

# Monel Alloys



[www.columbiametals.com](http://www.columbiametals.com)  
[sales@columbiametals.co.uk](mailto:sales@columbiametals.co.uk)

BS3076:NA13 / ASTM B164:N04400  
 BS3076:NA18 / ASTM B164:N05500

## Alloy 400 / NA13 / N04400

Monel Alloy 400 is primarily a nickel copper with small additions of manganese, silicon and iron to enhance the grade's overall strength and corrosion resistance. Structurally, this is a single phase, solid solution strengthened material which can be tempered or cold worked to improve its mechanical properties. Columbia Metals' standard stock material is supplied in the cold worked stress relieved condition below 60mm diameter and in the hot worked stress relieved condition for larger sizes. This ensures the maximum mechanical strength, the optimum machinability and best surface condition for the ultimate application.



The high strength and toughness of Alloy 400 is maintained over a wide range of temperatures up to 400°C. There is an increase in strength and hardness at sub-zero temperatures with only a slight decrease in elongation. Without a ductile to brittle transition temperature the Alloy 400 is also suited to many applications where ferrous metals cannot be used.

Alloy 400 exhibits exceptional corrosion resistance to hydrofluoric acid and many reducing media. It is one of only a few alloys that can be used in contact with fluorine and hydrogen fluoride. Alloy 400 is also highly resistant to many forms of sulphuric and hydrochloric acids under reducing conditions, as well as to alkalis. It offers excellent resistance in flowing seawater, making it widely utilised in chemical and marine engineering.

Alloy 400 offers good fabrication capabilities and can be hot or cold formed, readily machined and joined via welding, brazing, or soldering. The cold drawn stress relieved condition also offers the best machinability and surface finish.

Typical applications include marine propeller and pump shafts, water feed and steam generator tubing in power plants, splash zone sheathing, offshore valves, pumps, fittings and fasteners, chemical and hydrocarbon processing equipment, industrial heat exchangers and cladding for oil distillation columns.

## Alloy K500 / NA18 / N05500

Monel Alloy K500 is a precipitation hardening nickel copper alloy that retains the excellent corrosion resistance of Alloy 400 with the added advantage of increased strength and hardness that can be maintained up to 650°C. The higher mechanical properties arise due to the small additions of aluminium and titanium to the composition which, upon aging, form Ni<sub>3</sub> precipitates in the matrix. Alloy K500 also offers an exceptionally high dimensional stability and, as with Alloy 400, its low temperature mechanical properties are very good with no transition temperature making the alloy suitable for many cryogenic applications.

The corrosion resistance of Alloy K500 is essentially the same as that of Alloy 400, except when in the age hardened condition. When heat treated Alloy K500 has a greater tendency toward stress-corrosion cracking in certain environments; however, it has been found to be resistant in sour-gas environments. The combination of its high strength and excellent marine corrosion resistance in high-velocity seawater make Alloy 500 particularly suitable for marine shafts and centrifugal pumps. In stagnant or slow-moving seawater fouling may occur followed by pitting, but this pitting does slow down after a fairly rapid initial attack.

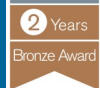
Alloy K500 can be readily fabricated and can be hot and cold formed, although heavy deformation or machining is best achieved in the annealed condition. If heavy machining is to be carried out it is common practice to machine to near net shape and precipitation harden prior to finish machining. This enables a better surface finish to be achieved as well as closer tolerances.

Typical applications include chains, springs, fasteners, flanges, offshore drill collars, pump shafts, impellers, pump and valve trim, marine propeller shafts, chemical processing equipment for processes containing organic acids, caustic soda and dry chlorine, electronic components and cryogenic equipment.

**PLEASE CONTACT US FOR AN IMMEDIATE QUOTATION OR TECHNICAL ADVICE**

**North, Scotland & International**  
 Tel: 01422 343026  
 Fax: 01422 346587  
[halifaxsales@columbiametals.co.uk](mailto:halifaxsales@columbiametals.co.uk)  
[export@columbiametals.co.uk](mailto:export@columbiametals.co.uk)

**South, Midlands & Wales**  
 Tel: 01234 608888  
 Fax: 01234 608800  
[sales@columbiametals.co.uk](mailto:sales@columbiametals.co.uk)



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## Technical Data



### Nominal Composition (%)

	Ni (+Co)	Cu	Al	Fe	Mn	Ti
<b>Alloy 400</b>	63 min	28 - 34	-	2.5 max	2.0 max	-
<b>Alloy K500</b>	63 min	27 - 33	2.30 - 3.15	2.0 max	1.5 max	0.35 - 0.85

### Mechanical Properties (specification minima)

	<b>Alloy 400</b> <40mm cold worked stress relieved	<b>Alloy K500</b> <25mm cold worked precipitation hardened
<b>Ultimate Tensile Strength (N/mm<sup>2</sup>)</b>	600	1000
<b>0.2% Proof Strength (N/mm<sup>2</sup>)</b>	415	760
<b>Elongation (%)</b>	20	14

### Typical Physical Properties

	<b>Alloy 400</b>	<b>Alloy K500</b> precipitation hardened
<b>Density (g/cm<sup>3</sup>)</b>	8.80	8.44
<b>Melting Range (°C)</b>	1300 - 1350	1315 - 1350
<b>Young's Modulus (Gpa)</b>	180	179
<b>Thermal conductivity (W/m°C)</b>	22	17.5
<b>Coeff. Thermal Expansion (µm/m°C)</b>	13.9 x 10 <sup>-6</sup>	13.4 x 10 <sup>-6</sup>
<b>Electrical Conductivity (IACS)</b>	34	28

### Round Bar Weight and Stock Sizes

Diameter	Weight		Diameter	Weight		Diameter	Weight	
	ins	kg/ft kg/m		ins	kg/ft kg/m		ins	kg/ft kg/m
1/4"	0.09	0.28	7/8"	1.04	3.41	1.3/4"	4.16	13.66
3/8"	0.19	0.63	1"	1.36	4.46	2"	5.44	17.84
10mm	0.21	0.69	1.1/8"	1.72	5.64	2.1/4"	6.88	22.58
1/2"	0.34	1.12	1.1/4"	2.12	6.97	2.1/2"	8.50	27.88
5/8"	0.53	1.74	1.3/8"	2.57	8.43	2.3/4"	10.28	33.73
16mm	0.54	1.77	1.1/2"	3.06	10.04	3"	12.24	40.14
3/4"	0.76	2.51	40mm	3.37	11.06	80mm	13.48	44.23
20mm	0.84	2.76	1.5/8"	3.59	11.78	3.1/2"	16.65	54.64

NB Weight data for guidance only

