are typical, for information only
2. Other tempers are available for sufficient quantity on request

Finish Annealed or cold rolled to temper.

Available Forms Austral Wright Metals can supply this alloy in sheet, strip, coil, plate, circles, bar, sections, wire.

General Description Electrolytic tough pitch (ETP) copper, alloy 110, has excellent ductility and high electrical and thermal conductivity, higher than for any other copper metal except oxygen free grades such as C10200. The electrical conductivity is at least 100% IACS (0.5800 microhm⁻¹.cm⁻¹) and is often as high as 101.5% IACS. Electrical and heat exchanger uses are common.

The dominant use of this alloy is in electrical conductors. It is also used widely for gaskets, switches, terminals and connectors, transformers, electronic parts, ball floats, drawn and spun holloware.

PHYSICAL PROPERTIES	Property	Metric Units	Imperial Units
	Melting Point (Liquidus)	1083°C	1981°F
	Melting Point (Solidus, eutectic)	1065°C	1950°F
	Density	8.89 gm/cm ³ @ 20°C	0.301 lb/in ³ @ 68°F
	Specific Gravity	8.89	8.89
	Coefficient of Thermal Expansion	17.7 x 10-6 /°K (20 - 300°C)	9.8 x 105/0F (68 - 572°F)
	Thermal Conductivity	388 W/m.°K @ 20°C	224 BTU/ft3/ft/hr/°F @ 68°F
	Thermal Capacity (Specific Heat)	385 J/kg.°K @ 20°C	0.092 BTU/lb/°F @ 68°F
	Electrical Resistivity (Annealed)	1.724 microhm.cm @ 20°C	10.3 ohms (circ mil/ft) @ 68°F
	Electrical Conductivity (Annealed)	0.58 – 0.59	100.0 – 101.5
		microhm ⁻¹ .cm ⁻¹ @ 20°C	% IACS @ 68°F
	Modulus of Elasticity (tension)	115 GPa	17 x 10 ⁶ psi
	Modulus of Rigidity (shear)	44 GPa	6.4 x 10 ⁶ psi
	Poisson's Ratio	0.33	0.33

FABRICATING PROPERTIES	
Cold Working Capacity	Excellent
Hot Working Capacity	Excellent
Hot Forging Rating	65% of forging brass
Hot Working Temperature	750-875°C
Annealing Temperature	375-650°C
Machinability Rating	20% of free cutting brass
Finishing	Excellent

JOINING PROPERTIES	
Soldering	Excellent
Brazing	Good
Oxy-Acetylene Welding	Not recommended
Carbon Arc Welding	Fair
Gas Shielded Arc Welding (GTAW/TIG, GMAW/MIG)	Fair
Coated Metal Arc Welding	Not recommended
Resistance Welding	Not recommended

CORROSION RESISTANCE

C11000 has excellent corrosion resistance to weathering and very good resistance to many chemicals. It is often used specifically for corrosion resistance. It is suitable for use with most waters, and can be used underground because it resists soil corrosion. It resists non-oxidising mineral and organic acids, caustic solutions and saline solutions.

Depending on concentration and specific conditions of exposure, copper generally resists:

Acids: mineral acids such as hydrochloric and sulphuric acids; organic acids such as acetic acid (including acetates and vinegar), carbolic, citric, formic, oxalic, tartaric and fatty acids; acidic solutions containing sulphur, such as the sulphurous acid and sulphite solutions used in pulp mills.

Alkalies: fused sodium and potassium hydroxide; concentrated and dilute caustic solutions.

Salt solutions: aluminium chloride, aluminium sulphate, calcium chloride, copper sulphate, sodium carbonate, sodium nitrate, sodium sulphate, zinc sulphate.

Waters: all potable waters, many industrial and mine waters, seawater and brackish water.

Other media: The corrosion resistance of C11000 is not adequate for: ammonia, amines and ammonium salts; oxidizing acids such as chromic and nitric acids and their salts; ferric chloride; persulphates and perchlorates; mercury and mercury salts. Copper may also corrode in aerated non oxidising acids such as sulphuric and acetic acids, although it is practically immune from these acids if air is completely excluded. Copper is not suitable for use with acetylene, which can react to form an acetylide which is explosive. C11000 is considered to be immune to stress corrosion cracking in ammonia and the similar media which cause season cracking in brass and other copper alloys. Consult Austral Wright Metals for your specific application.

WELDING

C11000 contains about 0.04% oxygen, as cuprous oxide. This intentional residue reduces the adverse effect on electrical conductivity of traces of impurity metals. The internal oxide renders the alloy subject to hydrogen embrittlement if heated in reducing atmospheres above about 370°C (dull red heat). C11000 is therefore unsuitable for gas welding and high temperature brazing. Oxygen free copper, C10200, or the deoxidised alloy C12200 is preferred where welding is required.

EFFECT OF COLD WORK ON MECHANICAL PROPERTIES

Copper in the annealed condition is among the most ductile of the engineering metals. Cold work, either cold rolling or deformation in fabrication, leads to rapid work hardening. The tempered grades of copper are produced by cold work, and the commercially pure coppers cannot be hardened by heat treatment.



PHOSPHORUS DEOXIDISED COPPER ALLOY 122 UNS C12200

Composition, AS2738.2 Copper, including silver >99.90%, Phosphorus 0.015 – 0.040%.

Equivalent Alloy Specifications

Specification	Designation
UNS	C12200
BS/EN	C106/CW024A
ISO	Cu-DHP
JIS	C1220

Australian Product Specifications

Specification	Product Form
AS1432	Copper tubes for water, gas & sanitation
AS1566	Rolled flat products
AS1567	Wrought bars & sections
AS1572	Seamless tube for engineering purposes

ASTM Product Specifications

Specification	Title
B5	High Conductivity Tough-Pitch Copper Refinery Shapes
B42	Seamless Copper Pipe, Standard Sizes
B68	Seamless Copper Tube, Bright Annealed
B75	Seamless Copper Tube
B88	Seamless Copper Water Tube
B111	Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
B152	Copper Sheet, Strip, Plate, and Rolled Bar
B187	Copper Bar, Bus Bar, Rod and Shapes
B280	Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
B302	Threadless Copper Pipe
B306	Copper Drainage Tube (DWV)
B359	Copper and Copper-Alloy Seamless Condenser and Heat Exchanger Tubes With Integral Fins
B360	Hard-Drawn Copper Capillary Tube for Restrictor Applications
B379	Phosphorized Coppers-Refinery Shapes
B395	U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
B447	Welded Copper Tube
B543	Welded Copper and Copper-Alloy Heat Exchanger Tube
B577	Detection of Cuprous Oxide (Hydrogen Embrittlement Susceptibility) in Copper
B640	Welded Copper and Copper Alloy Tube for Air Conditioning and Refrigeration Service
B698	Seamless Copper and Copper Alloy Plumbing Pipe and Tube
B743	Seamless Copper Tube in Coils
B837	Seamless Copper Tube for Natural Gas and Liquified Petroleum (LP) Gas Fuel Distribution Systems

Mechanical Properties (AS1566, Rolled flat products, and AS1567, Wrought rods, bars and sections)

Product	Temper	Thickness mm	Grain size mm	Tensile Strength minimum MPa	Elongation minimum %	Hardness maximum HV
Plate & rolled bar	Annealed, M or O	3.2 – 60.0	–	210	35	50*
	Hard	3.2 – 12.0	–	280	15	85*
Sheet, strip & foil	Annealed, O4		0.025 – 0.045	220*	45*	60
	½ hard	0.15 – 3.2	–	245	10	75 – 90
	Hard	0.15 – 3.2	–	310	7	90 – 115

* - typical

Available Forms Austral Wright Metals can supply this alloy as sheet, strip, foil and tube.



General Description C12200, Phosphorus deoxidised copper, has been made weldable and brazeable by deoxidising with phosphorus. It is widely used as flat products and tubing, especially where it is to be welded or brazed. Phosphorus significantly reduces the conductivity, which may go as low as 70% IACS, but also raises the softening temperature when work hardened and promotes fine grain size. C12200 has almost exactly the same mechanical properties as the high purity copper alloys such as C11000. It has excellent deep drawing characteristics and resistance to pitting corrosion when exposed to severe weather and water environments.

