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PRODUCT DATA SHEET

Monel 400, R-405 UNS N04400

Nickel Alloys

Monel 400 is a versatile nickel copper alloy with good strength and toughness, combined with outstanding corrosion resistance. **Monel R-405** is a free cutting version with similar properties.

Chemical Composition

(ASTM B127 – Plate, sheet & strip)

Element	%	Element	%
Nickel	63.0 min	Manganese	2.0 max
Copper	28.0 – 34.0	Silicon	0.5 max
Iron	2.5 max	Carbon	0.3 max
Sulphur (Monel 400)	0.024 max	Sulphur (Monel R-405)	0.025 – 0.060

Specified Minimum

Mechanical

Properties

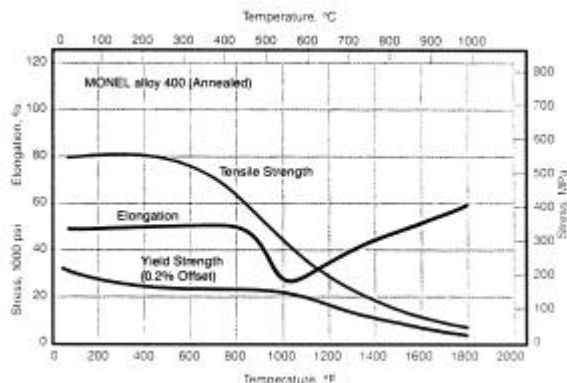
(ASTM B127 – Plate, sheet & strip)

	As hot rolled	Annealed	Hard
0.2% Proof Stress, MPa	275	195	620
Tensile Strength, MPa	515	485	690
Elongation, %	25	35	2

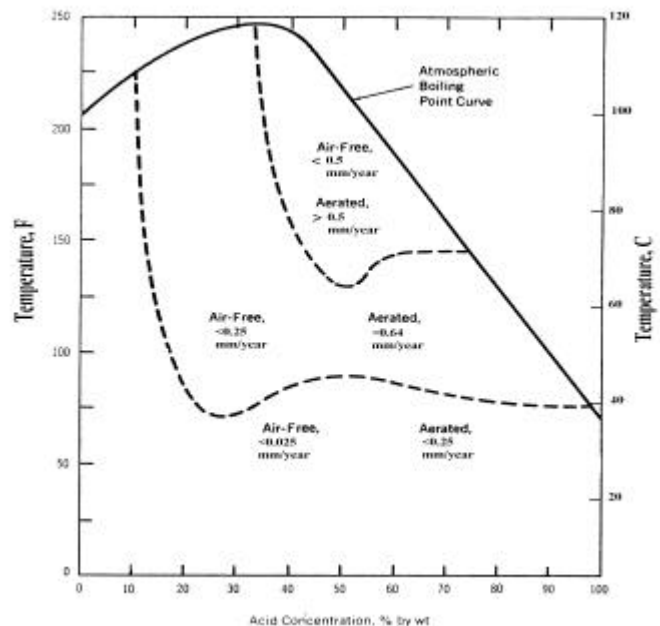
Typical Applications Chemical plant, valves and pumps, pump & propeller shafts, marine fixtures and fasteners, electrical components, springs, gasoline & fresh water tanks, petroleum stills, process vessels & piping, boiler feedwater heaters and other heat exchangers, deaerating heaters.

Description Monel 400 is a nickel copper alloy with good strength and ductility, good weldability and excellent resistance to corrosion. It is tough over a wide range of temperatures. It is often used in marine applications. Corrosion rates in strongly agitated and aerated sea water are extremely low. The alloy has useful properties to 540°C in oxidising atmospheres and higher temperatures in reducing conditions. Monel 400 is readily welded and brazed.

Austral Wright Metals can supply Monel 400 as plate, sheet and strip, rod and bar, seamless and welded tube and pipe, condenser and heat exchanger tube, welding fittings, forgings and forging billet, wire. Monel R-405 is available as rod and bar.



