



COPPER ALLOY GUIDE

NOTE: This information is presented for alloy comparison purposes and is not intended for use as purchasing specifications

OLIN Alloy No. ASTM Spec. No.	COPPERS				HIGH PERFORMANCE ALLOYS					BRASSES						LEADED BRASSES		TIN BRASSES			
	102 B152	110 B152	122 B152	1093 B152	151 B747	19025 B422	194 B465	195 B465	197 B465	210 B36	220 B36	226 B36	230 B36	240 B36	260 B36	268 B36	350 B121	353 B121	411 B591	422 B591	425 B591
OLIN ALLOY NAME AND NOMINAL COMPOSITION	Oxygen Free Copper 99.95 Cu Min.	ETP Copper 99.90 Cu Min. .05 Oxygen Max	Deoxidized Copper (DHP) 99.9 Cu Min .015-.040 P	Silver Bearing Low Oxygen Copper 13 oz/ton Ag Min	Olin 151 99.9 Cu .1 Zn	Olin 19025 98.1 Cu 1Ni .9 Sn .05 P NEW	Olin 194 97.5 Cu 2.35 Fe .03 P .12 Zn	Olin 195 97 Cu 1.5 Fe .18 P .8 Co .6 Sn	Olin 197 99 Cu .6 Fe .2 P .05 Mg	Sliding Metal 95 Cu 5 Zn	Commercial Bronze 90 Cu 10 Zn	Jewelry Bronze 87 Cu 13 Zn	Red Brass 85 Cu 15 Zn	Low Brass 80 Cu 20 Zn	Cartridge Brass 70 Cu 30 Zn	Yellow Brass 66 Cu 34 Zn	Medium-Leaded Brass 62 Cu 37 Zn 1 Pb	High Leaded Brass 62 Cu 36 Zn 2 Pb	Luballoy 91 Cu 8 Zn .5 Sn	Lubronze 87.5 Cu 11.5 Zn 1 Sn	Luballoy X 88.5 Cu 9.5 Zn 2 Sn

DENSITY Lbs. per cu In. at 68°F (x 27.68 = gms/cu cm at 20°C)	.323	.322	.323	.322	.323	.322	.322	.322	.319	.320	.318	.317	.316	.313	.308	.306	.306	.306	.318	.318	.317
MOD. OF ELAST. x 10 ⁶ PSI, tension (Kgf/mm ² = KSI x .7031)	17	17	17	17	17	18.8	17	17	17	17	17	17	17	16	16	15	15	15	16	16	16
ELECT. COND. % IACS at 68°F (20°C) as annealed	101	101	85	101	95	40	60	50	80	56	44	40	37	32	28	27	26	26	32	31	28
THERM. COND. BTU • ft. @ 68°F ft ² • hr • °F (20°C)	226	226	196	226	208	100	150	115	185	135	109	100	92	81	70	67	67	67	75	75	69
COEF. OF TH. EXP. Inches/inch°F x 10 ⁻⁶ 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	9.6	9.6	10.0	10.2	10.3	10.4	10.6	11.1	11.3	11.3	11.3	10.2	10.2	10.2

TENSILE STRENGTH

x 1000 PSI (N/mm² = KSI x 6.895)
x 1000 PSI (Kgf/mm² = KSI x .7031)

YIELD STRENGTH

x 1000 PSI (Nominal 0.2% offset) (N/mm² = KSI x 6.895)
x 1000 PSI (Nominal 0.2% offset) (Kgf/mm² = KSI x .7031)

ANNEALED	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	38-44	41-49	41-47
	10	13	38	28	23	10	12	15	13	20	21	23	23	21	14	19	17
1/4 HARD	34-42	40-45	60-72	60-72	60-72	37-47	40-50	42-52	44-54	48-58	49-59	49-59	49-59	49-59	42-54	47-57	49-59
	32	35	57	57	57	30	33	32	35	29	33	34	32	29	35	38	37
1/2 HARD	37-46	43-51	63-76	53-63	68-78	53-63	42-52	47-57	49-59	51-61	55-65	57-67	55-65	55-65	49-60	54-65	57-6
	37	38	68	45	71	48	44	47	50	48	42	51	44	46	49	55	58
3/4 HARD	41-50	47-56	75-85	75-85	75-85	46-56	52-62	55-65	57-67	61-71	64-74	62-72	62-72	62-72	55-66	60-72	62-74
	43	50	77	77	77	50	54	58	55	53	62	53	60	55	58	64	64
HARD	43-52	53-62	72-83	60-70	82-90	60-70	50-59	57-66	60-69	63-72	68-77	71-81	68-78	68-78	61-72	67-79	70-82
	45	56	76	60	83	60	53	58	62	61	61	72	57	68	67	64	71
EX. HD.	47-56	59-65	78 Min.	67-73	67-73	56-64	64-72	69-77	72-80	78-87	83-92	79-89	79-89	79-89	67-78	75-85	76-88
	50	60	75 Min.	67	67	59	63	70	68	68	83	67	79	78	70	75	79
SPRING	50-58	64-71	70-76	88-97	70-76	60-68	69-77	75-83	78-86	85-93	91-100	86-95	86-95	86-95	73-83	82-92	84-94
	52	66	70	88	70	63	68	76	72	76	86	71	84	84	75	82	90
EX. SPR.	52 Min		73-80	70-78	61-69	72-80	78-86	82-90	89-97	95-104	90-99	90-99	90-99	90-99	78 Min	88 Min.	92 Min
	51 Min		73	74	64	70	78	76	78	89	73	89	88	75 Min	82 Min	87 Min	