Typical Applications: Tubes for hot & cold water, gas & heating installations, soil & waste pipes, storage tanks, cisterns & cylinders, rainwater goods, roofing, fascias, building facades, evaporators, heat exchangers, stills, vats, chemical equipment, anodes for electroplating baths.

PHYSICAL PROPERTIES	Property	Metric Units	Imperial Units
	Melting Point (Liquidus)	1083°C	1981°F
	Melting Point (Solidus)	1083°C	1981°F
	Density	8.90 gm/cm ³ @ 20°C	0.321 lb/in ³ @ 68°F
	Specific Gravity	8.90	8.90
	Coefficient of Thermal Expansion	17.7 x 10 ⁻⁶ /°K (20 - 300°C)	9.83 x 10 ⁻⁶ /°F (68 - 572°F)
	Thermal Conductivity	293 - 364 W/m.°K @ 20°C	169 - 211 BTU/ft ³ /ft/hr/°F @ 68°F
	Thermal Capacity (Specific Heat)	385 J/kg.°K @ 20°C	0.092 BTU/lb/°F @ 68°F
	Electrical Resistivity (Annealed)	2.5 – 1.9 microhm.cm @ 20°C	15 - 12 ohms (circ mil/ft) @ 68°F
	Electrical Conductivity (Annealed)	0.41 – 0.52 microhm ⁻¹ .cm ⁻¹ @ 20°C	70 – 90 % IACS @ 68°F
	Modulus of Elasticity (tension)	115 GPa	17 x 10 ⁶ psi
	Modulus of Rigidity (shear)	44 GPa	6.4 x 10 ⁶ psi

FABRICATING PROPERTIES	
Cold Working Capacity	Excellent
Hot Working Capacity	Good
Hot Working Temperature	750 – 950°C
Annealing Temperature	250 – 650°C
Stress Relieving Temperature	200 – 250°C
Machinability Rating	20% of free cutting brass (C36000)
Polishing/electroplating finishing	Excellent

JOINING PROPERTIES	
Soldering	Excellent
Brazing	Excellent
Oxy-Acetylene Welding	Good
Gas Shielded Arc Welding (GTAW/TIG, GMAW/MIG)	Good
Coated Metal Arc Welding (Manual electrodes)	Not recommended
Resistance Welding - Spot	Fair
- Seam	Fair

Corrosion Resistance

C12200 has similar corrosion resistance to C11000. It gives excellent resistance to weathering and very good resistance to many chemicals. It is often used specifically for corrosion resistance. It is suitable for use with most waters, and can be used underground because it resists soil corrosion. It resists non-oxidising mineral and organic acids, caustic solutions and saline solutions. Depending on concentration and specific conditions of exposure, copper generally resists: Acids: mineral acids such as hydrochloric and sulphuric acids; organic acids such as acetic acid (including acetates and vinegar), carbolic, citric, formic, oxalic, tartaric and fatty acids; acidic solutions containing sulphur, such as the sulphurous acid and sulphite solutions used in pulp mills. Alkalies: fused sodium and potassium hydroxide; concentrated and dilute caustic solutions. Salt solutions: aluminium chloride, aluminium sulphate, calcium chloride, copper sulphate, sodium carbonate, sodium nitrate, sodium sulphate, zinc sulphate. Waters: all potable waters, many industrial and mine waters, seawater and brackish water. Other media: The corrosion resistance of C12200 is not adequate for: ammonia, amines and ammonium salts; oxidizing acids such as chromic and nitric acids and their salts; ferric chloride; persulphates and perchlorates; mercury and mercury salts. Copper may also corrode in aerated non oxidising acids such as sulphuric and acetic acids, although it is practically immune from these acids if air is completely excluded. Copper is not suitable for use with acetylene, which can react to form an acetylide which is explosive. Consult Austral Wright Metals for your specific application.



— *at the cutting edge*

90/10 GILDING METAL COPPER ALLOY 220 UNS C22000

Also known as Red Brass, Commercial Bronze, Gilding Metal

Composition, AS2738.2 Copper 89.0 – 91.0 %, Iron 0.05% max, Lead 0.02% max, Zinc balance ~10%

Equivalent Alloy Specifications

Specification	Designation
UNS	C22000
BS/EN	CZ101/CW501L
ISO	Cu Zn 10
JIS	C2200
SAE	CA220

Australian Product Specifications

Specification	Product Form
AS1566	Rolled flat products
AS1567	Wrought bars & sections

ASTM Product Specifications (Other product specifications available on enquiry)

Specification	Title
B36	Brass Plate, Sheet, Strip, And Rolled Bar
B130	Commercial Bronze Strip for Bullet Jackets
B131	Copper Alloy Bullet Jacket Cups
B134	Brass Wire
B135	Seamless Brass Tube

Mechanical Properties (AS1566, Rolled flat products, and AS1567, Wrought rods, bars and sections)

Product	Temper	Tensile Strength MPa, minimum	Elongation %, minimum	Hardness HV
Sheet & Flats	Annealed			80 maximum
Sheet & Flats, <= 2.0 mm	½ hard	310	7	95 - 115
Sheet & Flats, 2.1 – 3.2 mm	½ hard	280	7	85 - 110
Rod & square bar >6mm	M	280	24	
Sheet & Flats, <= 2.0 mm	Hard	360	3	110 – 135
Sheet & Flats, 2.1 – 3.2 mm	Hard	320	3	100 – 125

Available Forms: Austral Wright Metals can supply this alloy as sheet, strip and round bar.

General Description: C22000 combines a rich golden colour with the best combination of strength, ductility and corrosion resistance of the plain copper-zinc alloys. It weathers to a rich bronze colour, and can be supplied in pre-patinated colours ranging from deep brown to green.

It has a lower rate of work hardening than the copper-zinc alloys with higher zinc content, such as 260 and 272. This is an advantage in multistage pressing applications without interstage annealing. It has excellent deep drawing characteristics and resistance to pitting corrosion and stress corrosion cracking when exposed to severe weather and water environments.

Typical Applications: Architectural fascias, grillwork, jewellery, ornamental trim, vitreous enamel base, badges, door handles, escutcheons, marine hardware, munitions, primer caps, rotating bands, metallic bellows, pen, pencil and lipstick tubes etc.

PHYSICAL PROPERTIES	Property	Metric Units	Imperial Units
	Melting Point (Liquidus)	1045°C	1910°F
	Melting Point (Solidus)	1020°C	1870°F
	Density	8.80 gm/cm ³ @ 20°C	0.318 lb/in ³ @ 68°F
	Specific Gravity	8.80	8.80
	Coefficient of Thermal Expansion	18.4 x 10 ⁻⁶ /°K (20 - 300°C)	10.2 x 10 ⁻⁶ /°F (68 - 572°F)
	Thermal Conductivity	189 W/m.°K @ 20°C	109 BTU/ft ³ /ft/hr/°F @ 68°F
	Thermal Capacity (Specific Heat)	376 J/kg.°K @ 20°C	0.09 BTU/lb/°F @ 68°F
	Electrical Resistivity (Annealed)	3.92 microhm.cm @ 20°C	10.3 ohms (circ mil/ft) @ 68°F
	Electrical Conductivity (Annealed)	0.255 microhm-1.cm-1@ 20°C	44 % IACS @ 68°F
	Modulus of Elasticity (tension)	115 GPa	17 x 10 ⁶ psi
	Modulus of Rigidity (shear)	44 GPa	6.4 x 10 ⁶ psi
	Poisson's Ratio	0.33	0.33

FABRICATING PROPERTIES	
Cold Working Capacity	Excellent
Hot Working Capacity	Excellent
Hot Forging Rating	65% of forging brass
Hot Working Temperature	750-875°C
Annealing Temperature	375-650°C
Machinability Rating	20% of free cutting brass
Finishing	Excellent

JOINING PROPERTIES	
Soldering	Excellent
Brazing	Good
Oxy-Acetylene Welding	Not recommended
Carbon Arc Welding	Fair
Gas Shielded Arc Welding (GTAW/TIG, GMAW/MIG)	Fair
Coated Metal Arc Welding (Manual electrodes)	Not recommended
Resistance Welding	Not recommended

Phase Diagram & Mechanical Properties of the Brasses

Corrosion Resistance

As an alpha brass with low zinc content, C22000 has excellent corrosion in most media. It is less susceptible to stress corrosion cracking than the higher zinc brasses such as 70/30 brass C26000, and is not considered susceptible in marine atmospheres. However, it should not be used in contact with aqueous ammonia and amines.

