

Copper-Nickel Alloy 70/30 (C71500, C71520)



Cu-Ni alloy 70/30 alloy provides great resistance to marine water corrosion. It is suitable for use in applications that need resistance to brine solutions, salt and aqueous corrosion. It is resistant to SCC and has high strength. 70-30 Cu Ni alloy is resistant to impingement corrosion and prevents attack by alkali and acidic media. It is used in ship building, desalination plants, evaporator vessels and heat exchanger systems.

Copper-Nickel alloy Cu70/Ni30 shows exciting features such as physical and mechanical features under regular loading at the high temperatures with excellent resistance to corrosion in the variety of sources particularly in the sea water. Few features of Copper-Nickel alloys are not sufficient for various operations which are appreciably improved by adding different elements. The additional elements including manganese, ferrous, tin, niobium and silicon are significant from the technical view. Moreover chromium, beryllium and aluminum are also essential.

Chemical Composition

Nickel (Ni)	29 to 32 %
Iron (Fe)	0.5 to 1.5 %
Manganese (Mn)	0.4 to 1 %
Copper (Cu)	Balance %

Physical Properties

Property	Values
Density at 20oC or 68oF	8.95 gram/ cm ³ or 0.325 ln per inch ³
Melting point	1170 to 1240oC or 2140 to 2265 oF
Linear Coefficient of thermal expansion at -183 to 10oC or -397 oF to 50 oF	0.000012 per oC or 0.000007 per oF
20oC to 300oC or 68 to 572oF	0.000016 per oC or 0.000009 per of
Specific heat capacity at 20oC or 68 oF	0.09 cal/goC or 0.09 Btu/lb oF
Thermal conductivity at 20oC or 68oF	0.07 cal cm/cm ² s oC or 178 BTU ft/ft ² h oF
Electrical conductivity at -269oC or -452oF (annealed)	0.34 ohm/mm ² /m or 207 ohms (circ mil per ft)
	34 microhm cm or 14 microhm inch
20 oC or 68oF (annealed or cold processed)	0.34 ohm mm ² /m or 207 ohms (circ mil/ft)
	34 micro ohm cm or 14 micro ohm inch
200oC or 392of (annealed or cold processed)	0.34 ohm mm ² /m or 207 ohms (cir mil per ft)
	34 micro ohm-cm or 14 micro ohm - inch
Temperature coefficient of electrical resistance at 20oC or 68oF (annealed or cold processed) from 0oC to 100oC or 32 to 212oF	0.00005 /oC (IACS 5%) or 0.00003 / oF (5 % IACS)
Modulus of elasticity (tension) at 20oC or 68 oF annealed	15500 kg/mm ² or 22000000 lg per inch ³
Cold processed	14600 kg / mm ² or 20800000 lb/ inch ³
Modulus of rigidity (torsion) at 20oC or 68 oF annealed	5750 kg/mm ³ or 82000000 lb / in ³
Cold processed	5400 kg/ mm ² or 7700000 lb/ in ²

Fabrication Properties

Casting temperature	1325 oC to 1400 oC	2415 oF to 2550 oF
Annealing temperature	650 oC to 850 oC	1200 oF to 1560 oF
Stress relieving temp	300 oC to 400 oC	570 oF to 750 oF
Hot processing temp	925 oC to 1025 oC	1695 oF to 1875 oF
Hot formability	Excellent	
Cold formability	excellent	

Cold reduction in annealed	50 %
Machining rate (free cutting brass – 100)	20
Soldering	Outstanding
Brazing	Outstanding
Oxy acetylene welding	Suitable
Carbon arc welding	Not preferred
Gas shielded arc welding	Outstanding
Coated metal arc welding	Suitable
Resistance welding	Suitable
Butt welding	suitable

