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ALLOY K-500
UNS N05500 / W.Nr. 2.4375

Available to the QQ-N-286 Rev. E requirements for Oil & Gas applications as well as the QQ-N-286 Rev. F&G requirements for Navy/Marine applications.

Description

Alloy K-500, commonly referred to as "K-MONEL®", is a precipitation hardenable, nickel-copper alloy. It has similar corrosion resistance to that of alloy 400, with the additional advantage of greater strength and hardness. The additions of aluminum and titanium to the nickel-copper base allow for subsequent heat treat that increases the mechanical properties. Alloy K-500 also has low magnetic permeability and strong non-magnetic characteristics over a wide range of temperatures, including subzero.

Industries & Applications

Alloy K-500 is frequently used in the marine, chemical processing, oil and gas, pulp and paper, pharmaceutical, food processing and electronic industries. End use applications for alloy K-500 include fasteners, springs, chains, pump and valve components, drill collars, doctor blades, scrapers, mixing shafts, impellers, sensors, electrical components and other highly corrosive applications where strength and hardness are important.

Resistance to Corrosion

The corrosion resistance of alloy K-500 is similar to alloy 400. However, when in the age-hardened condition, alloy K-500 can experience stress corrosion cracking in certain environments. Resistance to hydrogen sulfide makes alloy K-500 useful in sour gas environments, making it an ideal choice for applications in the oil patch. Low corrosion rates in seawater make alloy K-500 optimal for use in the marine industry. Pitting may occur in stagnant or low velocity seawaters, but the rate of pitting eventually slows following the initial incursion.

Fabrication and Heat Treatment

Alloy K-500 can be fabricated by using standard commercial procedures. Hot working of alloy K-500 should be performed at temperatures between 1600°F and 2100°F, but care should be taken to avoid prolonged soaking time at the higher temperatures. Material should be water quenched from a temperature no lower than 1450°F after hot working. Cold forming in the annealed condition can also be performed using standard methods, although may require considerable force to form. Machining of alloy K-500 is easiest in the annealed condition. Therefore, the best practice is to machine oversize, age harden, then machine finish to size. Contraction can occur during aging and 0.0002 in/in should be accounted for in size prior to aging.

Welding alloy K-500 is best achieved by gas tungsten arc welding (GTAW). Filler metal AWS A5.14 ERNiCu-7 is typically used for joining. Weldments using this filler metal will not have the strength of the base metal because it cannot be age-hardened. For welds that require strength, AWS 5.14 ERNiFeCR-2 filler metal can be used.

Solution annealing of the alloy should be performed prior to aging to dissolve phases in the microstructure that may have formed during previous processing. If the material is hot finished, then the anneal temperature should be 1800°F. If the material is cold worked, then the temperature should be 1900°F. Time at temperature should be kept at a minimum to avoid excessive grain growth. Quenching in water immediately after solution annealing will avoid any partial precipitation of age hardening constituents. Age hardening of annealed (soft) material to obtain maximum properties should be performed as follows: heat material between 1100°F & 1125°F and hold temperature for 16 hours followed by furnace cooling at a rate of 15°F to 25°F per hour until the material reached a temperature of 900°F. Once the material reached 900°F, cooling can continue via furnace cooling, air cooling or quenching.

K-MONEL® alloy K-500 is a registered trademark of Special Metals Corporation, a PCC Company.

Chemical Composition (%)

(Ni) Nickel	63.0 to 70.0
(Cu) Copper	Remainder
(Al) Aluminum	2.30 to 3.15
(Fe) Iron	2.0 max
(Mn) Manganese	1.5 max
(Si) Silicon	0.50 max
(Ti) Titanium	0.35 to 0.85
(C) Carbon	0.18 max
(P) Phosphorous	0.02 max
(Zn) Zinc	0.02 max
(Pb) Lead	0.006 max
(S) Sulfur	0.006 max
(Sn) Tin	0.006 max

Physical Properties

Density @ Room Temp.	0.305 lb/in.^{3}
Elastic Modulus @ Room Temp.	26 x 10^3 ksi
Melting Range	2400°F to 2460°F
Specific Heat[1] @ Room Temp.	0.100 Btu/lb•°F
Thermal Conductivity[1] @ Room Temp.	121 Btu•in/ft^2•h•°F
Electrical Resistivity[2] @ Room Temp.	0.615 µΩ•m
Magnetic Permeability[2] @ Room Temp.	1.002@200 Oerstead
Curie Temperature	-150°F

[1]Material annealed prior to test.
[2]Material annealed and age-hardened.

The information contained in this technical data sheet is intended to be used as a guide and may be revised at any time without prior notice. The information is believed to be reliable and accurate, however Corrosion Materials does not make any warranty or assume any legal liability with respect to the accuracy, completeness or usefulness of the information.

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Mechanical Properties at Room Temperature

Product Form	Condition	Tensile (min. ksi)	0.2% Yield (min. ksi)	Elongation (min. %)	Hardness
Bar	Hot-Finished/Aged	140	100	20	27-35 HRC[1]
Bar	Hot-Finished/Annealed	-	-	-	90 HRB
Bar	Hot Finished or Cold Drawn/Annealed and Aged[2]	130	85-90	20	24-35 HRC[3]
Plate	Hot Rolled/Annealed/Aged	130	80	20	-
Sheet	Cold Rolled/Annealed	130	90	15	-

[1]Hardness restricted by Schlumberger 100248736
[2]Dependant on size.
[3]For information only.

Shear Strength

Condition	Max Strength (ksi)	Tensile Strength (ksi)	Elongation (%)
Annealed	65.3	97.5	49.0
Annealed/Aged	96.5	147.2	29.0

Fatigue Strength at Room Temperature

Form	Condition	Fatigue Strength @ 108 cycles (ksi)	Tensile Strength (ksi)	Ratio (Fatigue Strength/Tensile Strength)
Bar	Annealed	38	88	0.43
Bar	Hot-Rolled	43	99	0.43
Bar	Hot-Rolled/Aged	51	155	0.33

Applicable Specifications*

Form	Federal Specification	Other
Bar	QQ-N-286[1,2]	Schlumberger 100248736, AMS4676
Plate & Sheet	QQ-N-286	-
Wire	QQ-N-286	-

** EN10204-3.1 applied to all product forms.*
[1]Revision E, Interim Amendment II, Form 2.
[2]Material made to QQ-N-286 Revision G requires slow strain rate tensile testing to the parameters specified in Sections 4.2.2.2, and 4.3.6.2. Each test is subject to evaluation under Section 4.3.6 and requires fracture surface photography to be reported with all material test reports. Material made to QQ-N-286 Revision E is not subject to this type of testing.

Please contact Corrosion Materials for a complete list of items available from our extensive inventory, as well as our value-added processing services.

We supply a complete range of items in many alloys, including C-276, 22, B-2, B-3®, 200/201, 400, 405, K-500, 625, 600, 800H/HT®, 20, F255, 6B, Titanium Gr. 2 and Titanium Gr. 5.

Our machine shop, welding shop and processing departments are equipped with state-of-the-art manufacturing equipment allowing Corrosion Materials the ability to provide the service you desire along with the economic and technical advantages you need and deserve.

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