



COPPER ALLOY GUIDE

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OLIN Alloy No.	TIN BRASSES			PHOSPHORBRONZES					HIGH PERFORMANCE ALLOYS					CUPRO-NICKELS		Cu-Ni-Sn		NICKEL SILVER		
	422	425	4252	510	511	5118	521	544	638	654	688	7025	7035	706	715	725	752	762	770	
ASTM Spec. No.	B591	B591	B591	B103	B103	B103	B103	B103	B422	B96	B592	B422	B422	B122	B122	B122	B122	B122	B122	
Olin Alloy Name	Lubronze	Luballoy X	Olin 4252	5% Phos.	4% Phos.	4% Mod. Bronze	8% Phos. Bronze	8% Mod. Bronze	Lead-Bearing Phos. Bronze	Olin 638	Olin 654	Olin 688	Olin 7025	Olin 7035	10% Copper Nickel	30% Copper Nickel	Cu-Ni-Sn	65-18 Nickel Silver	59-12 Nickel Silver	55-18 Nickel Silver
Nominal Composition	Cu - 87.5 Zn - 11.5 Sn - 1	Cu - 88.5 Zn - 9.5 Sn - 2	Cu - 89.5 Zn - 8 Sn - 2.25 Ni - .13 Fe - .13 P - .03	Cu - 94.9 Zn - 5 P - 0.1	Cu - 95.9 Zn - 4 P - 0.1	Cu - 95.5 Zn - 4.2 Fe - .10 Ni - .15 P - .03	Cu - 91.9 Sn - 8 P - 0.1	Cu - 91.8 Sn - 8 Fe - .10 Ni - .10 P - .03	Cu - 89 Pb - 4 Sn - 4 Zn - 3	Cu - 95 Al - 2.8 Si - 1.8 Co - 0.4	Cu - 95.4 Si - 3.0 Sn - 1.5 Cr - 0.4	Cu - 73.5 Zn - 22.7 Al - 3.4 Co - 0.4	Cu - 96.2 Ni - 3 Si - .65 Mg - 0.15	Cu - 96.8 Ni - 1.5 Co - 1.1 Si -	Cu - 88.6 Ni - 10 Fe - 1.4	Cu - 69.4 Ni - 30 Fe - .4	Cu - 88.2 Ni - 9.5 Sn - 2.3	Cu - 65 Zn - 17 Ni - 18	Cu - 59 Zn - 29 Ni - 12	Cu - 55 Zn - 27 Ni - 18

DENSITY g / cm ³ @ 20°C (÷ 27.6799 = Lbs. / in ³)	8.80	8.77	8.80	8.86	8.86	8.89	8.80	8.80	8.89	8.28	8.55	8.19	8.80	8.82	8.94	8.94	8.89	8.75	8.58	8.69
MOD. OF ELAST. kN / mm ² , tension (÷ 6.8948 = psi X 10 ⁹)	110	110	110	110	110	110	110	110	103	115	117	116	131	131	124	152	138	124	124	124
ELECT. COND. MS / m at 20°C (68°F)32. as annealed or mill hardened	18	16.1	17	8.7	11.6	11.6	7.5	7.5	11.6	5.8	4.1	10.4	23	29	5.2	2.7	5	3.5	5	3.2
THERM. COND. W / m °K @ 20°C (68°F)	130	121	130	69	86	86	62	62	86	38	36	81	172	200	45	29	54	31	41	29
COEF OF TH. EXP. PPM / °C from 20°C to 300°C (68°F to 572°F)	18.36	18.36	18.36	17.82	17.82	17.82	18.18	18.18	17.28	17.1	17.46	18.18	17.64	17.64	17.1	16.2	16.56	16.2	16.2	16.74

TENSILE STRENGTH N / mm² (KSI = N/mm² ÷ 6.8948)

YIELD STRENGTH N / mm² (Nominal 0.2% offset or range) (KSI = N/mm² ÷ 6.8948)

