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## PRODUCT DATA SHEET

## Inconel 625, 625LCF UNS N06625

## Nickel Alloys

**Inconel 625** is a nickel chromium molybdenum alloy with high strength at elevated temperatures, combined with outstanding corrosion resistance. It has the best all-round combination of strength and corrosion resistance of the Inconel family of alloys. It is pre-qualified for use in pressure vessels up to 815°C. Inconel 625LCF is a special quality of the alloy for use in bellows.

### Chemical Composition (ASTM B446 – Bar)

Element	%	Element	%	Element	%
Nickel	58.0 min	Cobalt (if determined)	1.0 max	Silicon	0.15 max
Chromium	20.0 - 23.0	Manganese	0.50 max	Phosphorus	0.015 max
Molybdenum	8.0 - 10.0	Carbon (Inconel 625)	0.10 max	Sulphur	0.015 max
Niobium + Tantalum	3.15 - 4.15	Carbon (Inconel 625LCF)	0.03 max	Aluminium	0.40 max
Iron	5.0 max	Nitrogen (Inconel 625LCF)	0.02 max	Titanium	0.40 max

### Specified Minimum Mechanical Properties (ASTM B446 – Bar)

Diameter	Grade 1 (Annealed)		Grade 2 (Solution annealed)
	Up to 102 mm	103 to 254 mm	All
0.2% Proof Stress, MPa	415	345	275
Tensile Strength, MPa	830	760	690
Elongation, %	30	25	30

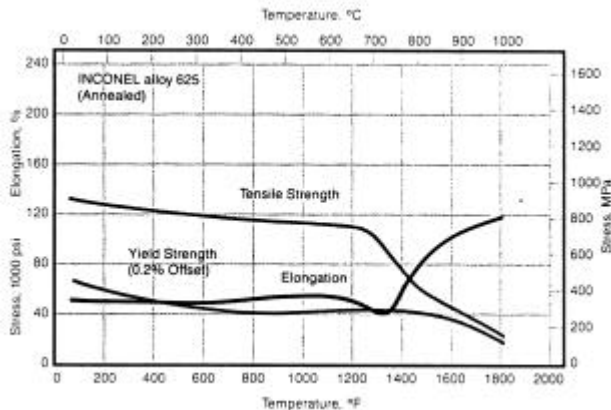
Grade 1 – annealed at 870°C minimum

Grade 2 – solution annealed at 1090°C (min), with or without stabilise anneal at 980°C (min) for sensitisation resistance.

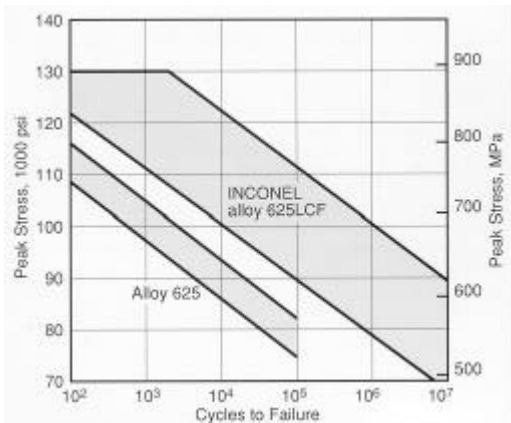
**Typical Applications** Chemical plant, bellows, submerged marine components, weld overlays, power station scrubber systems, general corrosion applications for aggressive environments, combustion and ducting systems, fuel nozzles, after burners, aerospace components.

**Description** Inconel 625 is a nickel chromium molybdenum solid solution strengthened high strength alloy, which retains strength to high temperatures. It is used from cryogenic temperatures to 980°C. Fatigue strength is outstanding, particularly as the bellows grade, Inconel 625LCF, where carbon, silicon and nitrogen are controlled to low levels. The alloys have good oxidation resistance and resist corrosion by many corrosive media. When exposed to high temperature for long periods, Inconel 625 will age harden due to the niobium, titanium and aluminium additions. When aged there is an increase in strength and some loss of ductility and toughness.

**Austral Wright Metals** can supply Inconel 625 as plate, sheet and strip, rod and bar, seamless and welded tube and pipe, welding fittings, forgings and forging billet. Inconel 625LCF is available as annealed sheet and strip from 0.13 mm to 2.54 mm thick, up to 1219 mm wide.



