

FREE MACHINING ROD & WIRE

TECHNICAL COPPER ALLOY GUIDE

CDA Number	LOW ALLOYED COPPER				BRASS									
	C14500	C18700	C19150	C19160	C31400	C33500	C33530	C34500	C35000	C35300	C36000	~C36000	C 38500	~C46400
Avins Mill Designation	C42	C99	C98	C97	90A	62C	62B	62A	61C	61B	61A	61D	58A	CuZn40V
Alloy Description	Tellurium Copper	Free Machining Copper	Free Machining Nickel Copper	Free Machining Nickel Copper	Commercial Bronze	Low Leaded Brass	Low Leaded Brass	Leaded Brass	Medium Leaded Brass	Medium Leaded Brass	Free Machining Brass	Non-magnetic Free Machining Brass	Free Machining Architectural Bronze	Non-leaded Free Machining DORECO Brass
Nominal Composition (%)	Cu - 99.4 Te - 0.6 P - 0.008	Cu - 98.8 Pb - 1.0 P - 0.2	Cu - 98.2 Ni - 1.0 Pb - 0.6 P - 0.2	Cu - 97.8 Ni - 1.0 Pb - 1.0 P - 0.2	Cu - 89.0 Zn - 9.1 Pb - 1.9	Cu - 64.0 Zn - 35.5 Pb - 0.5	Cu - 64.0 Zn - 35.0 Pb - 1.0	Cu - 62.5 Zn - 35.5 Pb - 2.0 Fe ≤ 0.1	Cu - 61.5 Zn - 37.0 Pb - 1.5	Cu - 61.5 Zn - 36.5 Pb - 2.0	Cu - 60.7 Zn - 35.85 Pb - 3.2 Fe ≤ 0.25	Cu - 62.0 Zn - 35.0 Pb - 3.0 Fe ≤ 0.01	Cu - 89.0 Zn - 9.1 Pb - 1.9	Cu - 60.0 Zn - 39.0 Al - 0.5 Sn - 0.5
ASTM Designation	B301	B301	-	-	B 140	B 121	B 121	B 453	B 453	B453	B 16	B 16	B 140	B 21

Physical Properties (at 68°F/20°C)

Property	C14500	C18700	C19150	C19160	C31400	C33500	C33530	C34500	C35000	C35300	C36000	~C36000	C 38500	~C46400
Electrical Conductivity (% IACS)	>90	>85	>50	>50	42	26	26	26	26	26	26	26	28	26
Density (lb./in. ³)	0.322	0.322	0.322	0.322	0.318	0.307	0.307	0.307	0.307	0.307	0.307	0.307	0.307	0.300
Modulus of Elasticity (1000 KSI)	16.68	16.68	17.98	17.98	16.68	15.23	15.23	14.50	14.36	14.07	14.36	14.36	13.92	13.77
Thermal Conductivity (Btu.·ft./hr.·ft. ² ·°F)	223	220	142	142	104	66	66	66	66	66	66	66	69	58
Thermal Expansion (µin./in.·°F from 68°F to 572°F)	9	9	10	10	10	11	11	11	11	11	11	11	12	11

Typical Mechanical Properties (as Delivered)

Property	1/2 Hard	1/2 Hard	Hard	Hard	1/2 Hard	1/2 Hard	1/2 Hard	1/2 Hard	1/2 Hard	1/2 Hard	1/2 Hard	1/2 Hard	Hard	1/2 Hard
Standard Temper	1/2 Hard	1/2 Hard	Hard	Hard	1/2 Hard	1/2 Hard	1/2 Hard	1/2 Hard	1/2 Hard	1/2 Hard	1/2 Hard	1/2 Hard	Hard	1/2 Hard
Tensile Strength (KSI)	42	42	86	86	50	54	54	55	57	60	59	59	73	58
Yield Strength (KSI)	35	35	75	75	30	39	39	38	25	36	44	44	57	35
Elongation (% in 2 inches)	15	15	6	6	7	8	8	7	7	10	10	10	8	10
Rockwell (HRB)	58	58	85	85	54	62	62	55	65	75	58	58	77	70

Range of Mechanical Properties (Soft - Extra Hard Temper)

Property	29-59	29-59	36-102	36-102	39-59	50-75	50-75	46-88	42-70	42-78	49-88	49-88	55-86	50-70
Tensile Strength (KSI)	29-59	29-59	36-102	36-102	39-59	50-75	50-75	46-88	42-70	42-78	49-88	49-88	55-86	50-70
Yield Strength (KSI)	6-52	6-52	12-80	12-80	15-52	35-57	35-57	17-74	15-25	30-50	19-73	19-73	26-73	25-45
Elongation (% in 2 inches)	40-8	40-8	30-6	30-6	35-10	12-4	12-4	38-5	35-7	45-7	30-3	30-3	28-3	15-5