ANNEALED (TM00 / AM)	285-340	285-325		315-385	315-370		385-450		310-360	530-600		530-600	620-760		295-345	360 Min	310-450	365-435	395-515	420-525	
	130	115		165	150		200		145	385		360	450-620		130	195	145	170	250	220	
1/4 HARD (TM01 / 1/4 HM)	325-395	340-405		340-420	315-400		435-515		325-405	620-705	515-620	600-695			350-460	400-495	380-515	400-495	450-560	475-600	
	260	255		255	240		330		260	565	415	525			365	325	505Max	310	360	435	
1/2 HARD (TM02 / 1/2 HM)	370-450	395-475	400-505	400-505	380-485	475-580	475-580	620-725	380-485	690-770	595-695	670-770	655-825		400-495	455-550	450-550	455-550	515-625	540-655	
	380	400	415	395	385	485	435	635	395	640	545	635	585-760		435	470	470	435	485	540	
3/4 HARD (TM03)	415-495	425-510	470-545	470-545	460-565	550-635	550-635	670-770	435-510	725-805	670-770		690-860						510-595	570-675	605-695
	440	440	490	470	495	565	530	660	455	685	635		655-825						515	565	635
HARD (TM04 / HM)	460-545	485-565	525-625	525-625	495-600	585-690	585-690	720-830	495-600	785-870	745-825	730-825	770-900		490-570	515-605	515-620	540-625	620-725	635-740	
	490	495	560	560	525	600	595	720	530	745	695	695	750-850		515	540	550	565	615	675	
EX. HD. (TM05 / SHM)	515-585	525-605	605-710	605-710	580-685	670-770	670-770	745-860	580-685	815-895	800-870	780-875			505-585	550-635	550-655	595-675	695-785	705-795	
	515	545	635	640	605	695	685	760	605	770	750	745			525	570	585	625	675	740	
SPRING (TM06 / XHM)	565-635	580-650	655-760	655-760	625-725	725-820	725-820	790-910	625-725	850-925	855-915	850-915	840-970		540-605	580-650	585-690	620-695	750-840	745-825	
	565	620	690	690	650	740	730	790	605 Min	800	805	785	810-920		525 Min	595	620	640	725	770	
EX. SPR. (TM08 / XHMS)	605 Min.	635 Min	690-785	690-785	660-750	760-840	760-840	830-965	660-750	895 Min	905-965	860 Min					620-725	660 Min	785 Min	800 Min	
	565 Min	600 Min	710	715	675	770	760	830	605 Min	820 Min	855	770 Min					655	655 Min	705 Min	795 Min	

ELONGATION Nominal % in 50 mm (= % in 2 inches)

DIAMOND PYRAMID HARDNESS Nominal-.020" gauge and over (Converted from appropriate Rockwell Hardness)

ANNEALED (TM00 / AM)	45	48		55	47		63		46	33		35	10 Min		35	30 Min	35	35	40	43
	71	71		79	75		93		70	168		66			75	88	92 Max	91	103	96
1/4 HARD (TM01 / 1/4 HM)	29	35		41	36		50		33	16	33	19			12	17	5 Min	24	35	26
	100	104		106	88		135		88	196	153	180			114	135	164 Max	110	132	137
1/2 HARD (TM02 / 1/2 HM)	16	20	20	24	21	22	37	25	19	10	23	9	7 Min		5	6	10	14	18	14
	126	126		130	120		150	220	120	206	188	200			132	150	150	137	162	168
3/4 HARD (TM03)	7	15	15	15	10	18	25	20	11	7	13		5 Min					8	10	8
	140	147		156	145		177		143	220	200							153	174	180
HARD (TM04 / HM)	4	9	10	10	7	10	21	18	6	4	6	4	4 Min		1 Min	3	3	5	4	4
	150	164		174	164		192	240	164	227	213	213			153	168	156	164	188	192
EX. HD. (TM05 / SHM)	2	6	6	4	3	6	13	12	3	3	4	2			1 Min	2	2	3	2	1 Min
	159	180		188	180		206	250	180	235	220	220			162	174	171	180	206	213
SPRING (TM06 / XHM)	2	4	4	2	3	5	6	8	4 Max	2	3	1 Min	1 Min		1 Max	1 Min	1 Min	1 Min	1 Max	1 Max
	168	188		200	188		220	260	188	235	235	227			171	177	180	188	220	220
EX. SPR. (TM08 / XHMS)	2Max	2Max	3	2	2	3	4	3	4Max	2Max	2	2Max					1 Max	2Max	1 Max	1 Max
	168 Min	188 Min		206	192		227	265	192	235 Min	227 Min						184	188 Min	220 Min	220 Min

- Alloys in White use standard English temper designations
- Alloys in Blue use standard English temper designations
- Alloys in Yellow use either temper in parenthesis ().