Low Temperature Mechanical Properties

Tensile properties – impact properties

Form	Temper	Temp		Tensile strength			Proof stress		Elongation		Reduction area %	Impact strength	
		oC	oF	Kg/m ²	Ton/inch ²	Psi	0.2 % offset kg/m ²	Yield strength 0.5 % ext, under load psi	%	Gauge length		Kg m/cm ²	Ft. lb
Rod 12 mm diam, 0.47 inch diam.	Cold processed	20 oC	68 oF	65	41.5	92500 psi	-	56900 psi	12 %	16 mm	-	-	-
		0 oC	32 oF	65	41.5	92500 psi	-	51200 psi	13 %	16 mm	-	-	-
		100 oC	148 oF	70	44.5	99500 psi	-	76800 psi	17 %	16 mm	-	-	-
		-196 oC	-321 oF	80	51	114000 psi	-	99600 psi	24 %	16 mm	-	-	-
		-224 oC	-371 oF	83	52.5	118000 psi	-	107000 psi	22 %	16 mm	-	-	-
		-247 oC	-413 oF	90	57	128000 psi	-	114000 psi	20 %	16 mm	-	-	-
		-269 oC	-452 oF	95	60.5	135000 psi	-	121000 psi	18 %	16 mm	-	-	-
Rod 19 mm dia, 0.75 inch diam	Annealed	22 oC	72 oF	40.5	26	57800 psi	-	18700 psi	47 %	4.52	68	19.9	115
		-78 oC	-108 oF	48	30.5	68000 psi	-	22200 psi	48 %	4.52	70	19.7	114
		-197 oC	323 oF	63	40	89800 psi	-	31600 psi	52 %	4.52	70	19.7	114

		-253 oC	-423 oF	72.5	46	103100 psi	-	38100 psi	51 %	4.52	68	19.7	114
Rod 22 mm diam. 0.875 inch. Diam.	Annealed	24 oC	75 oF	38	24.5	54400 psi	15.1	-	52 %	2 inch	80.5	-	-
		-30 oC	-22 oF	41	26	58600 psi	15.5	-	49.5 %	2 inch	79	-	-
		-78 oC	-108 oF	45	28.5	64300 psi	16.9	-	56 %	2 inch	77.5	-	-
		-140 oC	-220 oF	50.5	32	71900 psi	19.3	-	57.5 %	2 inch	77.5	-	-
		-196 oC	-320 oF	59	37.5	83700 psi	21.7	-	61.5 %	2 inch	77.5	-	-

High Temperature Mechanical Properties

Short term tensile Characteristics

Form	Temper	temperature		Tensile strength			Proof stress			Elongation	
		oC	oF	Kg/m ²	Ton/in ²	psi	Kg/mm ²	Ton/in ²	psi	%	Gauge length
Plate	Hot rolled	20 oC	68 oF	37.5	23.9	53500 psi	12.4	7.4	-	50 %	2 inch
		66 oC	150 oF	35.5	22.7	51000 psi	12.4	7.5	-	49 %	2 inch
		121 oC	250 oF	33.5	21.4	48000 psi	11.5	6.7	-	48 %	2 inch
		177 oC	350 oF	32.5	20.5	48000 psi	10.4	6.3	-	48 %	2 inch
		232 oC	450 oF	31.	19.7	44000 psi	10.6	6.2	-	46 %	2 inch
		288 oC	550 oF	30	19	42500 psi	10.2	8	-	55 %	2 inch
		343 oC	650 oF	29	18.5	41500 psi	9.29	5.2	-	54 %	2 inch
		371 oC	700 oF	29	18.3	41000 psi	9.45	5.6	-	63 %	2 inch
Plate	Hot processed	20 oC	68 oF	38	24	54000 psi	13.5	-	-	-	-
		100 oC	212 oF	38	24	54000 psi	13.5	-	--	-	-
		200 oC	392 oF	35.5	22.5	50500 psi	12	-	-	-	-
		300 oC	572 oF	33	21	47000 psi	11.5	-	-	-	-
		400 oC	752 oF	30	19	42500 psi	10	-	-	-	-
Strip 2 mm, 0.08 inch	Annealed	20 oC	68 oF	40.5	25.8	58000 psi	-	7.9	-	44 %	2 inch
		100 oC	212 oF	37.5	23.8	53500 psi	-	7.5	-	40 %	2 inch
		200 oC	392 oF	34.5	21.9	49000 psi	-	6.6	-	37 %	2 inch
		300 oC	572 oF	32.5	20.5	46000 psi	-	6.1	-	34 %	2 inch

