

# COPPER ALLOY GUIDE

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Olin Brass Alloy No.	COPPERS				HIGH PERFORMANCE ALLOYS								BRASSES						LEADED BRASSES		
	102	110	122	1092	151	19020	19025	194	195	197	1972	18080	210	220	226	230	240	260	268	350	353
ASTM Spec. No.	B152	B152	B152	B152	B747	B422	B422	B465	B465	B465	B465	B936	B36	B36	B36	B36	B36	B36	B36	B121	B121
Olin Brass Alloy Name	Oxygen Free Copper	ETP Copper	DHP Copper	Low O ETP Copper	Olin Brass 151	Olin Brass 19020	Olin Brass 19025	Olin Brass 194	Olin Brass 195	Olin Brass 197	Olin Brass 1972	Olin Brass 18080	Gilding Metal	Commercial Bronze	Jewelry Bronze	Red Brass	Low Brass	Cartridge Brass	Yellow Brass	Med. Lead Brass	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 Oxygen .02 max	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 Co - .8 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 - .03 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>3</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>4</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

## YIELD STRENGTH

	x 1000 PSI (N/mm <sup>2</sup> = KSI x 6.895) x 1000 PSI (Kgf/mm <sup>2</sup> = KSI x .7031)								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	37-42			40-63	50-60	43-53			34-40	36-42	37-45	39-47	44-54	45-61	44-61	47-59	46-54
1/4 HARD (TM01 / 1/4 HM)	34-42	40-45		47-69		60-72				37-47	40-50	42-52	44-54	48-58	49-59	49-59	49-59	49-59
1/2 HARD (TM02 / 1/2 HM)	37-46	43-51	58-70	63-76	53-63	68-78	53-63	56-63		42-52	47-57	49-59	51-61	55-65	57-67	55-65	55-65	55-65
3/4 HARD (TM03)	41-51	47-56				75-85				46-56	52-62	55-65	57-67	61-71	64-74	62-72	62-72	62-72
HARD (TM04 / HM)	43-52	53-62	65-74	72-83	60-70	82-90	60-70	60-70	70-81	50-59	57-66	60-69	63-72	68-77	71-81	68-78	68-78	68-78
EX. HD. (TM05 / SHM)	47-56	59-65	71-80	78-89	67-73		67-73	67-73		56-64	64-72	69-77	72-80	78-87	83-92	79-89	79-89	79-89
SPRING (TM06 / XHM)	50-58	64-71	77 Min	84-95	70-76	88-97	70-76			60-68	69-77	75-83	78-86	85-93	91-100	86-95	86-95	86-95
EX. SPR. (TM08 / XHMS)	52 Min			91-106	73-80		73-80		78-91	61-69	72-80	78-86	82-90	89-97	95-104	90-99	90-99	90-99

## ELONGATION

## ROCKWELL B HARDNESS

	Nominal % in 2 inches (= % in 50mm)								Nominal-.020" gauge and over (Rockwell F, 30T, 15N or H, where noted)									
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				30	27	28	27	26	46	42	44	48
1/2 HARD (TM02 / 1/2 HM)	20	15	7	15	17	6	17	17		17	12	19	14	18	30	36	28	35
3/4 HARD (TM03)	14	8				3				9	6	9	8	10	16	25	16	21
HARD (TM04 / HM)	9	4	5	10	7	2	7	7	8	5	4	6	7	4	10	19	9	12
EX. HD. (TM05 / SHM)	4	2	4	8	2		6	6		2 Max	2	4	4	2	3	7	4	6
SPRING (TM06 / XHM)	3	1 Min	3	6	2	2	5			2 Max	1 Min	3	3	1 Min	1 Min	5	3	4
EX. SPR. (TM08 / XHMS)	3 Max			4	2 Max		1 Min		4	2 Max	1 Max	3 Max	2 Min	1 Max	1 Min	5 Max	1 Min	5 Max

