



Langley Alloys

Nickel
Alloys

Alloy K-500

Specifications:

UNS N05500, Werkstoff No. 2.4375, BS 3072-3076 (NA18), ASTM B865, NACE MR0175 / ISO 15156, AMS 4676, DIN 17743

Alloy K-500 is a precipitation-hardenable Nickel-Copper alloy. Although Langley Alloys supply Alloy K-500 in all conditions, we predominantly supply material in the Hot Worked and Precipitation Treated condition, which offers the optimum combination of high strength and ductility across the size range. The increased properties are obtained by adding Aluminium and Titanium to the nickel-copper base, and by heating under controlled conditions so that particles of 'Y' $\text{Ni}_3(\text{Ti, Al})$ are precipitated throughout the matrix. The thermal processing used to effect precipitation is commonly called age hardening or ageing.

This alloy provides excellent corrosion resistance in a range of environments including sea water, hydrofluoric acid, sulphuric acid and alkalis. It has found to be resistant to a sour-gas environment and is listed within NACE MR0175. The combination of very low corrosion rates in high-velocity sea water and high strength make it well-suited for marine shafts in stagnant or slow-moving sea water, fouling may occur followed by pitting but this pitting slows down after a fairly rapid initial attack.

Alloy K-500 is refined by Electro Slag Refining (ESR), ensuring the cleanest and highest quality of material is supplied. This increased alloy purity limits the likelihood of hard non-metallic inclusion that can increase machining difficulty, processing times and ultimately part failures. It also has low permeability and is nonmagnetic to temperatures as low as -150°F (-101°C).

Key Features:

- High strength and hardness from sub-zero to elevated temperatures
- Excellent corrosion resistance in a wide range of environments
- Resistant to chloride stress corrosion
- Good resistance to impingement attack
- High fatigue strength in seawater
- Low magnetic permeability to very low temperatures

Typical Applications:

- Process industry applications such as doctor blades & scrapers involving organic acids, caustic soda, dry chlorine, chlorinated plastics
- Marine industry and shipbuilding applications such as propellers, shafts, fasteners, gyroscopes, springs
- Oil & Gas industry pump shafts, valve stems, drill collars, instrumentation
- Sensors and electronic components
- Heat exchanger components

Physical Properties:

Density (Kg/m^3)	8430
Magnetic Permeability (20°C)	<1.005 (1.002 typical)
Young's Modulus (kN/mm^2)	179
Specific Electrical Resistance, 20°C ($\mu\Omega\text{-m}$)	0.62
Mean coefficient of thermal expansion, $20\text{-}100^\circ\text{C}$ ($\text{m/m}^\circ\text{C}$)	13.4×10^{-6}
Specific Heat, 20°C (J/kg.K)	418
Thermal conductivity, 20°C (W/m.K)	17.5
Curie Temperature ($^\circ\text{C}$)	-90

Product Forms Available:

Bar	✓
Plate	Enquiry
Tube	Enquiry
Fittings	Enquiry
Forgings	To order
Castings	To order

Machining Advice:

Operation	Cutting Speed m/min (ft/min)	Feed Rate mm/rev (in/rev)	Depth of cut mm (in)
Milling	10 (32)	0.08-0.15 mm/tooth 0.003-0.006 in/tooth	0.2 - 3.0 (0.007 - 0.12)
Drilling 6.4mm (1/4") dia	6 - 8 (19 - 25)	0.08 (0.003)	
Drilling 12.7mm (1/2") dia	6 - 8 (19 - 25)	0.13 (0.005)	
Drilling 25.4mm (1") dia	6 - 8 (19 - 25)	0.20 (0.008)	
Turning - Roughing	18 - 24 (60 - 75)	0.25 - 0.40 (0.010 - 0.020)	2.5 (0.10)
Turning - Finishing	31 - 38 (100 - 120)	0.10 - 0.20 (0.004 - 0.008)	0.25 (0.01)
Tooling	Milling/Turning: Carbide (SANDVIK GC 235, SECO T25M) Drilling: HSS, point angle 118° , chisel angle 120°		

Mechanical Properties:

	Cold Worked & Precipitation Treated		Cold Worked, Solution Treated & Precipitation Treated		Hot Worked & Precipitation Treated		Hot Worked, Solution Treated & Precipitation Treated		
	≤25mm	≤25mm	≤25mm	≤25mm	≤110mm	110 - 300mm	≤25mm	25- 110mm	110 - 300mm
Bars section size or diameter									
0.2% Proof Stress N/mm ² (ksi)	760 (110)	690 (100)	620 (89.9)	550 (79.8)	724 (105)	724 (105)	500 (72.5)	585 (84.8)	500 (72.5)
Tensile Strength, N/mm ² (ksi)	1000 (145)	970 (140.6)	900 (130.5)	830 (120)	965 (140)	965 (140)	830 (120.3)	900 (130.5)	830 (120.3)
Elongation, 5.65√S0 and 4D	14%	16%	20%	20%	20%	20%	15%	20%	15%
Hardness (Rockwell C)	27-35	27-35	27-35	27-35	27-35	27-35	27-35	27-35	27-35
Impact Strength (-29°C or lower)	27J av (20J min)	27J av (20J min)	27J av (20J min)	27J av (20J min)	27J av (20J min)	27J av (20J min)	27J av (20J min)	27J av (20J min)	27J av (20J min)

Notes:

1. Testing shall be carried out in accordance with ASTM A370 or EN ISO 6892-1 (tensile), EN ISO 6506-1 (hardness)
2. Minimum properties quoted (tested at room temperature in a longitudinal direction)
3. Testing performed on each melt of material per heat treatment batch

Chemical Composition:

	Cr	Ni	Mo	Co	Nb (+Ta)	Ti	V	W	Cu	C	Mn	N	Si	P	S	Fe	Al
Min		63.00				0.35			27.0								2.30
Max						0.85			33.0	0.25	1.50		0.50		0.010	2.0	3.15

Product Comparison:

Alloy Comparisons	N05500	N04400	S31803	N07718 (Aged)	Ferrallium® 255-SD50
0.2% Proof Strength (N/mm ²)	690	170	450	827	600
Corrosion Rate (mm/year) - Seawater	0.18	0.25	<0.10	<0.01	<0.01
Corrosion Rate (mm/year) - 10% sulphuric acid at 80°C	0.1	0.06	0.4	<0.15	<0.15
Corrosion Rate (mm/year) - Boiling 50% nitric acid	<2	1.1	>5	>1.5	>5

Production Route:

Alloy K-500 is produced through high-quality melting processes to ensure cleanliness and consistency.

- a) All material shall be refined by Electro Slag Refining (ESR)
- b) The minimum forging ratio utilised is at least 4:1, between 900-1170°C.
- c) Precipitation Treatment shall be undertaken by
 - a. Double-ageing at 580-610°C, then 480°C, followed by air cool
 - b. Double-ageing at 640°C, then 480°C, followed by air cool
- d) Bars are supplied peeled and polished to a surface finish of 125CLA or better
- e) Each bar is ultrasonically tested and visually inspected

Further Processing:

- Order processing and stock control is facilitated by a fully-integrated computer system which links to item production and inspection.
- Automated band saws are available for accurate stock cutting up to a section size of 650mm (25").
- First-stage processing, including water jet cutting, turning, boring and grinding can be undertaken to help manage your overall supply chain
- Additional documentation and certification can be supplied as required

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