C22000 should not be used with acetic acid, acetylene, brines, calcium chloride, moist chlorine, chromic acid, hydrochloric acid, mercury or its compounds, nitric acid and sodium hypochlorite.

Please consult Austral Wright Metals for advice on your specific application.



— *at the cutting edge*

70/30 BRASS ALLOY 260 UNS C26000

Also known as Cartridge Brass, Spinning Brass, Spring Brass

Composition, AS1572

Copper		Lead	Iron	Zinc
Min	Max	Max	Max	Max
68.5	71.5	0.07	0.05	Remainder

Equivalent Alloy Specifications

Specification	Designation
UNS	C26000
ISO	CuZn30
BS/EN	CZ106/CW505L
JIS	C 2600

Australian Product Specifications

Specification	Product Form
AS1566	Rolled flat products
AS1567	Wrought rods, bars & sections
AS1571	Seamless tubes for air conditioning & refrigeration

Mechanical Properties (AS1566, Rolled flat products, and AS1567, Wrought rods, bars and sections)

Product	Temper	Tensile Strength MPa, minimum	Elongation %, minimum	Hardness HV
Sheet & Flats	Annealed			< 110
Sheet & Flats, <= 2.0 mm	½ hard	360	20	110 – 135
Sheet & Flats, 2.1 – 3.2 mm	½ hard	340	20	100 – 125
Rod & square bar >6mm	O	280	45	
Rod & square bar >6mm	M	340	28	
Sheet & Flats, <= 2.0 mm	Hard	420	3	135 – 165
Sheet & Flats, 2.1 – 3.2 mm	Hard	360	3	> 125

Available Forms: Austral Wright Metals can supply this alloy as coil, sheet, plate, rods, bars, sections. See alloy C26130 (formerly alloy 259) for tube & fittings.

General Description: 70/30 brass has excellent ductility and good strength. It is often used where its deep drawing qualities are needed. The alloy is the most common brass in sheet form. The alloy consists of the face centred cubic alpha phase, and has the optimum combination of strength and ductility in the copper-zinc series. C26000 has the distinctive clear bright yellow colour normally associated with ‘brass’.

Typical Applications: Architecture, grillwork, appliances, drawn & spun containers and components, radiator cores and tanks, electrical terminals, plugs and lamp fittings, locks, door handles, name plates, plumbers hardware, fasteners, cartridge cases, cylinder liners for pumps.

**PHYSICAL
PROPERTIES**

Property	Metric Units	Imperial Units
Melting Point (Liquidus)	965°C	1770°F
Melting Point (Solidus) (eutectic)	910°C	1670°F
Density	8.58 gm/cm³ @ 20°C	0.310 lb/in³ @ 68°F
Specific Gravity	8.58	8.58
Coefficient of Thermal Expansion	20.0 x 10-6 /°K (20 - 300°C)	11.0 x 10-5/°F (68 - 572°F)
Thermal Conductivity	120 W/m.°K @ 20°C	70 BTU/ft³/ft/hr/°F @ 68°F
Thermal Capacity (Specific Heat)	375 J/kg.°K @ 20°C	0.09 BTU/lb/°F @ 68°F
Electrical Resistivity (Annealed)	6.2 microhm.cm @ 20°C	37 ohms (circ mil/ft) @ 68°F
Electrical Conductivity (Annealed)	0.16 microhm ⁻¹ .cm ⁻¹ @ 20°C	28% IACS
Temperature Coefficient of Electrical Resistance (Annealed)	0.0015 / °C @ 0 - 100°C	0.0008 / °F @ 32 - 212°F
Modulus of Elasticity (tension)	110 GPa @ 20°C	16.0 x 10 ⁶ psi @ 68°F
Modulus of Rigidity (torsion)	40 GPa @ 20°C	6.0 x 10 ⁶ psi @ 68°F
Poisson's Ratio	0.33	0.33

FABRICATING PROPERTIES

Cold Working Capacity	Excellent
Hot Working Capacity	Fair
Hot Working Temperature	725 - 850°C
Annealing Temperature	375 - 650°C
Stress Relieving Temperature	250 - 300°C
Machinability Rating	30% of free cutting brass (C36000)
Polishing/Electroplating Finish	Excellent

JOINING PROPERTIES

Soldering	Excellent
Brazing	Excellent
Oxy-Acetylene Welding	Good
Gas Shielded Arc Welding (GTAW/TIG, GMAW/MIG)	Fair
Coated Metal Arc Welding (Manual electrodes)	Not recommended
Resistance Welding - Spot	Good
- Seam	Good

DEZINCIFICATION RESISTANT MACHINING BRASS ALLOY 352 UNS C35330

Also known as Leaded 63/37 Arsenical Brass

Composition, Typical

Copper	Lead	Arsenic	Zinc
61.5%	3.25%	0.15%	Remainder

Equivalent Specifications

AS1567 - C35330 BS 2873 – CZ119

Available as:

Straight Lengths	Drawn ?	Coils	Drawn ?
Rounds	Yes	Rounds	Yes
Hexagons	Yes	Hexagons	Yes
Squares	Yes	Squares	Yes
Flats	No		
Sections	No		
Hollows	No		

Typical Mechanical Properties

Temper	Yield Stress (0.2% Proof) MPa	Tensile Strength MPa	Elongation %	Surface Hardness, HV
Drawn	165	370	30	110

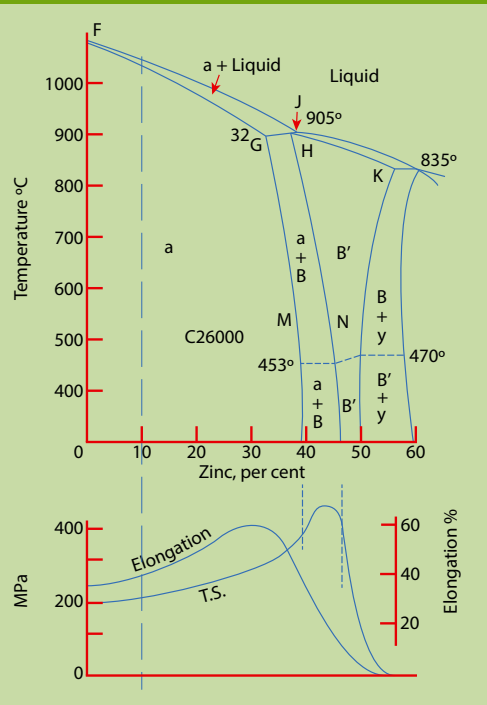
General Description

Chlorinated potable water supplies (town water) can cause dezincification of brasses containing more than 15% zinc. The careful formulation of this alloy combined with heat treatment produces a dezincification resistant brass suitable for high speed machining applications.

Typical applications

Plumbers hardware, valve spindles, fittings.

Phase Diagram & Mechanical Properties of the Brasses



Corrosion Resistance

C26000 has good corrosion resistance to weathering and very good resistance to many chemicals. It may undergo dezincification in stagnant or slowly moving salt solutions, brackish water or acidic solutions. Although it will resist most waters, C26130 is preferred as it contains a small arsenic addition which inhibits corrosion.

C26000 should not be used in contact with ammonia or ammonia compounds, as it may suffer stress corrosion cracking. Beware of corrosion inhibitors in piping systems containing carbon steels, which should be checked for compatibility with alloy C26000. 70/30 brass should not be used with acetic acid, acetylene, brines, calcium chloride, moist chlorine, chromic acid, hydrochloric acid, mercury or its compounds, nitric acid and sodium hypochlorite. Please consult Austral Wright Metals for your specific application.