		400 oC	752 oF	30.5	19.4	43500 psi	-	5.8	-	31 %	2 inch
		500 oC	932 oF	26	16.4	36500 psi	-	5.4	-	20 %	2 inch
Rod 14 mm diameter, or 0.55 inch	Annealed	20 oC	68 oF	44	28	62500 psi	16	-	-	38 %	11.3 inch
		100 oC	212 oF	41	25	58500 psi	11	-	-	36 %	11.3 inch
		200 oC	392 oF	38	24	54000 psi	11	-	-	33 %	11.3 inch
		300 oC	572 oF	35	22	50000 psi	11	-	-	32 %	11.3 inch
		390 oC	734 oF	33.5	21.5	47500 psi	11	-	-	29 %	11.3 inch
		500 oC	932 oF	28	18	40000 psi	11	-	-	22 %	11.3 inch
		600 oC	1112 oF	19	12	27000 psi	9	-	-	16 %	11.3 inch
		700 oC	1292 oF	11	7	15500 psi	8	-	-	6 %	11.3 inch
		790 oC	1454 oF	6.5	4	9000 psi	5.5	-	-	3 %	11.3 inch
		Rod, dia25 mm or 0.875 inch	Cold processed, 25 %	24 oC	75 oF	52.5	33.5	74500 psi	50.9	-	-
149 oC	300 oF			48	30.5	68600 psi	45.7	-	-	17 %	2 inch
371 oC	700 oF			40.5	25.5	57600 psi	39	-	-	13 %	2 inch
482 oC	900 oF			30.5	19.5	43600 psi	27.1	-	-	11.5 %	2 inch
649 oC	1200 oF			12	7.5	16900 psi	6.82	-	-	26 %	2 inch
816 oC	1500 oF			5	3	7200 psi	2.88	-	-	16 %	2 inch
927 oC	1700 oF			3	2	4110 psi	1.16	-	-	22 %	2 inch
Cold processed, 70 %	24 oC		75 oF	67	42.5	95200 psi	65	-	-	16 %	2 inch
	149 oC		300 oF	81.5	39	87500 psi	56.8	-	-	16 %	2 inch
	371 oC		700 oF	51.5	33	73600 psi	50	-	-	11 %	2 inch
	482 oC		900 oF	40	25.5	56900 psi	37	-	-	14 %	2 inch
	649 oC		1200 oF	12	7.5	16900 psi	6.89	-	-	29 %	2 inch
	816 oC		1500 oF	5	3	6990 psi	2.60	-	-	19 %	2 inch
	927 oC		1700 oF	2.5	1.5	3680 psi	1.12	-	-	22.5 %	2 inch
Rod 25mm dia., 1 inch	Annealed	28 oC	82 oF	45	28.5	64100 psi	-	-	32000	34.5 %	2 inch
		260 oC	500 oF	37.5	24	53300 psi	-	-	26300	31.5 %	2 inch
		343 oC	650 oF	34.5	22	49200 psi	-	-	25000	27 %	2 inch
		427 oC	800 oF	33	21	46700 psi	-	-	22500 psi	25.6 %	2 inch
		510 oC	950 oF	26	16.5	37250 psi	-	-	21500 psi	18.2 %	2 inch
		593 oC	1100 oF	18.5	12	28500 psi	-	-	20000 psi	12.3 %	2 inch
Rod 27	Annealed,	20 oC	68 oF	41.5	26.5	59500 psi	13.7	8.6	-	56 %	4 inch

