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## PRODUCT DATA SHEET

## INCOLOY Alloy 825 UNS N08825

## Nickel Alloys

**Incoloy alloy 825** is a nickel iron chromium alloy with additions of molybdenum, copper and titanium, with exceptional resistance to many aggressive corrosion environments.

### Chemical Composition (ASTM B163 – Heat Exchanger Tube)

Element	%	Element	%
Nickel	38.0 – 46.0	Carbon	0.05% max
Chromium	19.5 – 23.5	Manganese	1.0 max
Molybdenum	2.5 – 3.5	Sulphur	0.03 max
Copper	1.5 – 3.0	Silicon	0.5 max
Titanium	0.6 – 1.2	Aluminium	0.2 max
Iron	22.0 min (~33%)		

**Typical Applications** Sulphuric acid piping and vessels, phosphoric acid evaporators, pickling tank heaters, pickling tanks and equipment, chemical process equipment, propellor shafts, tank trucks, calorifiers, electrostatic precipitator electrodes, hot vessels for food, water and seawater, ammonium sulphate vessels, expansion bellows, marine exhaust systems, power station ash hoppers.

### Typical Room Temperature Tensile Properties

(NOT FOR DESIGN. Consult the relevant material or product specification for design values)

Form	Condition	0.2% Proof Stress MPa	Tensile Strength MPa	Elongation %
Tube	Annealed	440	770	35
Tube	Cold Drawn	880	1000	15
Bar	Annealed	325	690	45
Plate	Annealed	340	660	45
Sheet	Annealed	420	760	39

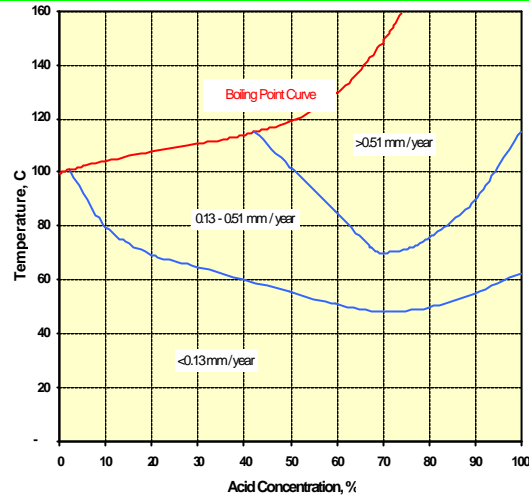
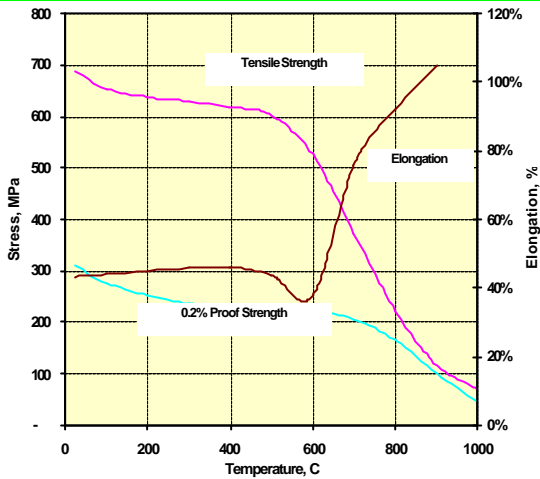
**Description** Incoloy 825 is highly resistant to corrosion. It has a high nickel content, sufficient to resist chloride ion stress corrosion cracking, and a very stable austenite structure. The levels of molybdenum and copper enable the alloy to resist reducing agents and acids. Chromium gives resistance to oxidising conditions, such as nitric acid solutions, nitrates and oxidising salts. The alloy is titanium stabilised to resist pitting and intergranular attack after fabrication, particularly welding, which includes heating in the critical sensitisation temperature range (650°C – 760°C).

Alloy 825 offers exceptional resistance to corrosion by sulphuric and phosphoric acids and is often the most cost effective alloy in sulphuric acid service.

