

## COPPER ALLOY GUIDE

NOTE: This is not a comprehensive listing of all alloys available by Wieland Rolled Products NA. Contact Wieland Rolled Products NA if additional alloys or tempers are required. This information is presented for alloy comparison purposes and is not intended for use as purchase specifications.

WRPNA 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	B936	B36	B36	B36	B36	B36	B36	B121	B121	
WRPNA Name	Oxygen Free Copper	ETP Copper	DHP Copper	Ag Bearing Low O	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 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 - .18 Zn - .12	Cu - 97 Fe - 1.5 P - .18 Co - .8 Sn - .6	Cu - 99 Fe - .6 P - .2 Mg - .05	Cu - 99 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	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
	10	13		38	28	23							10	12	15	13	20	21	23	23	21
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
	32	35		53	57								30	33	32	35	29	33	34	32	29
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
	37	38	63	66	45	71	48	48					44	47	50	48	42	51	44	46	42
3/4 HARD (TM03)	41-50	47-56				75-85							46-56	52-62	55-65	57-67	61-71	64-74	62-72	62-72	62-72
	43	50				77							50	54	58	55	53	62	53	60	55
HARD (TM04 / HM)	43-52	53-62	65-74	72-83	60-70	82-90	60-70	60-70					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					53	58	62	61	61	72	57	68	67
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
	50	60	73	80	67		67	67					59	63	70	68	68	83	67	79	78
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
	52	66	74 Min.	87	70	88	70						63	68	76	72	76	86	71	84	84
EX. SPR. (TM08 / XHMS)	52 Min	51 Min			91-106	73-80		73-80					61-69	72-80	78-86	82-90	89-97	95-104	90-99	90-99	90-99
					97	73		73					64	70	78	76	78	89	73	89	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		23	26	20 Min							45	47	40	45	50	53	52	50	56
		49F				45F							45F	65F	64F	71F	70F	75F	75F	80F	72F
1/4 HARD (TM01 / 1/4 HM)	23	22		25		14							30	27	28	27	26	46	42	44	48
	72F	32				71							36	41	44	47	51	52	52	52	52
1/2 HARD (TM02 / 1/2 HM)	20	15	7	15	17	6	17	17					17	12	19	14	18	30	36	28	35
	83F	37			59	78	66	68					50	58	61	63	66	68	65	65	65
3/4 HARD (TM03)	14	8				3							9	6	9	8	10	16	25	16	21
	86F	47				81							57	64	68	71	74	77	75	75	75
HARD (TM04 / HM)	9	4	5	10	7	2	7	7					5	4	6	7	4	10	19	9	12
	89F	57			71	83	69	69					62	70	73	76	80	82	80	80	80
EX. HD. (TM05 / SHM)	4	2	4	8	2		6	6					2 Max	2	4	4	2	3	7	4	6
	91F	60			74	72	72	72					68	75	78	81	86	88	86	86	86
SPRING (TM06 / XHM)	3	1 Min	3	6	2	2	5						2 Max	1 Min	3	3	1 Min	1 Min	5	3	4
	94F	62 Min			76	85	74						71	78	81	84	89	91	89	89	89
EX. SPR. (TM08 / XHMS)	3 Max			4	2 Max		1 Min						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 ( )

