



COPPER ALLOY GUIDE

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OLIN Alloy No.	COPPERS				HIGH PERFORMANCE ALLOYS								BRASSES								LEADED BRASSES	
	102	110	122	1093	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	B465	B36	B36	B36	B36	B36	B36	B36	B121	B121	
Olin Alloy Name	Oxygen Free Copper	ETP Copper	DHP Copper	Ag Bearing Low O Copper	Olin 151	Olin 19020	Olin 19025	Olin 194	Olin 195	Olin 197	Olin 1972	Olin 18080	Gliding 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 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 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 - .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 ⁶ PSI, tension (Kgf/mm ² = 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 ² • 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 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	9.7	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/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 (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)	10	13			38	28	23			10	12	15	13	20	21	23	23	21
1/2 HARD (TM02 / 1/2 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
3/4 HARD (TM03)	32	35			53	57				30	33	32	35	29	33	34	32	29
HARD (TM04 / 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
EX. HD (TM05 / SHM)	37	38	63	66	45	71	48	48		44	47	50	48	42	51	44	46	42
EX. SPRING (TM06 / XHM)	41-50	47-56			75-85					45-56	52-62	55-65	57-67	61-71	64-74	62-72	62-72	62-72
EX. SPRING (TM08 / XHMS)	43	50			77					50	54	58	55	53	62	53	60	55
	43-52	53-62	65-74	72-83	60-70	82-90	60-70	60-70	71-81	50-59	57-66	60-69	63-72	68-77	71-81	68-78	68-78	68-78
	45	56	67	76	60	83	60	60	70	53	58	62	61	61	72	57	68	67
	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
	50	60	73	80	67	67	67			59	63	70	68	68	83	67	79	78
	50-58	64-71	77 Min	84-95	70-76	88-97	70-76	70-76		60-68	69-77	75-83	78-86	85-93	91-100	86-95	86-95	86-95
	52	66	74 Min	87	70	88	70	70		63	68	76	72	76	86	71	84	84
	52 Min				91-106	73-80	73-80		77-87	61-69	72-80	78-86	82-90	89-97	95-104	90-99	90-99	90-99
	51 min				97	73	73		80	64	70	78	76	78	89	73	89	88

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

ROCKWELL B HARDNESS 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)		49F					45F			45F	65F	64F	71F	70F	75F	75F	80F	72F
1/2 HARD (TM02 / 1/2 HM)	23	22	25		14					30	27	28	27	26	46	42	44	48
3/4 HARD (TM03)	72F	32			71					36	41	44	47	51	52	52	52	52
HARD (TM04 / HM)	20	15	7	15	17	6	17	17		17	12	19	14	18	30	36	28	35
EX. HD (TM05 / SHM)	83F	37			59	78	66	68		50	58	61	63	66	68	65	65	65
EX. SPRING (TM06 / XHM)	14	8			3					9	6	9	8	10	16	25	16	21
EX. SPRING (TM08 / XHMS)	86F	47			81					57	64	68	71	74	77	75	75	75
	9	4	5	10	7	2	7	7	8	5	4	6	7	4	10	19	9	12
	89F	57			71	83	69	69		62	70	73	76	80	82	80	80	80
	4	2	4	8	2		6	6		2 Max	2	4	4	2	3	7	4	6
	91F	60			74		72	72		68	75	78	81	86	88	86	86	86
	3	1 Min	3	6	2	2	5	5		2 Max	1 Min	3	3	1 Min	1 Min	5	3	4
	94F	62 Min			76	85	74	74		71	78	81	84	89	91	89	89	89
	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
	92 MinF				77		75			72	80	83	86	90	93	90	90	90

- 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.