Olin believes the information contained herein to be reliable. However, the technical information is given by Olin without charge, and the user shall employ such information at his own discretion and risk; Olin assumes no responsibility for results obtained or damages incurred from the use of such information in whole or in part.



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OLIN Alloy No. ASTM Spec. No. Olin Alloy Name Nominal Composition	COPPERS				HIGH PERFORMANCE ALLOYS								BRASSES								Leaded Brasses	
	102 B152 Oxygen Free Copper	110 B152 ETP Copper	122 B152 DHP Copper	1093 B152 Ag Bearing Low O	151 B747 Olin 151	19020 B422 Olin 19020	19025 B422 Olin 19025	194 B465 Olin 194	195 B465 Olin 195	197 B465 Olin 197	1972 B465 Olin 1972	18080 B936 Olin 18080	210 B36 Gilding Metal	220 B36 Commercial Bronze	226 B36 Jewelry Bronze	230 B36 Red Brass	240 B36 Low Brass	260 B36 Cartridge Brass	268 B36 Yellow Brass	350 B121 Med Lead Brass	353 B121 High Lead Brass	
	Cu - Min. 99.95	Cu - Min. 99.9 Oxygen .05 max	Cu - Min. 99.9 P-.015-.040	Cu - Min. 99.9 Ag Min. 13 oz./ton	Cu - 99.9 Zr - .1	Cu - 98.4 Ni - 1 Sn - .5 P - .05	Cu - 98 Ni - 1 Sn - .9 P - .05	Cu - 97.5 Fe - 2.35 P - .03 Zn - .12	Cu - 97 Fe - 1.5 P - .18	Cu - 99 Fe - .6 P - .2 Mg - .05	Cu - 99.4 Fe - .3 P - .1 Mg - .13	Cu - 99.2 Cr - .5 Ag - .1 Fe - .08 Ti - .06 Si - .03	Cu - 95 Zn - 5	Cu - 90 Zn - 10	Cu - 87 Zn - 13	Cu - 85 Zn - 15	Cu - 80 Zn - 20	Cu - 70 Zn - 30	Cu - 66 Zn - 34	Cu - 62 Zn - 37 Pb - 1	Cu - 62 Zn - 36 Pb - 2	

DENSITY g / cm ³ @ 20°C (± 27.6799 = Lbs. / in ³)	8.94	8.91	8.94	8.91	8.94	8.91	8.91	8.91	8.91	8.83	8.83	8.86	8.86	8.80	8.77	8.75	8.66	8.53	8.47	8.47	8.47
MOD. OF ELAST. kN / mm ² , tension (± 6.8948 = psi X 10 ⁶)	117	117	117	117	121	130	130	121	119	119	119	140	117	117	117	117	110	110	103	103	103
ELECT. COND. MS / m at 20°C (68°F) as annealed	58.6	58.6	49.3	58.6	55.1	29	23.2	34.8	29	46.4	46.4	46.4	32.5	25.5	23.2	21.5	18.6	16.2	15.7	15.1	15.1
THERM. COND. W / m *K @ 20°C (68°F)	390	390	339	390	371	200	173	260	200	320	320	320	233	189	173	161	139	121	116	113	113
COEF. OF TH. EXP. PPM / °C from 20°C to 300°C (68°F to 572°F)	17.64	17.64	17.64	17.64	17.64	17.46	17.46	17.46	17.28	17.28	17.28	17.64	18	18.36	18.54	18.72	19.08	19.98	20.34	20.34	20.34

TENSILE STRENGTH N / mm² (KSI = N/mm² ÷ 6.8948)

YIELD STRENGTH N / mm² (Nominal 0.2% offset or range) (KSI = N/mm² ÷ 6.8948)