mm dia., 1 inch	grain size 0.025 to 0.035 mm	250 oC	482 oF	35	22.2	49500 psi	10.9	6.8	-	45 %	4 inch
		350 oC	662 oF	34	21.6	48500 psi	10.4	6.5	-	39 %	4 inch
		450 oC	842 oF	31.5	20	45000 psi	10.7	6.6	-	42 %	4 inch
		550 oC	1022 oF	26.5	16.7	37500 psi	11.8	6.8	-	33 %	4 inch
Condense r tubes	Annealed	20 oC	68 oF	43	27.5	61000 psi	16	-	-	38 %	11.3 inch
		100 oC	212 oF	39	25	55500 psi	14.5	-	-	35 %	11.3 inch
		200 oC	392 oF	36	23	51000 psi	13.5	-	-	36 %	11.3 inch
		300 oC	572 oF	34.5	22	49000 psi	12	-	-	28 %	11.3 inch
		400 oC	752 oF	33	21	47000 psi	11	-	-	30 %	11.3 inch
		500 oC	932 oF	24	15	34000 psi	10	-	-	25 %	11.3 inch
		600 oC	1112 oF	17	11	24000 psi	8	-	-	25 %	11.3 inch

Creeping Strength

Creep Rupturing Strength of Nickel-Copper Cu70/Ni30 alloy

The creep rupturing strength at the particular temperature is static. The highest load that a material can adhere without fracture for an extremely long period is termed as permanent strain. The creeping strength and 1% creeping limit of **Copper-Nickel alloy** that concludes the temperature limit for using the alloy for the prolonged loading is shown below:

Temp, oC	Creep strength in N/mm ² for time [h]				1% Creep limit in N/mm ² for the time [h]			
20	-	-	-	-	-	123	116	-
300	239	212	172	(121)	-	105	(93)	-
350	194	143	91	(55)	-	108	65	-
400	121	73	41	-	-	76	45	-
450	-	-	-	-	-	-	-	-
500	-	-	-	-	-	-	-	-
550	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-

The creeping strength and 1% creeping limit for Cu70/Ni30 sheet are shown in the following table:

Temp°C	Creep strength in N/mm ² for time [h]				1% Creep limit in N/mm ² for time [h]			
20	-	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-	-
350	(391)	(363)	(326)	-	361	317	(258)	-
400	351	305	244	-	299	232	(166)	-
450	292	221	153	-	211	145	(97)	-

Fatigue Strength

The following table shows the fatigue strength of Cu70/Ni30 and Cu90/Ni10 and other Cu-Ni alloys for 10(8) load cycles:

Cu-Ni Alloy	Fatigue strength in N/mm ²
CuNi10Fe1Mn ¹	150
CuNi25 ²	275
CuNi30Mn1Fe ³	245
CuNi44Mn1 ⁴	290

Applications

Power Industry

Copper-Nickel Cu70/Ni30 alloy sheet is utilized on the commercial scale in the power stations and heat exchanging systems. The extruded bar and forged parts combined with the casting are excellent choice for the cryogenic vessels and superheaters using in the low temperature, large pressure and steam boiler fitting for condenser tubes and plates in the power production house, oil purification plant, for nuts, pump components, hot steam valves etc.



Mechanical Engineering

In mechanical engineering, the Cu-Ni alloys are utilized in the feed water heater, large pressure heater, seawater evaporator and super heater in the power stations. The cast and wrought materials with the large amount of iron and other elements are better for turbine blades, worm and gear wheels, brazing alloy for the large chromium steels that are utilized in making permanent magnets.



In aeronautic engineering, the intercooler and oil cooler and honey comb radiators of Cu-Ni alloys comprising of Iron are utilized. Some automobile manufacturers utilize the Copper-Nickel Cu70/Ni30 tubing as the resistance to corrosion tube in the production of automobile brake lines. Moreover the retro fit sets of Copper-Nickel Cu70/Ni30 tubing are used for the various types of automobiles. The performance period of alloy 70/30 tubing brake lines is normally more than the expected period of vehicle life.

Available Forms

Wire, Strip, Sheet, Plate, Mesh, Rod, Bar, Foil, Pipe, Flanges