PHYSICAL PROPERTIES

Property	Metric Units
Melting Point	8850C
Density	8.47 gm/cm ³ @ 200C
Specific Gravity	8.47
Coefficient of Thermal Expansion	20.5 x 10 ⁻⁶ /0K (20 - 3000C)
Thermal Conductivity	123 W/m.oK @ 200C
Electrical Resistivity (Annealed)	6.63 microhm.cm @ 200C 27% IACS
Electrical Conductivity (Annealed)	0.15 microhm-1.cm-1 @ 200C
Modulus of Elasticity (tension)	103 GPa @ 200C
Modulus of Rigidity (torsion)	39 GPa @ 200C
Poisson's Ratio	0.33

FABRICATING PROPERTIES

Cold Working Capacity	Excellent
Thread Rolling	Excellent
Bending	Excellent
Cold Heading	Good
Hot Working Capacity	Poor
Hot Working Temperature	8000C
Annealing Temperature	5700C
Stress Relieving Temperature	2750C
Machinability Rating	100% of free cutting brass (C36000)

JOINING PROPERTIES

Soldering	Good
Brazing	Good
Oxy-Acetylene Welding	Fair
Gas Shielded Arc Welding (GTAW/TIG, GMAW/MIG)	Fair
Coated Metal Arc Welding (Manual electrodes)	Not recommended
Resistance Welding	Not recommended

ENGRAVING BRASS ALLOY 356 UNS C35600

Also known as Extra high leaded brass

Composition, AS2738.2 - 1984, Compositions & designations

Copper		Lead		Iron	Zinc
Min	Max	Min	Max	Max	
59.0	64.5	2.0	3.0	0.10	Remainder

Equivalent Alloy Specifications

Specification	Designation
UNS	C35600
ISO	CuZn39Pb2
BS/EN	CZ128/CW612N
JIS	C 3560

ASTM Product Specifications

Specification	Product Form
B16	Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
B121	Leaded Brass Plate, Sheet, Strip, and Rolled Bar
B453	Copper-Zinc-Lead Alloy (Leaded-Brass) Rod

Mechanical Properties ASTM B121 (Leaded Brass Plate, Sheet, Strip, and Rolled Bar)

	Units	Annealed (Soft) O3	Hard H	Quarter hard ¼ H	Half hard ½ H	Extra hard EH
Tensile Strength	MPa	310*	470 – 540	340 – 405	380 – 450	545 – 615
Hardness	HRB	85	76 – 84	40 – 65	57 – 74	83 – 89

Notes: 1. Properties marked * are typical, for information only
2. Annealed and hard tempers are available from stock. Other tempers available for sufficient quantity on request.

Available Forms: Austral Wright Metals can supply this alloy as plate, sheet and bar.

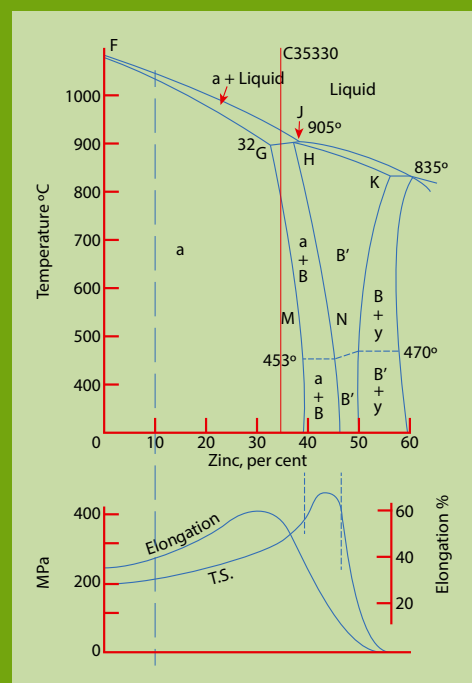
General Description: Engraving brass is traditionally used for machine engraved name plates due to its combination of high strength and free machining characteristics. It is an alpha / beta brass with a duplex structure which renders it unsuitable for acid etched work, for which the single phase brasses such as C26000 (70/30 brass) are preferable.

C35600 weathers to the warm brown bronze tone which is desirable for name plates.

C37000 is also available, with lower (0.9–1.4%) lead content. It has excellent free cutting properties, but machinability is only 70% of C35600.

Typical Applications: engraved name plates and plaques, appliance trim, clock components, builders hardware, gear meters, free machining sheet and plate.

Phase Diagram & Mechanical Properties of the Brasses



Corrosion Resistance

C35330 has excellent corrosion resistance in potable water.

C35330 should not be used in contact with ammonia or ammonia compounds, as it may suffer stress corrosion cracking. Beware of corrosion inhibitors in piping systems containing carbon steels, which should be checked for compatibility with alloy C33300.

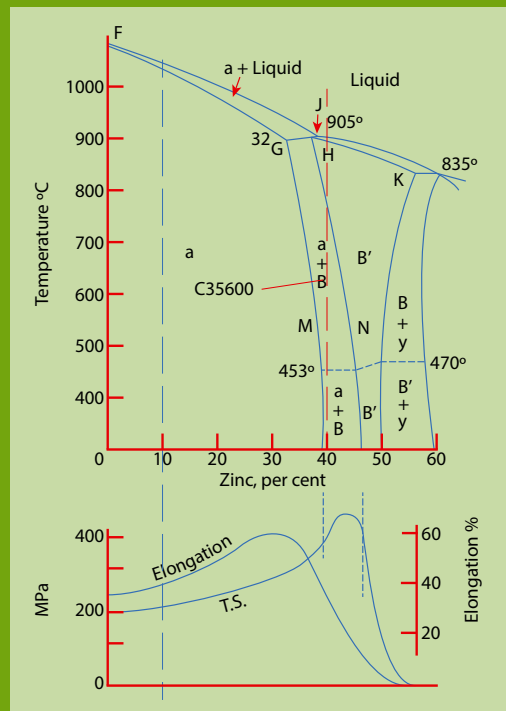
Brass should not be used with acetic acid, acetylene, brines, calcium chloride, moist chlorine, chromic acid, hydrochloric acid, mercury or its compounds, nitric acid and sodium hypochlorite. Please consult Austral Wright Metals for your specific application.

PHYSICAL PROPERTIES	Property	Metric Units	Imperial Units
	Melting Point (Liquidus)	905°C	1660°F
	Melting Point (Solidus)	885°C	1630°F
	Density	8.50 gm/cm ³ @ 20°C	0.307 lb/in ³ @ 68°F
	Specific Gravity	8.50	8.50
	Coefficient of Thermal Expansion	20.5 x 10 ⁻⁶ /°K (20 - 300°C)	11.4 x 10 ⁻⁵ /°F (68 - 572°F)
	Thermal Conductivity	115 W/m.°K @ 20°C	67 BTU/ft ² /hr/°F @ 68°F
	Thermal Capacity (Specific Heat)	380 J/kg.°K @ 20°C	0.09 BTU/lb/°F @ 68°F
	Electrical Resistivity (Annealed)	6.6 microhm.cm @ 20°C	38.4 ohms (circ mil/ft) @ 68°F
	Electrical Conductivity (Annealed)	0.152 microhm-1.cm-1 @ 20°C	26% IACS
	Modulus of Elasticity (tension)	97 GPa @ 20°C	14.0 x 10 ⁶ psi @ 68°F
	Modulus of Rigidity (torsion)	37 GPa @ 20°C	5.3 x 10 ⁶ psi @ 68°F
	Poisson's Ratio	0.32	0.32

FABRICATING PROPERTIES	
Cold Working Capacity	Poor
Hot Working Capacity	Fair
Hot Working Temperature	700 - 800°C
Annealing Temperature	425 - 600°C
Stress Relieving Temperature	250 - 300°C
Machinability Rating	100% of free cutting brass (C36000)
Polishing/Electroplating Finish	Good

JOINING PROPERTIES	
Soldering	Excellent
Brazing	Good
Oxy-Acetylene Welding	Not recommended
Gas Shielded Arc Welding (GTAW/TIG, GMAW/MIG)	Not recommended
Coated Metal Arc Welding (Manual electrodes)	Not recommended
Resistance Welding	Not recommended

Phase Diagram & Mechanical Properties of the Brasses



Corrosion Resistance

C35600 has good corrosion resistance to weathering and fair resistance to many waters. There is some risk of failure by dezincification.

C35600 should not be used in contact with ammonia, ammonia compounds or amines, as it may suffer stress corrosion cracking. It is more susceptible to stress corrosion and dezincification than the single phase high copper brasses, but these are seldom a serious problem in atmospheric conditions.

Please consult Austral Wright Metals for advice on your specific application.