ELONGATION

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

ROCKWELL B HARDNESS

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

ANNEALED	35	38	23	26	20 Min.	45	47	40	45	50	53	52	50	56	45	43	48
		49F				45F	65F	64F	71F	70F	75F	75F	80F	72F	61F	68F	72F
1/4 HARD	23	22	14		30	27	28	27	26	46	42	44	48	34	23	35	
	72F	32	71		36	41	44	47	51	52	52	52	52	47	56	59	
1/2 HARD	20	15	17	17	6	17	17	12	19	14	18	30	36	28	13	16	20
	83F	37	59	78	66	50	58	61	63	66	68	65	65	65	61	70	70
3/4 HARD	14	8		3		9	6	9	8	10	16	25	16	21	7	7	15
	86F	47		81		57	64	68	71	74	77	75	75	75	69	76	79
HARD	9	4	9	7	2	7	5	4	6	7	4	10	19	9	12	6	9
	89F	57	71	83	69	62	70	73	76	80	82	80	80	74	80	85	
EX. HD.	4	2	6	2	6	2 Max	2	4	4	2	3	7	4	6	4	2	6
	91F	60	74		72	68	75	78	81	86	88	86	86	86	79	83	90
SPRING	3	1 Min	2	2	5	2 Max	1 Min	3	3	1 Min	1 Min	5	3	4	3	2	4
	94F	62 Min	76	85	74	71	78	81	84	89	91	89	89	89	82	86	92
EX. SPR.	3 Max		2 Max		1 Min.	2 Max	1 Max	3 Max	2 Min	1 Max	1 Min	5 Max	1 Min	5 Max	2 Max	2 Max	2 Max
	92 MinF		77		75	72	80	83	86	90	93	90	90	90	80 Min	86 Min	92 Min

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COPPER ALLOY GUIDE

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OLIN Alloy No. ASTM Spec. No.	PHOSPHOR BRONZES				HIGH PERFORMANCE ALLOYS					CUPRO-NICKELS		Cu-Ni-Sn	NICKEL SILVER			BERYLLIUM COPPERS			
	510 B103	511 B103	521 B103	544 B103	638 B422	654 B96	663 B591 NEW	688 B592	7025 B422	706 B122	715 B122	725 B122	752 B122	762 B122	770 B122	17510 B534	170 B194	172 B194	186 NEW
OLIN ALLOY NAME AND NOMINAL COMPOSITION	Phosphor Bronze 5% 94.9 Cu 5 Sn 0.1 P Grade A	Phosphor Bronze 4% 95.9 Cu 4 Sn 0.1 P	Phosphor Bronze 8% 91.9 Cu 8 Sn 0.1 P Grade C	Lead Bearing Bronze 89 Cu 4 Pb 4 Sn 3 Zn Grade B-2	Olin 638 95.0 Cu 2.8 Al 1.8 Si 0.4 Co	Olin 654 95.4 Cu 3.0 Si 1.5 Sn 0.1 Cr	Olin 663 86 Cu 9.85 Zn 2.25 Sn 1.9 Fe	Olin 688 73.5 Cu 22.7 Zn 3.4 Al 0.4 Co	Olin 7025 96.2 Cu 3.0 Ni .65 Si .15 Mg	Copper Nickel 10% 88.6 Cu 10 Ni 1.4 Fe	Copper Nickel 30% 69.4 Cu 30 Ni 0.6 Fe	Copper Nickel-Tin Alloy 88.2 Cu 9.5 Ni 2.3 Sn	Nickel Silver 65-18 65 Cu 17 Zn 18 Ni	Nickel Silver 59-12 59 Cu 29 Zn 12 Ni	Nickel Silver 55-18 55 Cu 27 Zn 18 Ni	Beryllium Copper 97.8 Cu 1.8 Ni .4 Be	Beryllium Copper 98.3 Cu 1.7 Be	Beryllium Copper 98.1 Cu 1.9 Be	Olin 186 Cu - Fe - Cr - Ti - Zr