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

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	TIN BRASSES			PHOSPHOR BRONZES			HIGH PERFORMANCE ALLOYS						CUPRO-NICKELS			Cu-Ni-Sn	NICKEL SILVERS		
Olin Brass Alloy No.	422	425	4252	510	511	5118	638	654	655	688	7025	7035	706	710	715	725	752	762	770
ASTM Spec. No.	B591	B591	B591	B103	B103	B103	B422	B96	B96	B592	B422	B422	B122	B122	B122	B122	B122	B122	B122
Olin Brass Alloy Name	Lubronze	Lubaloy X	Olin Brass 4252	5% Phos. Bronze	4% Phos. Bronze	4% Adv. Phos. Bronze	Olin Brass 638	Olin Brass 654	High Silver Bronze	Olin Brass 688	Olin Brass 7025	Olin Brass 7035	10% Copper Nickel	20% 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 Sn - 5 P - 0.1	Cu - 95.9 Sn - 4 P - 0.1	Cu - 95.5 Sn - 4.2 Fe - .10 Ni - .15 P - .03	Cu - 95 Al - 2.8 Si - 1.8 Co - 0.4	Cu - 95.4 Si - 3.0 Sn - 1.5 Cr - 0.4	Cu - 97.0 Si - 3.0 Sn - .09	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 Fe - .08 Si - 0.6	Cu - 88.6 Ni - 10 Fe - 1.4	Cu - 79 Ni - 20 Fe - .5	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	0.299	0.309	0.308	0.296	0.318	0.318	0.323	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	17	17	15	17	19	19	18	20	22	20	18	18	18
ELECT. COND. % IACS at 68°F (20°C) as annealed or mill hardened	31	28	30	15	20	20	10	7	7	18	40	50	9	6.5	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	20	22	21	21	47	100	115	26	21	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	9.5	9.7	10.0	10.1	9.8	9.8	9.5	9.1	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	41-47		46-56	46-54		77-87			77-87	90-110		43-50	43-53	52 Min	45-65	53-63	57-75	61-76
	19	17		24	22		56			52	65-90		19	21	28	21	25	36	32
1/4 HARD (TM01 / 1/4 HM)	47-57	49-59		49-61	46-58		90-102	75-90	60-74	87-101			51-67	47-63	58-72	55-75	58-72	65-81	69-87
	38	37		37	35		82	60	40	76			53	40	47	73 Max	45	52	63
1/2 HARD (TM02 / 1/2 HM)	54-65	57-69	58-73	58-73	55-70	69-84	100-112	86-101	72-86	97-112	95-120		58-72	56-70	66-80	65-80	66-80	75-91	78-95
	55	58	60	57	56	70	93	79	45	92	85-110		63	57	68	68	63	70	78
3/4 HARD (TM03)	60-72	62-74	68-79	68-79	67-82	80-92	105-117	97-112			100-125						74-86	83-98	88-101
	64	64	71	68	72	82	99	92			95-120						75	82	92
HARD (TM04 / HM)	67-79	70-82	76-91	76-91	72-87	85-100	114-126	108-120	85-99	106-120		112-130	71-83	67-79	75-88	75-90	78-91	90-105	92-107
	71	72	81	81	76	87	108	101	80	101		109-123	75	70	78	80	82	89	98
EX. HD. (TM05 / SHM)	75-85	76-88	88-103	88-103	84-99	97-112	118-130	116-126	95-109	113-127	67-73		73-85	72-84	80-92	80-95	86-98	101-114	102-115
	75	79	92	93	88	101	112	109	93	108	67		76	75	83	85	91	98	107
SPRING (TM06 / XHM)	82-92	84-94	95-110	95-110	91-105	105-119	123-134	124-133	102-116	123-133		122-140	78-88		84-94	85-100	90-101	109-122	108-120
	82	90	100	100	74 Min.	107	116	117	100	114		118-133	76 Min		86	90	93	105	112
EX. SPR. (TM08 / XHMS)	88 Min.	92 Min	100-114	100-114	96-109	110-122	130 Min	131-140		125 Min						90-105	96 Min	114 Min	116 Min
	82 Min	87 Min	103	104	98	112	119 Min	124		112 Min						95	95 Min	102 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	48		55	47		33			35	10 Min		35	40	30 Min	35	35	40	43
	72F	72F		78F	75F		74 (30T)			68F			75F		83F	50Max30T	85F	90F	87F
1/4 HARD (TM01 / 1/4 HM)	29	35		41	36		16	33	30	19			12	15	5 Min	17	24	35	26
	56	59		60	46		94	81	72	90			64	58	74	85 Max	62	73	75
1/2 HARD (TM02 / 1/2 HM)	16	20	20	24	21	22	10	23	17	9	7 Min		5	5	6	10	14	18	14
	70	70		72	72		96	92	85	95			73	71	80	80	75	84	86
3/4 HARD (TM03)	7	15	15	15	10	18	7	13			5 Min						8	10	8
	76	79		82	78		98	95									81	88	90
HARD (TM04 / HM)	4	9	10	10	7	10	4	6	8	4		4 Min	1 Min	2	3	3	5	4	4
	80	85		88	85		99	97	92	97			81	80	86	82	85	92	93
EX. HD. (TM05 / SHM)	2	6	6	4	3	6	3	4	6	2			1 Min	1 Min	4	2	3	2	1 Min
	83	90		92	90		100	98	94	98			84	83	88	87	90	96	97
SPRING (TM06 / XHM)	2	4	4	2	3	5	2	3	4	1 Min		1 Min	1 Max		1 Min	1 Min	1 Min	1 Max	1 Max
	86	92		95	92		100	100	97	99			87		89	90	92	98	98
EX. SPR. (TM08 / XHMS)	2 Max	2 Max	3	2	2	3	2 Max	2		2 Max						1 Max	2 Max	1 Max	1 Max
	86 Min	92 Min		96	93		100 Min	101		99 Min						91	92 Min	98 Min	98 Min

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