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OLIN Alloy No.	TIN BRASSES				PHOSPHOR BRONZES						HIGH PERFORMANCE ALLOYS				CUPRO-NICKELS		Cu-Ni-Sn	NICKEL SILVERS		
	411	422	425	4252	510	511	5118	521	5218	544	638	654	688	7025	706	715	725	752	762	770
ASTM Spec. No.	B591	B591	B591	B591	B103	B103	B103	B103	B103	B103	B422	B96	B592	B422	B122	B122	B122	B122	B122	B122
Olin Alloy Name	Lubaloy	Lubronze	Lubaloy X	Olin 4252	5% Phos. Bronze	4% Phos. Bronze	4% Mod. Phos. Bronze	8% Phos. Bronze	8% Mod. Phos. Bronze	Lead-Bearing Bronze	Olin 638	Olin 654	Olin 688	Olin 725	10% Copper Nickel	30% Copper Nickel	Cu-Ni-Sn	65-18 Nickel Silver	59-12 Nickel Silver	55-18 Nickel Silver
Nominal Composition	Cu-91 Zn-8 Sn-5	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-91.9 Sn-8 P-0.1	Cu-91.8 Sn-8 Fe-.10 Ni-.10 P-.03	Cu-89 Pn-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-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	0.318	0.317	0.318	0.320	0.320	0.321	0.318	0.318	0.321	0.299	0.309	0.296	0.318	0.323	0.323	0.321	0.316	0.310	0.314
MOD. OF ELAST. x 10 ⁶ PSI, tension (Kgf/mm ² = KSI x .7031)	16	16	16	16	16	16	16	16	16	15	17	17	17	19	18	22	20	18	18	18
ELECT. COND. % IACS at 68°F (20°C) as annealed	32	31	28	30	15	20	20	13	13	19	10	7	18	40	9	4.6	11	6	9	5.5
THERM. COND. BTU • ft. @ 68°F ft ² • hr • F (20°C)	75	75	69	75	40	50	50	36	36	50	22	21	47	100	26	17	31	19	24	17
COEF. OF TH. EXP. Inches/inch / F x 10 ⁶ from 68°F to 572°F (20°C to 300°C)	10.2	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	9.5	9.0	9.2	9.0	9.0	9.3

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 (TM00 / AM)	38-44	41-49	41-47		46-56	46-54		56-65		45-52	77-87	77-87	77-87	90-110	43-50	52 Min	45-65	53-63	57-75	61-76
1/4 HARD (TM01 / 1/4 HM)	42-54	47-57	49-59		49-61	46-58		63-75		47-59	90-102	75-90	87-101		51-67	58-72	55-72	58-72	65-81	69-87
1/2 HARD (TM02 / 1/2 HM)	49-60	54-65	57-69	58-73	58-73	55-70	69-84	69-84	83-98	55-70	100-112	86-101	97-112	95-120	58-72	66-80	65-80	66-80	75-91	78-95
3/4 HARD (TM03)	55-66	60-72	62-74	68-79	68-79	67-82	80-92	80-92		63-74	105-117	97-112		100-125					74-86	83-98
HARD (TM04 / HM)	61-72	67-79	70-82	76-91	76-91	72-87	85-100	85-100	98-112	72-87	114-126	108-120	106-120		71-83	75-88	75-90	78-91	90-105	92-107
EX. HD (TM05 / SHM)	67-78	75-85	76-88	88-103	88-103	84-99	97-112	97-112	112-127	84-99	118-130	116-126	113-127		73-85	80-92	80-95	86-98	101-114	102-115
SPRING (TM06 / XHM)	73-83	82-92	84-94	95-110	95-110	91-105	105-119	105-119	122-142	91-105	123-134	124-133	123-133		78-88	84-94	85-100	90-101	109-122	108-120
EX. SPRING (TM08 / XHMS)	78 Min 75 Min	88 Min 82 Min	92 Min 87 Min	100-114 103	100-114 104	96-109 98	110-122 112	110-122 110	130 Min 125 Min	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 50 mm)

ROCKWELL B HARDNESS

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

ANNEALED (TM00 / AM)	43	45	48		55	47		63		46	33		35	10 Min	35	30 Min	35	35	40	43
1/4 HARD (TM01 / 1/4 HM)	23	29	35		41	36		50		33	16	33	19		12	17	5 Min	24	35	26
1/2 HARD (TM02 / 1/2 HM)	13	16	20	20	24	21	22	37	20	19	10	23	9	7 Min	5	6	10	14	18	14
3/4 HARD (TM03)	7	7	15	15	15	10	18	25		11	7	13		5 Min				8	10	8
HARD (TM04 / HM)	6	4	9	10	10	7	10	21	15	6	4	6	4		1 Min	3	3	5	4	4
EX. HD (TM05 / SHM)	4	2	6	6	4	3	6	13	10	3	3	4	2		1 Min	2	2	3	2	1 Min
SPRING (TM06 / XHM)	3	2	4	4	2	3	5	6	5	4 Max	2	3	1 Min		1 Max	1 Min	1 Min	1 Min	1 Max	1 Max
EX. SPRING (TM08 / XHMS)	2 Max 80 Min	2 Max 86 Min	2 Max 92 Min	3	2	2	3	4	3	4 Max 93	2 Max 100 Min	2 101	2 Max 99 Min				1 Max 91	2 Max 92 Min	1 Max 98 Min	1 Max 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 ()

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