SECTION BRASS ALLOY 380 UNS C38010

Composition, AS1572

Copper		Lead		Iron	Aluminium		Zinc
Min	Max	Min	Max	Max	Min	Max	Max
55.0	60.0	1.5	3.0	0.30	0.10	0.6	Remainder

Equivalent Alloy Specifications

Specification	Designation
UNS	C38010
ISO	CuZn43Pb3
BS	CZ121

Australian Product Specifications

Specification	Product Form
AS1567	Wrought rods, bars & sections
AS2738	Compositions & designations

Mechanical Properties (AS1567, Wrought rods, bars & sections)

	Units	Temper M
Tensile Strength minimum	MPa	380
Elongation minimum	%	12
Hardness maximum	HV	(90)

() – for information only

Available Forms: Austral Wright Metals can supply alloy C38010 as extruded sections – rods, angles, channels, flats, other extruded shapes

General Description: Section brass is a readily extrudable leaded alpha / beta brass alloy with a small aluminium addition, which gives a bright golden colour. The alloy is supplied only as extruded sections and shapes, with a minimum amount of cold work. The bright gold colour is lost if severe cold working operations are applied – alloy 385 is a better choice for cold work. The lead addition renders the alloy free cutting, and it is used widely in components produced by automatic machining. C38010 weathers to a warm bronze tone.

Typical Applications: include builders hardware.

PHYSICAL PROPERTIES	Property	Metric Units	Imperial Units
	Melting Point (Liquidus)	890°C	1635°F
	Melting Point (Solidus)	875°C	1610°F
	Density	8.47 gm/cm ³ @ 20°C	0.306 lb/in ³ @ 68°F
	Specific Gravity	8.47	8.47
	Coefficient of Thermal Expansion	20.9 x 10 ⁻⁶ /°K (20 - 300°C)	11.0 x 10 ⁻⁵ /°F (68 - 572°F)
	Thermal Conductivity	121 W/m.°K @ 20°C	70 BTU/ft ³ /ft/hr/°F @ 68°F
	Thermal Capacity (Specific Heat)	377 J/kg.°K @ 20°C	0.09 BTU/lb/°F @ 68°F
	Electrical Resistivity (Annealed)	6.16 microhm.cm @ 20°C	38 ohms (circ mil/ft) @ 68°F
	Electrical Conductivity (Annealed)	0.162 microhm ⁻¹ .cm ⁻¹ @ 20°C	28% IACS
	Modulus of Elasticity (tension)	96 GPa @ 20°C	14.2 x 10 ⁶ psi @ 68°F
	Modulus of Rigidity (torsion)	36 GPa @ 20°C	5.3 x 10 ⁶ psi @ 68°F
	Poisson's Ratio	0.34	0.34

FABRICATING PROPERTIES	
Cold Working Capacity	Poor
Hot Working Capacity	Fair
Hot Working Temperature	700 - 800°C
Annealing Temperature	425 - 600°C
Stress Relieving Temperature	250 - 300°C
Machinability Rating	80% of free cutting brass (C36000)
Polishing/Electroplating Finish	Good

JOINING PROPERTIES	
Soft Soldering	Good
Silver Soldering	Fair - Good
Brazing	Good
Oxy-Acetylene Welding	Fair
Gas Shielded Arc Welding (GTAW/TIG, GMAW/MIG)	Not recommended
Coated Metal Arc Welding (Manual electrodes)	Not recommended
Resistance Welding	Not recommended



— at the cutting edge

FREE CUTTING BRASS ALLOY 385 UNS C8500
Also known as Architectural Bronze

Composition, AS2738.2 Compositions & designations

Copper		Lead		Zinc
Min	Max	Min	Max	Max
56.0	60.0	2.5	4.5	Remainder

Equivalent Alloy Specifications

Specification	Designation
UNS	C38510
ISO	CuZn39Pb3
BS/EN	CZ121/CW614N

Australian Product Specifications

Specification	Product Form
AS1567	Wrought rods, bars & sections
AS2738	Compositions & designations

Mechanical Properties (AS1567, Wrought rods, bars & sections Temper 'M', as manufactured)

	Units	AS1567	Typical values
0.2% Proof Stress	MPa	–	215
Tensile Strength	MPa	380 minimum	495
Elongation	%	12 minimum	15
Hardness	HV	–	150

Available Forms: Austral Wright Metals are able to supply this alloy as extruded rods.

General Description: Free cutting brass is a significantly improved form of 60/40 brass, with excellent free cutting characteristics. It is used in the mass production of brass components on high speed lathes where maximum output and longest tool life are required, and where no further cold forming after machining is needed.

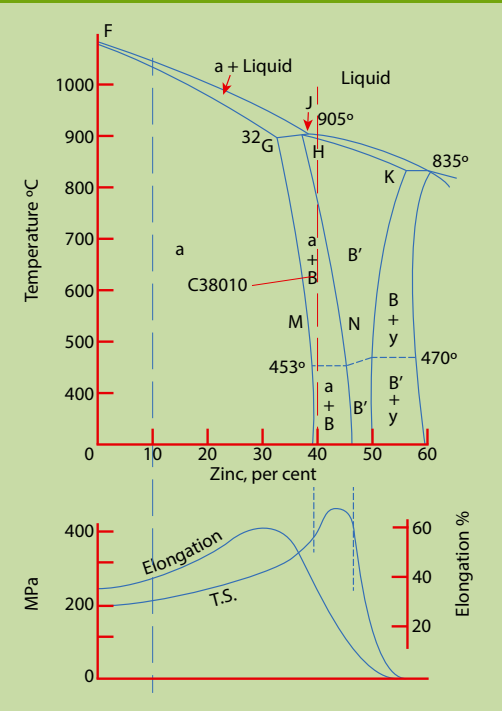
The superior machining characteristics of alloy 385 are due to the rapid chill effect of continuous casting, which gives a fine uniform lead distribution without segregation, and suppresses the formation of brittle phases which cause tool wear.

The alloy gives:

- Superior surface finish without tooling modification
- Improved tool life and reduced tool sharpening
- Cleaner threads with no build-up and no breakage
- Cutting tools previously used with a negative rake can be modified to zero top rake

Typical Applications: are nuts, bolts, screw threads.

Phase Diagram & Mechanical Properties of the Brasses



Corrosion Resistance

C38010 has good corrosion resistance to weathering and fair resistance to many waters.

C38010 should not be used in contact with ammonia, ammonia compounds or amines, as it may suffer stress corrosion cracking.

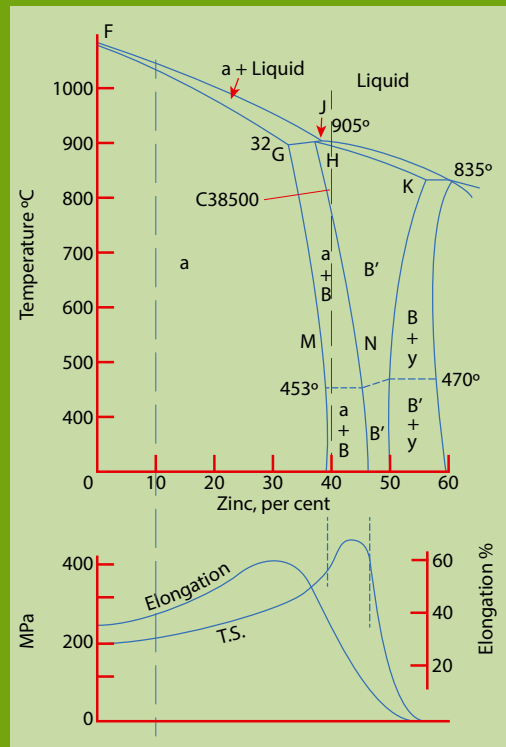
Please consult Austral Wright Metals for advice on your specific application.