DENSITY Lbs. per cu. in. at 68°F (x 27.68 = gms/cu cm at 20°C)	.320	.320	.318	.321	.299	.309	.317	.296	.318	.323	.323	.321	.316	.310	.314	.319	.304	.302	.320
MOD. OF ELAST. x 10 ⁶ PSI, tension (Kgf/mm ² = KSI x .7031)	16	16	16	15	17	17	18	17	19	18	22	20	18	18	18	20	19	19	18.5
ELECT. COND. % IACS at 68°F (20°C) as annealed or mill hardened	15	20	13	19	10	7	25	18	40	9	4.6	11	6	9	5.5	45	20	20	70
THERM. COND. BTU • ft. @ 68°F ft ² • hr • °F (20°C)	40	48.4	36	50	22	21	62	47	100	26	17	31	19	24	17	100	45	45	162
COEF. OF TH. EXP. Inches/inch°F x 10 ⁶ from 68°F to 572°F (20°C to 300°C)	9.9	9.9	10.1	9.6	9.5	9.7	9.9	10.1	9.8	9.5	9.0	9.2	9.0	9.0	9.3	9.8	9.7	9.7	9.8

TENSILE STRENGTH

x 1000 PSI (N/mm² = KSI x 6.895)
x 1000 PSI (Kgf/mm² = KSI x .7031)

YIELD STRENGTH

x 1000 PSI (Nominal 0.2% offset) (N/mm² = KSI x 6.895)
x 1000 PSI (Nominal 0.2% offset or range) (Kgf/mm² = KSI x .7031)

ANNEALED (TM00 / AM)	46-56	46-54	56-65	45-52	77-87	75-90	77-87	90-110	43-50	52 Min	45-65	53-63	57-75	61-76	100-130	100 Min	100 Min	
1/4 HARD (TM01 / 1/4 HM)	49-61	46-58	63-75	47-59	90-102	75-90	87-101	65-90	19	28	21	25	36	32	80-110	70-95	70-95	
1/2 HARD (TM02 / 1/2 HM)	58-73	55-70	69-84	55-70	100-112	86-101	58-73	95-120	58-72	66-80	65-80	66-80	75-91	78-95		120 Min	120 Min	70-90
3/4 HARD (TM03)	68-79	67-82	80-92	63-74	105-117	97-112		100-125				74-86	83-98	88-101				
HARD (TM04 / HM)	76-91	72-87	85-100	72-87	114-126	108-120	76-91	95-120	71-83	75-88	75-90	78-91	90-105	92-107	110-140	135 Min	135 Min	75-95
EX. HD. (TM05 / SHM)	88-103	84-99	97-112	84-99	118-130	116-126	88-103	113-127	73-85	80-92	80-95	86-98	101-114	102-115		150 Min	150 Min	
SPRING (TM06 / XHM)	95-110	91-105	105-119	91-105	123-134	124-133	95-110	123-133	78-88	84-94	85-100	90-101	109-122	108-120	120-150	160 Min	160 Min	
EX. SPR. (TM08 / XHMS)	100-114	96-109	110-122	96-109	130 Min	131-140	100-114	125 Min			90-105	96 Min	114 Min	116 Min		—	175 Min	85-105

ELONGATION

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

ROCKWELL B HARDNESS

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

ANNEALED (TM00 / AM)	55	47	63	46	33		35	10 Min	35	30 Min	35	35	40	43	10 Min	18 Min	18 Min	
1/4 HARD (TM01 / 1/4 HM)	41	36	50	33	16	33	19		12	17	5 Min	24	35	26		15 Min	16 Min	
1/2 HARD (TM02 / 1/2 HM)	24	21	37	19	10	23	20 Min	9	7 Min	5	6	10	14	18	14	12 Min	14 Min	8
3/4 HARD (TM03)	15	10	25	11	7	13		5 Min				8	10	8				
HARD (TM04 / HM)	10	7	21	6	4	6	17	4	1 Min	3	3	5	4	4	8 Min	9 Min	11 Min	6
EX. HD. (TM05 / SHM)	4	3	13	3	3	4	8	2	1 Min	2	2	3	2	1 Min		9 Min	10 Min	
SPRING (TM06 / XHM)	2 Min	3	6	4 Max	2	3	6	1 Min	1 Max	1 Min	1 Min	1 Min	1 Max	1 Max	1 Min	4 Min	5 Min	
EX. SPR. (TM08 / XHMS)	2	2	4	4 Max	2 Max	2	3	2 Max			1 Max	2 Max	1 Max	1 Max		—	3 Min	2

- 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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