Capacity of Forming / Machining / Other Qualities

Property	85	85	50	70	75	65	70	80	80	90	100	100	100	70
Machinability Rating (C36000 = 100)	85	85	50	70	75	65	70	80	80	90	100	100	100	70
Tool Life Rating (C36000 = 110)	71	71	40	70	80	70	75	80	80	80	110	110	100	70
Cold Deformability (C26000 = excellent)	good	good	good	good	good	excellent	good	good	good	fair	fair	fair	bad	fair
Electroplating	excellent	excellent	excellent	excellent	good	good	good	good	good	good	good	good	good	good
Corrosion Resistance	poor	poor	fair	fair	fair	bad	bad	bad	bad	bad	bad	bad	poor	poor

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CDA Number	PHOSPHOR BRONZE			NICKEL SILVER					HIGH PERFORMANCE			
	C51000	C53400	C54400	C75200 C75900 C76400	C76300	C79300	C79800	C79860	C53800	C69750	Pending	C17300
Avins Mill Designation	BZ5	BP5	BZ4	M18	N29	N12	NM2/NM3	NM6	B05	PS2	NP6	CuBe2Pb
Alloy Description	Phosphor Bronze 5%	Phosphor Bronze 4.5%	Phosphor Bronze 4%	Non-lead Nickel Silver	Nickel Silver 18%	Nickel Silver 12%	Nickel Silver 7%	Nickel Silver 12%*	High Tin Bronze	Silicon Brass	Spinodal Copper Nickel Tin	Beryllium Copper
Nominal Composition (%)	Cu - 95.22 Sn - 4.7 P - 0.08	Cu - 94.5 Sn - 4.4 Pb - 1.0 P - 0.1	Cu - 88.0 Pb - 4.0 Sn - 4.0 Zn - 3.9 P - 0.1	Cu - 61.0 Zn - 21.5 Ni - 17.5	Cu - 61.5 Zn - 19.65 Ni - 17.8 Pb - 1.05	Cu - 57.0 Zn - 29.8 Ni - 12.0 Pb - 1.2	Cu - 49.10 Zn - 40.95 Ni - 7.25 Pb - 2.70 Mn - 2.45	Cu - 43.0 Zn - 43.2 Ni - 12.25 Mn - 6.0 Pb - 1.55	Cu - 86.0 Sn - 13.5 Pb - 0.5	Cu - 80.5 Zn - 16.45 Si - 2.0 Pb - 1.05	Cu - 84.1 Ni - 8.9 Sn - 6.0 Pb - 1.0	Cu - 97.3 Be - 1.9 Ni - 0.4 Pb - 0.4
ASTM Designation	B 139	B 139	B 139	B 151	B 151	-	-	-	-	-	-	-

Physical Properties (at 68°F/20°C)

Electrical Conductivity (% IACS)	20	20	19	6	6	8	7	5	9	10	14	22
Density (lb./in. ³)	0.319	0.318	0.318	0.316	0.316	0.313	0.305	0.300	0.314	0.311	0.324	0.298
Modulus of Elasticity (1000 KSI)	16.70	17.69	17.11	18.85	18.85	18.00	16.68	15.95	12.76	15.23	17.40	18.56
Thermal Conductivity (Btu.·ft./hr.·ft. ² ·°F)	48	49	46	19	19	20	19	17	20	23	17	72
Thermal Expansion (μin./in.·°F from 68°F to 572°F)	10	10	9.4	9	9	9	11	11	11	11	9	10

Typical Mechanical Properties (as Delivered)

Standard Temper	Spring Hard	Spring Hard	Spring Hard	Hard	Hard	Hard	Hard	Hard	Hard	Spring Hard	Hard	Aged	Hard (TD04)	Aged (TH04)
Tensile Strength (KSI)	110	115	115	95	93	93	113	118	146	142	130	165	110	195
Yield Strength (KSI)	87	94	95	84	80	80	102	>104	134	120	115	155	75	165
Elongation (% in 2 inches)	2	3	3	7	2	>1	3	>2	1	1	2	1	8	2
Rockwell (HRB)	93	94	94	97	92	93	96	94	104	101	24 HRC	35 HRC	17 HRC	41 HRC

Range of Mechanical Properties (Soft - Extra Hard Temper)

Tensile Strength (KSI)	70-120	49-120	49-120	58-100	58-93	60-93	71-122	67-122	67-150	65-146	115-145	150-175	60-130	165-225
Yield Strength (KSI)	58-87	23-109	25-105	43-90	22-80	41-80	29-107	29-107	25-138	22-124	100-130	145-160	20-75	130-160
Elongation (% in 2 inches)	15-2	40-3	35-2	45-3	40-2	20-1	40-2	40-2	60-1	50-1	5 max	5 max	20-8 min.	4-2 min.

Capacity of Forming / Machining / Other Qualities

Machinability Rating (C36000 = 100)	20	60	90	50	50	55	90	90	75	90	90	50
Tool Life Rating (C36000 = 110)	20	60	80	50	50	55	90	90	80	80	70	30
Cold Deformability (C26000 = excellent)	excellent	fair	good	excellent	good	good	good	good	good	bad	good	good
Electroplating	good	good	good	excellent	good	good	good	good	excellent	excellent	excellent	bad
Corrosion Resistance	fair	good	good	excellent	excellent	good	fair	excellent	good	fair	excellent	fair

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