ANNEALED (TM00 / AM)	180-260 70	255-290 90			275-435 260	345-415 195	295-365 160					235-275 70	250-290 85	255-310 105	270-325 90	305-370 140	310-420 145	305-420 160	325-405 160	325-405 145	315-370 145
1/4 HARD (TM01 / 1/4 HM)	235-290 220	275-310 240			325-475 365	415-495 395						255-325 205	275-345 230	290-360 220	305-370 240	330-400 240	340-405 230	340-405 235	340-405 220	340-405 200	340-405 200
1/2 HARD (TM02 / 1/2 HM)	255-315 255	295-350 260	400-485 435	435-525 455	365-435 310	470-540 490	365-435 330	365-435 330				290-360 305	325-395 325	340-405 345	350-420 330	380-450 290	395-460 360	380-450 305	380-450 315	380-450 290	380-450 290
3/4 HARD (TM03)	285-345 295	325-385 345				515-585 530						315-385 345	360-425 370	380-450 400	395-460 380	420-490 365	440-510 425	425-495 365	425-495 415	425-495 380	425-495 380
HARD (TM04 / HM)	295-360 310	365-425 385	450-510 460	495-570 525	415-485 415	565-620 570	415-485 415	415-485 415	480-560 450 Min	345-405 365	395-455 400	415-475 425	435-495 420	470-530 420	490-560 495	470-540 460	490-560 495	470-540 460	470-540 545	470-540 540	470-540 460
EX. HD. (TM05 / SHM)	325-385 345	405-450 415	490-550 505	540-615 550	460-505 460		460-505 460	460-505 460		385-440 405	440-495 435	475-530 485	495-550 470	540-600 470	570-635 570	545-615 460	545-615 545	545-615 545	545-615 545	545-615 545	545-615 545
SPRING (TM06 / XHM)	345-400 360	440-490 455	530 Min 510 Min	580-655 600	485-525 485	605-670 605	485-525 485	485-525 485		415-470 435	475-530 470	415-570 525	540-595 495	585-640 525	625-690 595	595-655 490	595-655 580	595-655 580	595-655 580	595-655 580	595-655 580
EX. SPR. (TM08 / XHMS)	360 Min 350 Min			625-730 670	505-550 505		505-550 505	505-550 505	530-630 520 Min	420-475 440	495-550 485	540-595 540	565-620 540	615-670 540	655-715 615	620-685 605	620-685 615	620-685 615	620-685 615	620-685 615	620-685 605

ELONGATION Nominal % in 50 mm (= % in 2 inches)

DIAMOND PYRAMID HARDNESS Nominal-.020" gauge and over (Converted from appropriate Rockwell Hardness)

ANNEALED (TM00 / AM)	35	38			23	26	20 Min			45	47	40	45	50	53	52	50	56
1/4 HARD (TM01 / 1/4 HM)	23	22		25		14				47	63	61	70	69	75	82	71	48
1/2 HARD (TM02 / 1/2 HM)	20	15	7	15	17	6	17	17		30	27	28	27	26	46	42	44	48
3/4 HARD (TM03)	14	8			3					79	83	86	89	93	95	95	95	95
HARD (TM04 / HM)	9	4	5	10	7	2	7	7	8	17	12	19	14	18	30	36	28	35
EX. HD. (TM05 / SHM)	4	2	4	8	2		6	6		92	103	108	112	118	122	116	116	116
SPRING (TM06 / XHM)	3	1 Min	3	6	2	2	5	5		9	6	9	8	10	16	25	16	21
EX. SPR. (TM08 / XHMS)	3 Max 110 Min			4	2 Max 140	164	135	135	4	101	114	122	128	135	142	137	137	137
										8	5	4	6	7	4	10	19	9
										2 Max	2	4	4	2	3	7	4	6
										2 Max	1 Min	3	3	1 Min	1 Min	5	3	4
										128	145	153	162	177	184	177	177	177
										2 Max	1 Max	3 Max	2 Min	1 Max	1 Min	5 Max	1 Min	5 Max
										130	150	159	168	180	192	180	180	180

- Alloys in White use standard English temper designations
- Alloys in Blue use standard English temper designations
- Alloys in Yellow use either temper in parenthesis ().

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