PHYSICAL PROPERTIES	Property	Metric Units	Imperial Units
	Melting Point (Liquidus)	890°C	1635°F
	Melting Point (Solidus)	875°C	1610°F
	Density	8.47 gm/cm ³ @ 20°C	0.306 lb/in ³ @ 68°F
	Specific Gravity	8.47	8.47
	Coefficient of Thermal Expansion	20.9 x 10 ⁻⁶ /°K (20 - 300°C)	11.0 x 10 ⁻⁵ /°F (68 - 572°F)
	Thermal Conductivity	121 W/m.°K @ 200C	70 BTU/ft ³ /ft/hr/°F @ 68°F
	Thermal Capacity (Specific Heat)	377 J/kg.°K @ 200C	0.09 BTU/lb/°F @ 68°F
	Electrical Resistivity (Annealed)	6.16 microhm.cm @ 20°C	38 ohms (circ mil/ft) @ 68°F
	Electrical Conductivity (Annealed)	0.162 microhm ⁻¹ .cm ⁻¹ @ 20°C	28% IACS
	Modulus of Elasticity (tension)	97 GPa @ 20°C	14.0 x 10 ⁶ psi @ 68°F
	Modulus of Rigidity (torsion)	37 GPa @ 20°C	5.3 x 10 ⁶ psi @ 68°F
	Poisson's Ratio	0.32	0.32

FABRICATING PROPERTIES	
Cold Working Capacity	Poor
Hot Working Capacity	Fair
Hot Working Temperature	700 - 800°C
Annealing Temperature	425 - 600°C
Stress Relieving Temperature	250 - 300°C
Machinability Rating	90% of free cutting brass (C36000)
Polishing/Electroplating Finish	Good

JOINING PROPERTIES	
Soft Soldering	Good
Silver Soldering	Fair - Good
Brazing	Good
Oxy-Acetylene Welding	Fair
Gas Shielded Arc Welding (GTAW/TIG, GMAW/MIG)	Not recommended
Coated Metal Arc Welding (Manual electrodes)	Not recommended
Resistance Welding	Not recommended

Phase Diagram & Mechanical Properties of the Brasses



Corrosion Resistance

Alloy 385 has good corrosion resistance to weathering and fair resistance to many waters.

Alloy 385 should not be used in contact with ammonia, ammonia compounds or amines, as it may suffer stress corrosion cracking.

Please consult Austral Wright Metals for specific advice on your application.

5% PHOSPHOR BRONZE UNS C51800

Composition, AS1572-1998

Copper	Tin		Phosphorus		Aluminium	Lead
	min	max	min	max	max	max
Remainder ~95%	4.0%	6.0%	0.10%	0.35%	0.01%	0.02%

Equivalent Alloy Specifications

Specification	Designation
UNS	C51800
ISO	Cu Sn5
BS /EN	PB102/CW451K
JIS	-

Australian Product Specifications

Specification	Product Form
AS1566	Rolled flat products
AS1567	Wrought rods, bars & sections

Mechanical Properties (AS1566, Rolled flat products, & AS1567, Wrought rods, bars & sections.)

Product	Thickness mm	Temper	0.2% Proof Stress MPa, min	Tensile Strength MPa, min	Elongation %, min	Hardness, HV
Sheet & Flats	All	Ann, O2	—	365	50	85 – 95
Sheet & Flats	0.15 – 3.2	½ hard	—	360	35	110 – 160
Sheet & Flats		½ hard	—	500	10	160 – 180
Sheet & Flats		Hard	—	590	4	180 – 200
Sheet & Flats	0.15 – 2.0	Extra Hard	—	650	—	200 – 220
Sheet & Flats	0.15 – 3.2	Spring Hard	—	700	—	> 220
Rod & square bar	6 – 20	M	350	460	12	—
Rod & square bar	21 – 40	M	320	430	12	—
Rod & square bar	41 – 70	M	280	380	16	—
Rod & square bar	71 – 120	M	240	310	20	—
Rod & square bar	> 120	M	80	270	24	—

Austral Wright Metals can supply this alloy as coil, sheet and round rod.

C51800: is the most widely used of the wrought phosphor bronzes, particularly in spring applications where the excellent resistance and fatigue endurance of various work-hardened tempers are major advantages of the alloy.

It also has a low coefficient of friction running against steel, combined with high strength. This makes it a popular choice for wear resistant guide strips and similar bearing applications involving boundary lubrication conditions.

Austral Wright Metals can also supply alloy C51000, a very similar alloy with 4.2-5.8% tin, 0.03-0.35% phosphorus without an aluminium addition, which has very similar properties and uses. Most material made to C51000 meets the specification requirements for C51800, and vice versa.

Japanese equipment often makes use of JIS C5191. This has 5.5-7.0% tin, and properties similar to C51800.

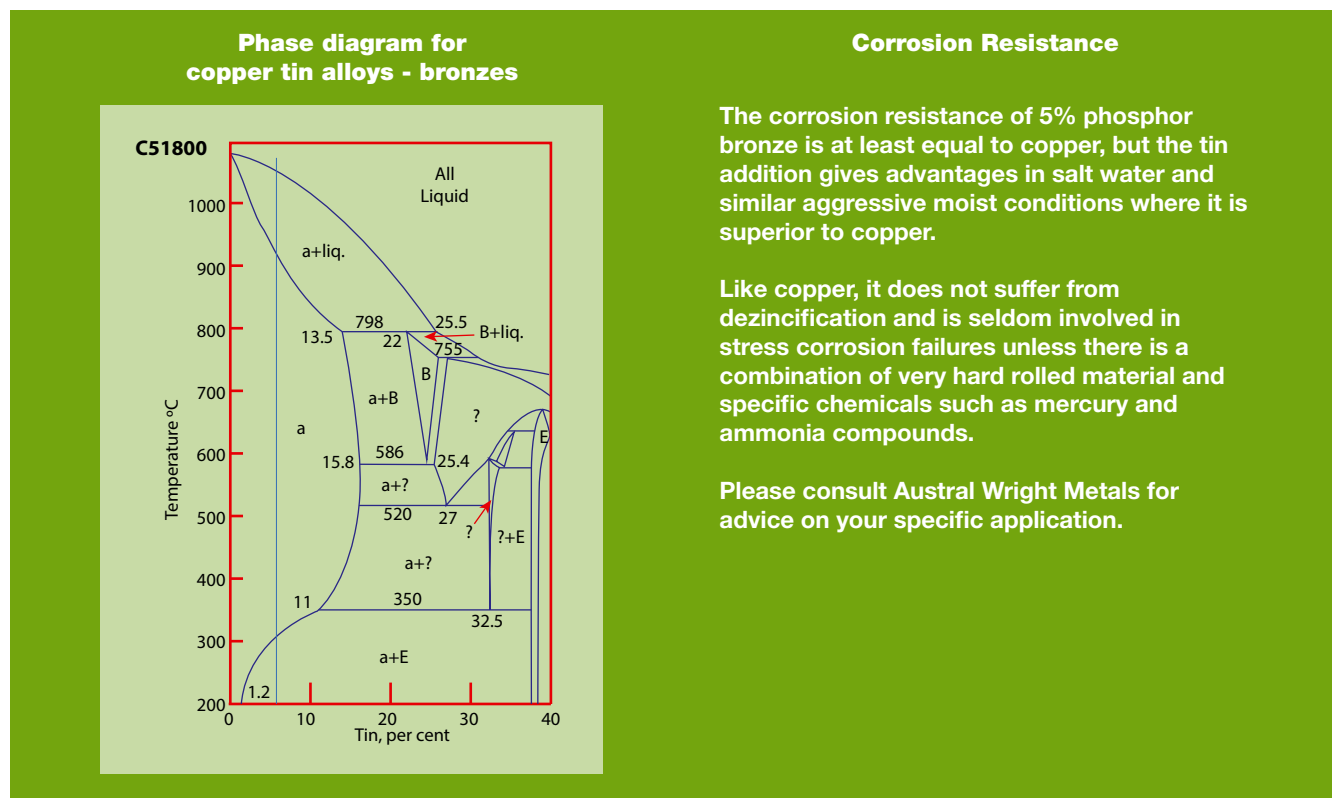
Typical Applications:

Engineering: bridge bearing plates, clutch discs, lock washers.
Electrical: fuse clips, terminal connectors, contacts, switch parts, springs.
Hardware: lock springs, fasteners.
Industrial: diaphragms, sleeve bushings, bellows, press tools.