**Austral Wright Metals** can supply this alloy as plate, sheet, strip, bar, rod, wire, tube, pipe, fittings, fasteners.

**Pressure Vessels** Incoloy 825 is approved for pressure vessel operating temperatures up to 525°C (AS1210, AS4041), 538°C (ASME Boiler & Pressure Vessel Code, Sections I, III, VIII, IX, Cases 1936, N-188). Brittle phases may form in alloy 825 at temperatures above ~ 540°C, so it is not normally used at these temperatures, where creep-rupture properties would be design factors.

**Corrosion Resistance** The outstanding property of Incoloy 825 is its corrosion resistance. In reducing & oxidising conditions, Incoloy 825 resists general corrosion, pitting & crevice corrosion, intergranular corrosion and stress corrosion cracking. It is particularly useful in sulphuric & phosphoric acids, sulphur containing flue gases, sour gas and oil wells and sea water.



High temperature tensile properties of annealed bar

Isocorrosion chart in laboratory pure sulphuric acid

**Fabrication** Incoloy 825 can be readily hot or cold worked. Hot working should be in the range 870 - 1180°C, finishing at 870 – 980°C. For maximum corrosion resistance hot worked parts should be stabilise annealed before use. The alloy is easier to cold form than stainless steels.

**Machinability** Incoloy 825 is classed as a 'C' alloy, and is reasonably easy to machine.

**Welding** The alloy is readily weldable by the normal processes (GMAW (MIG), GTAW (TIG), SMAW (manual), SAW). The joint must be clean to avoid contamination of the weld pool.

**Welding Consumables**

	Normal Service	Higher Strength	Best Corrosion Resistance
Welding electrode	Inconel WE 112	Inconel WE 112	Inconel WE 112
Filler metal	Inconel FM 625	Inconel FM 625	Inconel FM 625
Flux cored wire	Inco Cored 625DH	Inco Cored 625DH	Inco Cored 625DH

**Heat Treatment** Incoloy 825 is stabilise annealed at 940°C. The softest structure is obtained at 980°C. Sections heavier than sheet, strip and wire should be quenched to avoid sensitisation. Please consult Austral Wright Metals for specific advice on your application.

**Equivalent Grade Designations**

Country	Body	Designation
USA	UNS	N08825
France	AFNOR	NC 21 FeDU
GB	BS	NA 16
Germany	DIN	NiCr21Mo
Germany	Werkstoff Nr	2.4858

**Physical Properties**

Property	at	value	unit	Property	at	value	unit
Density	20°C	8,140	kg/m <sup>3</sup>	Melting Range		1370 – 1400	°C
Electrical Resistivity	25°C	1.13	micro ohm . m	Specific Heat	20°C	440	J/kg. °C
Modulus of Elasticity				Thermal Conductivity	25°C	11.1	W/m . °C
Tension	23°C	206	GPa	Coefficient of Expansion	20-100°C	14.1	x 10 <sup>-6</sup> /°C
Torsion	23°C	72.5	GPa		20-300°C	15.3	x 10 <sup>-6</sup> /°C
Poisson's Ratio	23°C	0.42			20-500°C	15.8	x 10 <sup>-6</sup> /°C
Curie Temperature		< - 196	°C				
Permeability	200 Oe	1.005					

**ASTM Product Specifications**

Specification	Title
B163	Seamless Nickel and Nickel Alloy Condenser and Heat-Exchanger Tubes
B423	Nickel-Iron-Chromium-Molybdenum-Copper Alloy (UNS N08825 and N08221)* Seamless Pipe and Tube
B424	Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825 and UNS N08221)* Plate, Sheet, and Strip
B425	Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825)
B704	Welded UNS N06625 and UNS N08825 Alloy Tubes
B705	Nickel-Alloy (UNS N06625 and N08825) Welded Pipe
B751	General Requirements for Nickel and Nickel Alloy Welded Tube