High temperature tensile properties of annealed Inconel 625 sheet.



Low cycle fatigue strength of Inconel 625 and Inconel 625LCF at 480 – 650°C.

**Pressure Vessels** AS1210 prequalifies Inconel 625 up to 625°C as flat products, and 650°C as bar and forgings. ASME Boiler & Pressure Vessel Code, Section VIII (Code Case 1409-5) allows annealed material to be used to 650°C, solution treated to 815°C.

**Corrosion Resistance** Inconel 625 has a corrosion resistance to many environments. In mild environments such as atmosphere, fresh water and sea water, neutral salts and alkaline media there is almost no attack. In more aggressive media nickel and chromium resist oxidising attack, while nickel and molybdenum resist reducing environments. Molybdenum provides exceptional resistance to pitting and crevice corrosion, and niobium stabilises against sensitisation and intergranular corrosion. The nickel content makes Inconel 625 essentially free from chloride ion stress corrosion cracking. Inconel 625 also has excellent corrosion fatigue properties. Please consult Austral Wright Metals for specific advice on your application.

Corrosion rates (mm/year) in a municipal waste incinerator at 650 – 700°C after 2050 hours & 6750 hours

Alloy	2050 hours	6750 hours	Alloy	2050 hours	6750 hours
Inconel 625	7	13	SS 310	48	89
<b>Incoloy 800</b>	35	Destroyed	<b>SS 316</b>	71	Destroyed
<b>Incoloy 825</b>	127	Destroyed	<b>SS 446</b>	82	54

**Equivalent Grade Specifications**

Country	Body	Grade
USA	UNS	N06625
France	AFNOR	NC 22 D Nb
GB	BS	NA21
Germany	DIN	2.4856

**Fabrication** Inconel 625 was developed for hot strength, so resists hot working. It is ductile and can be readily hot worked with high forces. The alloy can also be cold formed with heavy forces. Intermediate annealing may be needed.

**Machinability** Inconel 625 is difficult to machine (class D-2). Heavy machines, sharp tools, slow speeds and deep uninterrupted cuts to remove the work hardened layer are needed.

**Welding** Inconel 625 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.

	Normal Service	Higher Strength	Best Corrosion Resistance
Welding electrode	Inconel WE 112	N/A	Inco Weld WE 686CPT
Filler metal	Inconel FM 625	Inco Weld FM725NDUR	Inco Weld FM 686CPT
Flux cored wire	Inco Cored 625DH	N/A	N/A

**Heat Treatment** Inconel 625 is annealed at 925–1040°C, cooling rate not critical. Solution anneal at 1090–1200°C. Stress relief, if required, is at 590–760°C, or up to 870°C for complete relief.

**Physical Properties (Inconel 625 and 625LCF, annealed)**

Property	at	value	unit	Property	at	value	unit
Density	20°C	8,440	kg/m <sup>3</sup>	Specific Heat	20°C	410	J/kg . °C
Melting Range		1290 – 1350	°C	Mean Coefficient of Expansion	20°C	12.8	x 10 <sup>-6</sup> / °C
Electrical Resistivity	20°C	1.29	micro-ohm . m	Thermal Conductivity	20°C	9.8	W / m . °C
Electrical conductivity	20°C	1.3	% IACS	Curie Temperature		< - 196	°C
Modulus of Elasticity (Annealed)				Modulus of Elasticity (Solution treated)			
Tension	20°C	208	GPa	Tension	20°C	205	GPa
Torsion	20°C	81.4	GPa	Torsion	20°C	77.9	GPa
Poisson's ratio	20°C	0.278		Poisson's ratio	20°C	0.312	

**ASTM Product Specifications**

Specification	Title
B366	Factory-Made Wrought Nickel and Nickel Alloy Fittings
B443	Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) Plate, Sheet, and Strip
B444	Nickel-Chromium-Molybdenum-Columbium Alloys (UNS N06625) Pipe and Tube
B446	Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) Rod and Bar
B564	Nickel Alloy Forgings
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

Note: the element niobium is called columbium in USA