



# COPPER ALLOY GUIDE

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OLIN Alloy No. ASTM Spec. No. Olin Alloy Name	TIN BRASSES			PHOSPHOR BRONZES					HIGH PERFORMANCE ALLOYS					CUPRO-NICKELS		Cu-Ni-Sn	NICKEL SILVERS			
	422 B591 Lubronze	425 B591 Lubaloy X	4252 B591 Olin 4252	510 B103 5% Phos. Bronze	511 B103 4% Phos. Bronze	5118 Phos. Bronze	521 B103 8% Phos. Bronze	5218 Phos. Bronze	544 B103 Lead-Bearing Bronze	638 B422 Olin 638	654 B96 Olin 654	688 B592 Olin 688	7025 B422 Olin 7025	7035 B422 Olin 7035	706 B122 10% Copper Nickel	715 B122 30% Copper Nickel	725 B122 Cu-Ni-Sn	752 B122 55-18 Nickel Silver	762 B122 59-12 Nickel Silver	770 B122 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 Zn - 8 P - 0.1	Cu - 91.8 Zn - 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 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 - 0.6	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 Lbs. per cu. in. at 68°F (x 27.68 = gms/cu cm at 20°C)	0.318	0.317	0.318	0.320	0.320	0.321	0.318	0.318	0.321	0.299	0.309	0.296	0.318	0.318	0.323	0.323	0.321	0.316	0.310	0.314
MOD. OF ELAST. x 10 <sup>6</sup> PSI, tension (Kgf/mm <sup>2</sup> = KSI x .7031)	16	16	16	16	16	16	16	16	15	17	17	17	19	19	18	22	20	18	18	18
ELECT. COND. % IACS at 68°F (20°C) as annealed or mill hardened	31	28	30	15	20	20	13	13	19	10	7	18	40	50	9	4.6	11	6	9	5.5
THERM. COND. BTU • ft. @ 68°F ft <sup>2</sup> •hr•°F (20°C)	75	69	75	40	50	50	36	36	50	22	21	47	100	115	26	17	31	19	24	17
COEF. OF TH. EXP. Inches/inch•°F x 10 <sup>6</sup> from 68°F to 572°F (20°C to 300°C)	10.2	10.2	10.2	9.9	9.9	9.9	10.1	10.1	9.6	9.5	9.7	10.1	9.8	9.8	9.5	9.0	9.2	9.0	9.0	9.3

## TENSILE STRENGTH x 1000 PSI (N/mm<sup>2</sup> = KSI x 6.895) x 1000 PSI (Kgf/mm<sup>2</sup> = KSI x .7031)

## YIELD STRENGTH x 1000 PSI (Nominal 0.2% offset) (N/mm<sup>2</sup> = KSI x 6.895) x 1000 PSI (Nominal 0.2% offset or range) (Kgf/mm<sup>2</sup> = KSI x .7031)

ANNEALED (TM00 / AM)	41-49 19	41-47 17		46-56 24	46-54 22		56-65 29		45-52 21	77-87 56		77-87 52	90-110 65-90		43-50 19	52 Min 28	45-65 21	53-63 25	57-75 35	61-76 32
1/4 HARD (TM01 / 1/4 HM)	47-57 38	49-59 37		49-61 37	46-58 35		63-75 48		47-59 38	90-102 82	75-90 60	87-101 76			51-67 53	58-72 47	55-75 73Max	58-72 45	65-81 52	69-87 63
1/2 HARD (TM02 / 1/2 HM)	54-65 55	57-69 58	58-73 60	58-73 57	55-70 56	69-84 70	69-84 63	90-105 92	55-70 57	100-112 93	86-101 79	97-112 92	95-120 85-110		58-72 63	66-80 68	65-80 68	66-80 63	75-91 70	78-95 78
3/4 HARD (TM03)	60-72 64	62-74 64	68-79 71	68-79 68	67-82 72	80-92 82	80-92 77	97-112 96	63-74 66	105-117 99	97-112 92		100-125 95-120					74-86 75	83-98 82	88-101 92
HARD (TM04 / HM)	67-79 71	70-82 72	76-91 81	76-91 81	72-87 76	85-100 87	85-100 86	105-120 104	72-87 77	114-126 108	108-120 101	106-120 101	112-130 109-123		71-83 75	75-88 78	75-90 80	78-91 82	90-105 89	92-107 98
EX. HD. (TM05 / SHM)	75-85 75	76-88 79	88-103 92	88-103 93	84-99 88	97-112 101	97-112 99	108-125 110	84-99 88	118-130 112	116-126 109	113-127 108			73-85 76	80-92 83	80-95 85	86-98 91	101-114 98	102-115 107
SPRING (TM06 / XHM)	82-92 82	84-94 90	95-110 100	95-110 100	91-105 94	105-119 107	105-119 106	115-132 115	91-105 88 Min	123-134 116	124-133 117	123-133 114	122-140 118-133		78-88 76 Min	84-94 86	85-100 90	90-101 93	109-122 105	108-120 112
EX. SPR. (TM08 / XHMS)	88 Min. 82 Min	92 Min 87 Min	100-114 103	100-114 96	96-109 98	110-122 112	110-122 110	120-140 120	96-109 88 Min	130 Min 119 Min	131-140 124	125 Min 112 Min					90-105 95	96 Min 95 Min	114 Min 102 Min	116 Min 115 Min