PHYSICAL PROPERTIES	Property	Metric Units	Imperial Units
	Melting Point (Liquidus)	930°C	1705°F
	Melting Point (Solidus) (eutectic)	1060°C	1940°F
	Density	8.85 gm/cm ³ @ 20°C	0.320 lb/in ³ @ 68°F
	Specific Gravity	8.85	8.85
	Coefficient of Thermal Expansion	18.0 x 10 ⁻⁶ /°K (20 - 300°C)	10.0 x 10 ⁻⁶ /°F (68 - 572°F)
	Thermal Conductivity	63-96 W/m.°K @ 20°C	35-56 BTU/ft ² /ft/hr/°F @ 68°F
	Thermal Capacity (Specific Heat)	377 J/kg.°K @ 20°C	0.09 BTU/lb/°F @ 68°F
	Electrical Resistivity (Annealed)	13.0-9.6 microhm.cm @ 20°C	80-58 ohms (circ mil/ft) @ 68°F
	Electrical Conductivity (Annealed)	0.077-0.104 microhm ⁻¹ .cm ⁻¹ @ 20°C	13 - 18% IACS
	Temperature Coefficient of Electrical Resistance (Annealed)	0.0009 / °C @ 0 - 100°C	0.0005 / °F @ 32 - 212°F
	Modulus of Elasticity (tension)	121 GPa @ 20°C	17.6 x 10 ⁶ psi @ 68°F
	Modulus of Rigidity (torsion)	44.8 GPa @ 20°C	6.5 x 10 ⁶ psi @ 68°F
	Poisson's Ratio	0.35	0.35

FABRICATING PROPERTIES	
Cold Working Capacity	Excellent
Hot Working Capacity	Limited
Hot Working Temperature	650 - 750°C
Annealing Temperature	500 - 700°C
Stress Relieving Temperature	200 - 350°C
Machinability Rating	20% of free cutting brass
Polishing/Electroplating Finish	Good

JOINING PROPERTIES	
Soldering	Excellent
Brazing	Excellent
Oxy-Acetylene Welding	Fair
Gas Shielded Arc Welding (GTAW/TIG, GMAW/MIG)	Good
Coated Metal Arc Welding (Manual electrodes)	Fair
Resistance Welding - Spot	Good
- Seam	Fair
- Butt	Excellent



FREQUENTLY ASKED QUESTIONS ON ARCHITECTURAL COPPER PRODUCTS

Can the naturally occurring green patina of copper be accelerated by artificial chemicals?

Due to the precise temperature, humidity and chemical requirements, it is generally not recommended that copper be artificially patinated in the field. However, there are field applied pre-patination systems that, with proper training, have proven successful. Currently there are sheet copper fabricators who may provide factory and field applied pre-patination systems under controlled environments. The patina is produced using patented chemical processes which result in true patina chemical conversion coatings. Please ask Austral Wright Metals for details of these companies.

How can the original copper colour be protected from weathering after installation?

There is no permanent protection system that will protect copper from weathering. There are clear coatings that will provide short term protection for exterior applications and longer term protection for interior applications. CDA has completed an extensive test program for various clear coatings meeting low VOC (USA) Federal requirements. Please ask Austral Wright Metals for details of the findings in the report.

Can I get copper or copper alloy samples?

Austral Wright Metals can supply samples of different alloys for consideration for architectural projects.

How can the staining of materials by copper be prevented?

The natural weathering of copper results in the formation of copper salts at the surface of a copper sheet. These salts are then mixed with rain water and if allowed to run on to other materials will cause the characteristic green stains. To prevent such stains, the use of overhangs, sloping of copper surfaces away from other materials, gutters and drip edges are all recommended. The use of a clear silicone-based coating on cement surfaces is also useful to help protect the surface during the initial and most aggressive weathering of the copper.

What is galvanic corrosion and how can it be prevented?

All metals have an inherent tendency to corrode: they can be rated on a scale from noble to active. When dissimilar metals are in contact with each other in the presence of oxygen and moisture the more noble metal will accelerate the corrosion of the less noble. Copper is one of the most noble of metals and must be separated from other less noble metals. Contact between dissimilar metals should always be avoided – they should be insulated from each other. If contact cannot be avoided, the adjacent surfaces should be painted with bituminous or zinc chromate primers or paints. Tapes or gaskets with non-absorptive and non conductive materials are also effective.

Care should be taken to prevent the wash from copper surfaces onto adjacent, exposed surfaces of less noble metals, since the traces of copper salts carried in the wash can accelerate the corrosion of less noble metals.

Are sealants required with copper systems?

Most copper installations depend on self-flashed details requiring no sealants. Under some conditions, such as low roof slope situations, the use of sealants is recommended as a secondary waterproofing material. However it should be noted that copper will outlast most sealants and that in any details using sealants a regular maintenance and inspection program will become necessary. In general, butyl, polysulfide and polyurethane sealants are reasonably compatible with copper. Acrylic, neoprene and nitrile based sealants actively corrode copper. Silicone sealants have a variety of success with copper and their suitability should be verified with the manufacturer.

What is the role of solder in a copper system?

In roof and wall systems where water-tight seams are required, soldering is specified. A soldered seam will join two pieces of copper into a cohesive, watertight unit that will expand and contract as one piece. Well soldered seams are, in many cases, stronger than the original base material and will provide many years of satisfactory service.

What are the typical sizes for architectural copper products?

Copper products are available in three distinct forms: Strip, Sheet, Coil. Austral Wright Metals can supply these products in the sizes detailed in the Product Catalogue, and other sizes on application. The maximum width is 1200 mm for half hard copper, and 900 mm for soft (annealed) copper.

Why does copper change colour?

The natural weathering of copper is a direct consequence of the corrosive attack of airborne sulphur compounds. This leads to a gradual change in the surface colour until equilibrium is reached and the change is stabilised. The final colour is different and depends on the location and local weather. Salt, moisture, sunlight, orientation all can affect the final colour. In general copper changes in hue from the natural salmon through a progression of russet browns, grays and finally to the blue-green or gray-green patina.

What are the advantages of using copper flashing?

Copper flashing offers beauty, low maintenance and a long service life. Unlike most other flashing materials, copper doesn't need to be replaced when the roof is replaced.

What is the service life of copper flashing?

Copper flashing, when correctly installed, can outlast the life of a house and far outlast the life of most roof systems. A service life of over 80 years has been common to copper flashing.

Is there further information available on copper in roofing?

Please ask Austral Wright Metals for a copy of TN32 Copper in Roofing - Design and Installation, No 93 Copper in Roofing - Pocket Book, or the CDRom - Imagine Building with Copper.



Copper in Architecture

FINISHES - NATURAL WEATHERING

The natural weathering of copper to the characteristic blue-green or gray-green patina is a direct consequence of the mild corrosive attack of airborne sulphur compounds.

As natural weathering proceeds, the metal exposed to the atmosphere changes in hue from the natural salmon pink colour through a series of russet brown shades to light and dark chocolate browns and finally to the ultimate blue-green or gray-green patina.



During the initial weeks of exposure, particularly in a humid atmosphere or in areas of frequent rainfall, radical colour changes often take place with iridescent pinks, oranges and reds interspersed with brassy yellows, blues, greens and purples. During continued exposure, these interference colours fade and are replaced by relatively uniform russet brown shades, referred to as statuary or oxidized finishes.

Due to varying fabricating procedures, some mills may coat coiled or flat sheet stock with a thin coat of anti-stain oil film. This film may give rise to dark purple or black surface colourations soon after installation and exposure. This temporary colour phase is caused by the thin oil film, which is quickly washed off by rain, allowing the natural weathering of copper to proceed.

In industrial and seacoast atmospheres, the natural patina generally forms in from five to seven years. In rural atmospheres, where the quantity of air-born sulphur dioxide is relatively low, patina formation may not reach a dominant

stage for 10 to 14 years. In arid environments, the basic sulphate patina may never form, due to the lack of sufficient moisture. Similarly, exposed horizontal surfaces develop the patina more rapidly than sloping surfaces which, in turn patinate more rapidly than vertical surfaces.

The critical variable, in all instances, is the dwell time of moisture on the exposed surfaces.

The progressive oxide, sulphide and sulphate films which develop on copper exposed to the atmosphere are quite thin – 0.05 to 0.08 millimetres – and highly adherent, but with relatively

low abrasion resistance. Neither the oxide nor sulphide films are particularly corrosion resistant. The sulphate patina, on the other hand, is highly resistant to all forms of atmospheric corrosion, once it has formed completely. It thus significantly increases the durability and, hence the service life of copper roofing and flashing. The natural weathering cycle of copper is illustrated by the 12 sequential colour plates in the Weathering Chart on the next page.