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

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WRPNA Alloy No.	TIN BRASSES			PHOSPHOR BRONZES					HIGH PERFORMANCE ALLOYS					CUPRO-NICKELS		Cu-Ni-Sn	NICKEL SILVER			
	422	425	4252	510	511	5118	521	5218	544	638	654	688	7025	7035	706	715	725	752	762	770
ASTM Spec. No.	B591	B591	B591	B103	B103	B103	B103	B103	B103	B422	B96	B592	B422	B422	B122	B122	B122	B122	B122	B122
WRPNA Alloy Name	Lubronze	Lubaloy X	Olin Brass 4252	5% Phos. Bronze	4% Phos. Bronze	4% Adv. Phos. Bronze	8% Phos. Bronze	8% Adv. Phos. Bronze	Lead-Bearing Bronze	Olin Brass 638	Olin Brass 654	Olin Brass 688	Olin Brass 7025	Olin Brass 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 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 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 - 0.6	Ni - 10 Fe - 1.4	Ni - 30 Fe - .4	Ni - 9.5 Sn - 2.3	Ni - 18 Zn - 17 Ni - 18	Ni - 12 Zn - 29 Ni - 12	Ni - 18 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	41-47		46-56	46-54		56-65		45-52	77-87		77-87	90-110	43-50	52 Min	45-65	53-63	57-75	61-76	
	19	17		24	22		29		21	56		52	65-90	19	28	21	25	36	32	
1/4 HARD (TM01 / 1/4 HM)	47-57	49-59		49-61	46-58		63-75		47-59	90-102	75-90	87-101		51-67	58-72	55-75	58-72	65-81	69-87	
	38	37		37	35		48		38	82	60	76		53	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	69-84	90-105	55-70	100-112	86-101	97-112	95-120	58-72	66-80	65-80	66-80	75-91	78-95	
	55	58	60	57	56	70	63	92	57	93	79	92	85-110	63	68	68	63	70	78	
3/4 HARD (TM03)	60-72	62-74	68-79	68-79	67-82	80-92	80-92	97-112	63-74	105-117	97-112		100-125				74-86	83-98	88-101	
	64	64	71	68	72	82	77	96	66	99	92		95-120				75	82	92	
HARD (TM04 / HM)	67-79	70-82	76-91	76-91	72-87	85-100	85-100	105-120	72-87	114-126	108-120	106-120		71-83	75-88	75-90	78-91	90-105	92-107	
	71	72	81	81	76	87	86	104	77	108	101	101		75	78	80	82	89	98	
EX. HD. (TM05 / SHM)	75-85	76-88	88-103	88-103	84-99	97-112	97-112	108-125	84-99	118-130	116-126	113-127		73-85	80-92	80-95	86-98	101-114	102-115	
	75	79	92	93	88	101	99	110	88	112	109	108		76	83	85	91	98	107	
SPRING (TM06 / XHM)	82-92	84-94	95-110	95-110	91-105	105-119	105-119	115-132	91-105	123-134	124-133	123-133	122-140	78-88	84-94	85-100	90-101	109-122	108-120	
	82	90	100	100	94	107	106	115	88 Min	116	117	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	110-122	120-140	96-109	130 Min	131-140	125 Min					90-105	96 Min	114 Min	116 Min
	82 Min	87 Min	103	104	98	112	110	120	88 Min	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, where noted)

ANNEALED (TM00 / AM)	45	48		55	47		63		46	33		35	10 Min	35	30 Min	35	35	40	43	
	72F	72F		78F	75F		86F		71F	74 (30T)		68F		75F	83F	50Max30T	85F	90F	87F	
1/4 HARD (TM01 / 1/4 HM)	29	35		41	36		50		33	16	33	19		12	17	5 Min	24	35	26	
	56	59		60	46		74		46	94	81	90		64	74	85 Max	62	73	75	
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	
	70	70		72	67		80		67	96	92	95		73	80	80	75	84	86	
3/4 HARD (TM03)	7	15	15	15	10	18	25	20	11	7	13		5 Min				8	10	8	
	76	79		82	78		89		77	98	95						81	88	90	
HARD (TM04 / HM)	4	9	10	10	7	10	21	18	6	4	6	4		4 Min	1 Min	3	3	5	4	
	80	85		88	85		93		85	99	97	97		81	86	82	85	92	93	
EX. HD. (TM05 / SHM)	2	6	6	4	3	6	13	12	3	3	4	2		1 Min	2	2	3	2	1 Min	
	83	90		92	90		96		90	100	98	98		84	88	87	90	96	97	
SPRING (TM06 / XHM)	2	4	4	2	3	5	6	5	4 Max	2	3	1 Min		1 Min	1 Min	1 Min	1 Min	1 Max	1 Max	
	86	92		95	92		98		92	100	100	99		87	89	90	92	98	98	
EX. SPR. (TM08 / XHMS)	2 Max	2 Max	3	2	2	3	4	3	4 Max	2 Max	2	2 Max					1 Max	2 Max	1 Max	
	86 Min	92 Min		96	93		99		93	100 Min	101	99 Min					91	92 Min	98 Min	98 Min

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