High temperature tensile properties of annealed Monel 400.



Isocorrosion chart of Monel 400 in hydrofluoric acid.

Pressure Vessels AS1210 & ASME Boiler & Pressure Vessel Code pre-qualify Monel 400 for use in pressure vessels up to about 475°C.

Corrosion Resistance Monel 400 is generally more corrosion resistant than both of the major constituents nickel and copper. It is highly resistant to chlorinated solvents, glass etching agents, sulphuric, hydrofluoric and many other acids, and practically all alkalis. The alloy gives excellent service in sea water under high velocity conditions, where resistance to cavitation and erosion are important. Corrosion rates in strongly agitated and aerated sea water are extremely low. It is generally free from chloride stress corrosion cracking, but only annealed material resists stress cracking in the presence of mercury or mercury salts, and in moist, aerated hydrofluoric acid vapour. It should not be used for nitric acid service. Please consult Austral Wright Metals for specific advice on your application.

Equivalent Grade Specifications	Country	Body	Grade
	USA	UNS	N04400
	France	AFNOR	NU30
	GB	BS	NA13
	Germany	DIN	2.4360, 2.4361

Fabrication Monel 400 can be readily hot worked, with lower forces than many steels. The alloy can easily be cold formed, with forces between those of carbon steel and grade 304 stainless steel.

Machinability Monel 400 is easy to machine (class B). Sharp tools, slow speeds and deep uninterrupted cuts to remove the work hardened layer are needed. Monel R-405 is a free cutting version of Monel 400, for rapid production in automatic screw machines. Toughness, strength and corrosion resistance are very similar to Monel 400.

Welding Monel 400 is readily welded by GMAW (MIG), GTAW (TIG), SMAW (manual) and SAW processes. Preheat, post heat and post weld heat treatment are not required. The area around the weld must be clean to prevent contamination of the weld pool. Argon shielding gas is used.

Filler Metal Selection (self welds)	Normal Service	Higher Strength	Best Corrosion Resistance	
	Welding electrode	Monel WE 190	Monel WE 190	Monel WE 190
	Filler metal	Monel FM 60	Monel FM 60	Monel FM 60
	Flux cored wire	-	Inco-Cored 82DH	-

Heat Treatment Monel 400 is annealed at 870–980°C, cooling rate not critical. Grain growth is rapid in this alloy, so use the lower end of the temperature range and minimal time to retain good strength. Stress relief, if required, is at 540-570°C. Stress equalising cold worked material at 300°C markedly increases the proof stress, without affecting other properties.

Physical Properties (Monel 400 and Monel R-405)

Property	at	value	unit	Property	at	value	unit	
Density	20°C	8,800	kg/m ³	Specific Heat	20°C	427	J/kg . °C	
Melting Range		1300 – 1350	°C	Mean Coefficient of Expansion	20°C	13.9	x 10 ⁻⁶ / °C	
Modulus of Elasticity				Thermal Conductivity	20°C	21.8	W / m . °C	
	Tension	20°C	179	GPa	Curie Temperature		20 – 50	°C
	Torsion	20°C	65.5	GPa	Electrical Resistivity	20°C	0.547	micro-ohm . m
Poisson's ratio	20°C	0.32		Electrical Conductivity	20°C	32	% IACS	

ASTM Product Specifications

Specification Title	
B163	Seamless Nickel and Nickel Alloy Condenser and Heat-Exchanger Tubes
B366	Factory-Made Wrought Nickel and Nickel Alloy Fittings
B564	Nickel Alloy Forgings
B127	Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
B164	Nickel-Copper Alloy Rod, Bar, and Wire
B165	Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube
B725	Welded Nickel (UNS N02200/UNS N02201) and Nickel Copper Alloy (UNS N04400) Pipe
B730	Welded Nickel (UNS N02200/UNS N02201) and Nickel Copper Alloy (UNS N04400) Tube