Although the plates represent a typical sequence, the weathering of any installation will depend on local environmental factors, orientation and amount of residual lubricants.

The weathering of copper will reach a final equilibrium with its local environment. This state of equilibrium is very stable and no further weathering will occur after this state is reached. However, the final equilibrium colour will vary depending on orientation, slope, and local weather conditions.

COPPER WEATHERING CHART



ANTIMICROBIAL COPPER

Antimicrobial
Copper **Cu⁺**

Copper and alloys are very efficient at killing fungus, viruses and bacteria, including MRSA (methicillin-resistant Staphylococcus aureus, the so-called superbugs which inhabit our hospitals). As such Copper Development Associations around the world are marketing their possibilities for passively killing harmful microbes in hospitals, nursing homes, kindergartens, bathrooms and toilets.

Copper is best at killing the bugs, and the higher the copper content of copper alloys, the quicker the bugs are killed. Tests show that after 90 minutes, 99.999% of MRSA bugs on copper are dead.

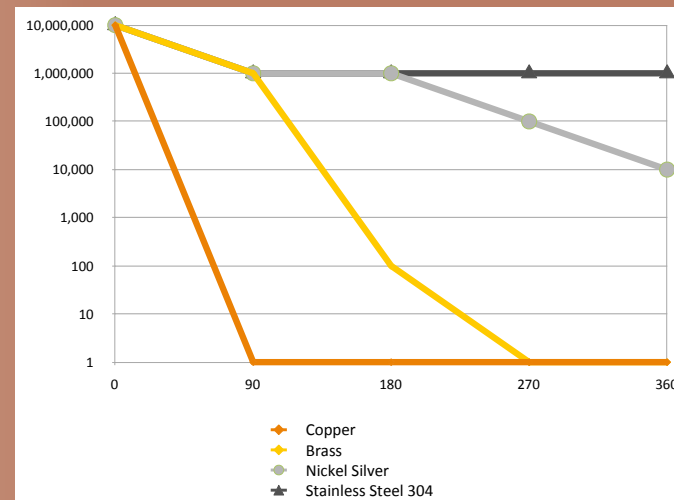
Alloys down to about 55% copper are registered as antimicrobial, but leaded free – cutting alloys are disqualified. But the higher the copper, the faster the killing.

It's the surface of the product that kills the bugs, so lacquer, wax, oil, paint etc must not be used. Even when anti microbial alloys are used, normal cleaning should still be done.

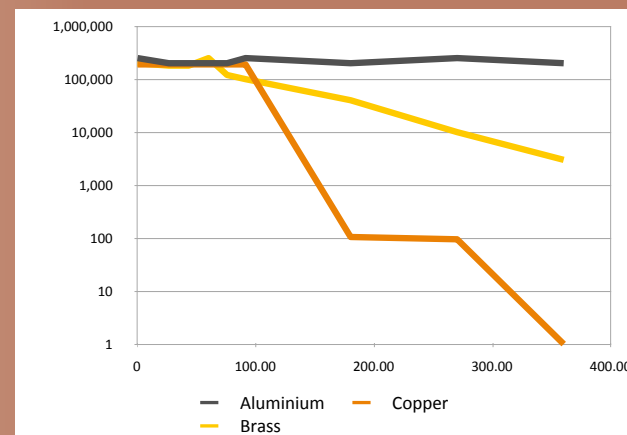
The alloys are being used for equipment such as beds, chair arms, drip stands, kick plates, door handles and plates, bench tops, sinks, toilet seats, grab rails.

Stainless steel and aluminium have no antimicrobial properties (there are some stainless steels with copper additions that claim to be antimicrobial, but with a few % of copper they are not as effective). Both rely on the sterilising solutions they are cleaned with to maintain a low microbe population. Stainless steel may look "clean", but it doesn't actively kill the bacteria.

MRSA viability on some metals at 20°C



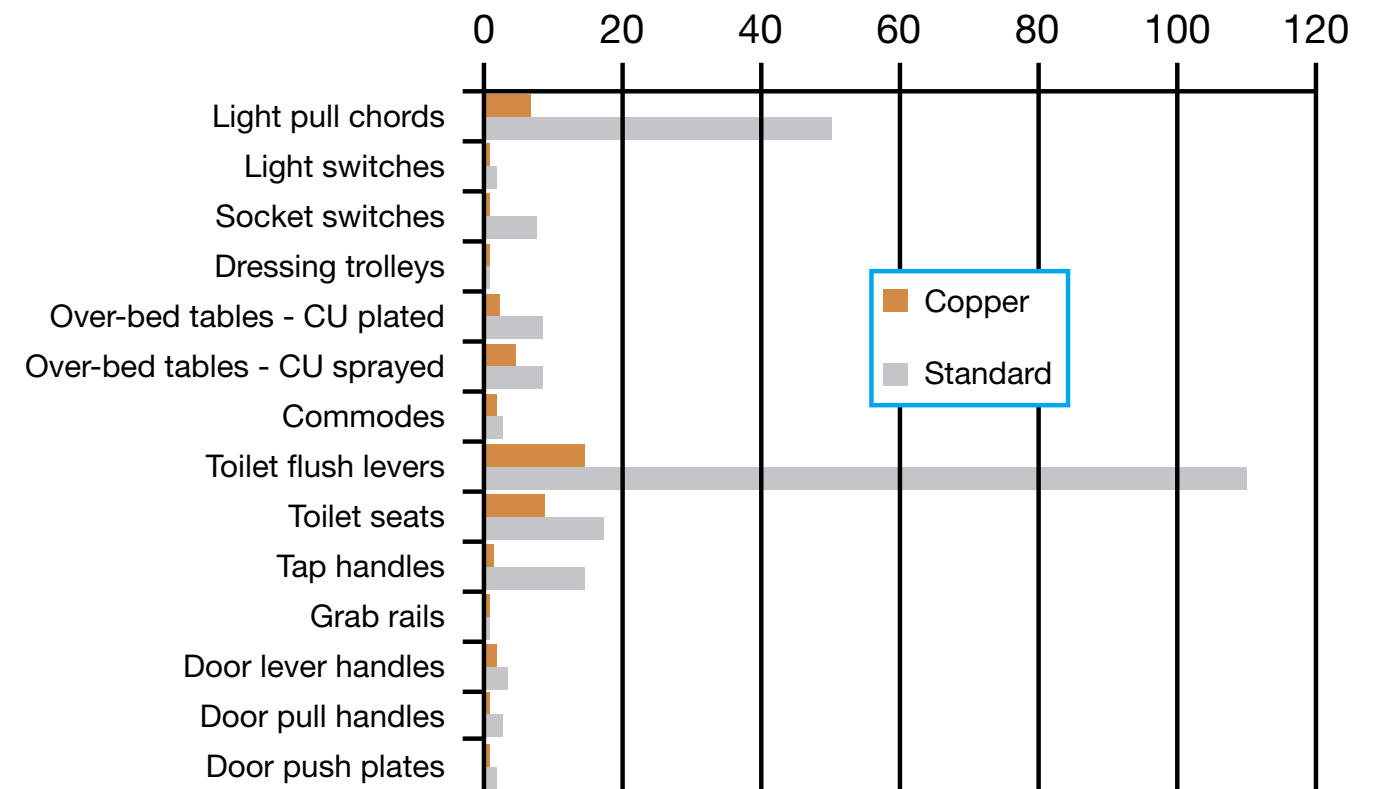
Viability of Aspergillus niger on surfaces of aluminium, brass C24000 and copper C11000 at 20°C



ANTIMICROBIAL COPPER



Median aerobic cfu per cm²



Average of 24 weekly bacterial counts in an acute medical ward in a UK hospital. Normal cleaning was maintained. The benefit of copper surfaces is clear, especially around toilets, taps and light pulls.

Other Product Catalogues Available

High Performance Alloys

Including sheet, strip, coil, bar, rod and tube

Stainless Steel

Including sheet, strip, coil, bar, rod and tube

Aluminium

Including sheet and strip