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

## ROCKWELL B HARDNESS Nominal-.020" gauge and over (Rockwell F, 30T, 15N or H<sub>v</sub> where noted)

ANNEALED (TM00 / AM)	45 72F	48 72F		55 78F	47 75F		63 86F		46 71F	33 74 (30T)		35 68F	10 Min		35 75F	30 Min 83F	35 50Max30T	35 85F	40 90F	43 87F
1/4 HARD (TM01 / 1/4 HM)	29 56	36 59		41 60	36 46		50 74		33 46	16 94	33 81	19 90			12 64	17 74	5 Min 85Max	24 62	35 73	26 75
1/2 HARD (TM02 / 1/2 HM)	16 70	20 70	20	24 72	21 67	22	37 80	25	19 67	10 96	23 92	9 95	7 Min		5 73	6 80	10 80	14 75	18 84	14 86
3/4 HARD (TM03)	7 76	15 79	15	15 82	10 78	18	25 89	20	11 77	7 98	13 95		5 Min					8 81	10 88	8 90
HARD (TM04 / HM)	4 80	9 85	10	10 88	7 85	10	21 93	18	6 85	4 99	6 97	4 97		4 Min	1 Min 81	3 86	3 82	5 85	4 92	4 93
EX. HD. (TM05 / SHM)	2 83	6 90	6	4 92	3 90	6	13 96	12	3 90	3 100	4 98	2 98			1 Min 84	2 88	2 87	3 90	2 96	1 Min 97
SPRING (TM06 / XHM)	2 86	4 92	4	2 95	3 92	5	6 98	5	4 Max 92	2 100	3 100	1 Min 99		1 Min	1 Max 87	1 Min 89	1 Min 90	1 Min 92	1 Max 98	1 Max 98
EX. SPR. (TM08 / XHMS)	2Max 86 Min	2Max 92 Min	3	2 96	2 93	3	4 99	3	4Max 93	2Max 100 Min	2 101	2Max 99 Min					1Max 91	2Max 92 Min	1Max 98 Min	1Max 98 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	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	19020 B422 Olin	19025 B422 Olin	194 B465 Olin	195 B465 Olin	197 B465 Olin	1972 B465 Olin	18080 B936 Olin	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	
Nominal Composition	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 - .5 P - .05	Cu - 98 Ni - 1 Sn - .9 P - .05	Fe - 97.5 Ni - 1 Fe - 2.35 Zn - .12	Cu - 97 Fe - 1.5 P - .18 Sn - .6	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 Lbs. per cu. in. at 68°F (x 27.68 = gms/cu cm at 20°C)	0.323	0.322	0.323	0.322	0.323	0.322	0.322	0.322	0.322	0.319	0.319	0.320	0.320	0.318	0.317	0.316	0.313	0.308	0.306	0.306	0.306
MOD. OF ELAST. x 10 <sup>6</sup> PSI, tension (Kgf/mm <sup>2</sup> = KSI x .7031)	17	17	17	17	17	18.8	18.8	17	17	17	17	20.3	17	17	17	17	16	16	15	15	15
ELECT. COND. % IACS at 68°F (20°C) as annealed	101	101	85	101	95	50	40	60	50	80	80	80	56	44	40	37	32	28	27	26	26
THERM. COND. BTU • ft. @ 68°F ft <sup>2</sup> •hr•°F (20°C)	226	226	196	226	208	115	100	150	115	185	185	185	135	109	100	92	81	70	67	67	67
COEF. OF TH. EXP. Inches/inch•°F x 10 <sup>-6</sup> from 68°F to 572°F (20°C to 300°C)	9.8	9.8	9.8	9.8	9.8	9.7	9.7	9.7	9.6	9.6	9.6	9.8	10	10.2	10.3	10.4	10.6	11.1	11.3	11.3	11.3

## TENSILE STRENGTH

x 1000 PSI (N/mm<sup>2</sup> = KSI x 6.895)  
x 1000 PSI (Kgf/mm<sup>2</sup> = KSI x .7031)

## YIELD STRENGTH

x 1000 PSI (Nominal 0.2% offset) (N/mm<sup>2</sup> = KSI x 6.895)  
x 1000 PSI (Nominal 0.2% offset or range) (Kgf/mm<sup>2</sup> = KSI x .7031)

ANNEALED (TM00 / AM)	26-38 10				37-42 13			40-63 38	50-60 28	43-53 23			34-40 10	36-42 12	37-45 15	39-47 13	44-54 20	45-61 21	44-61 23	47-59 23	46-54 21
1/4 HARD (TM01 / 1/4 HM)	34-42 32				40-45 35		47-69 53	60-72 57					37-47 30	40-50 33	42-52 32	44-54 35	48-58 29	49-59 33	49-59 34	49-59 32	49-59 29
1/2 HARD (TM02 / 1/2 HM)	37-46 37				43-51 38	58-70 63	63-76 66	53-63 45	68-78 71	53-63 48	56-63 48		42-52 44	47-57 47	49-59 50	51-61 48	55-65 42	57-67 51	55-65 44	55-65 46	55-65 42
3/4 HARD (TM03)	41-50 43				47-56 50			75-85 77					46-56 50	52-62 54	55-65 58	57-67 55	61-71 53	64-74 62	62-72 53	62-72 60	62-72 55
HARD (TM04 / HM)	43-52 45				53-62 56	65-74 67	72-83 76	60-70 60	82-90 83	60-70 60	60-70 60	70-81 65 Min	50-59 53	57-66 58	60-69 62	63-72 61	68-77 61	71-81 72	68-78 57	68-78 68	68-78 67
EX. HD. (TM05 / SHM)	47-56 50				59-65 60	71-80 73	78-89 80	67-73 67		67-73 67	67-73 67		56-64 59	64-72 63	69-77 70	72-80 68	78-87 68	83-92 83	79-89 67	79-89 79	79-89 78
SPRING (TM06 / XHM)	50-58 52				64-71 66	77 Min 74 Min	84-95 87	70-76 70	88-97 88	70-76 70			60-68 63	69-77 68	75-83 76	78-86 72	85-93 76	91-100 86	86-95 71	86-95 84	86-95 84
EX. SPR. (TM08 / XHMS)	52 Min 51 Min						91-106 97	73-80 73		73-80 73			61-69 64	72-80 70	78-86 78	82-90 76	89-97 78	95-104 89	90-99 73	90-99 89	90-99 88

## ELONGATION

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

## ROCKWELL B HARDNESS

Nominal-.020" gauge and over (Rockwell F, 30T, 15N or H, where noted)

ANNEALED (TM00 / AM)	35				38 49F			23	26	20 Min			45 45F	47 65F	40 64F	45 71F	50 70F	53 75F	52 75F	50 80F	56 72F
1/4 HARD (TM01 / 1/4 HM)	23 72F				22 32		25		14				30 36	27 41	28 44	27 47	26 51	46 52	42 52	44 52	48 52
1/2 HARD (TM02 / 1/2 HM)	20 83F				15 37	7 15	15	17	6	17	17		17 50	12 58	19 61	14 63	18 66	30 68	36 65	28 65	35 65
3/4 HARD (TM03)	14 86F				8 47			3					9 57	6 64	9 68	8 71	10 74	16 77	25 75	16 75	21 75
HARD (TM04 / HM)	9 89F				4 57	5	10	7	2	7	7	8	5 62	4 70	6 73	7 76	4 80	10 82	19 80	9 80	12 80
EX. HD. (TM05 / SHM)	4 91F				2 60	4	8	2		6	6		2 Max 68	2 75	4 81	4 86	2 88	3 88	7 86	4 86	6 86
SPRING (TM06 / XHM)	3 94F				1 Min 62 Min	3	6	2	2	5			2 Max 71	1 Min 78	3 81	3 84	1 Min 89	1 Min 91	5 89	3 89	4 89
EX. SPR. (TM08 / XHMS)	3 Max 92 MinF						4	2 Max		1 Min			2 Max 72	1 Max 80	3 Max 83	2 Min 86	1 Max 90	1 Min 93	5 Max 90	1 Min 90	5 Max 90

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