Alloy 625

Alloy 625 is a high-strength, corrosion-resistant nickel-chromium-molybdenum-niobium superalloy known for exceptional performance from cryogenic temperatures up to 1800°F (982°C). Strength is derived from solid-solution hardening by molybdenum and niobium, meaning no precipitation-hardening heat treatment is required.

Standards & Designations

- **UNS**: S41000
- **EN / W. Nr.**: 2.4856
- **AMS**: 5599 (sheet/plate), 5666 (bars/forgings)
- **ASTM/ASME**: B443 (sheet/plate), B444 (tube/pipe), B446 (bars), B704/B705 (welded tube/pipe)

Corrosion Resistance: Alloy 625 offers strong, versatile corrosion resistance, protecting against pitting and crevice attack, chloride-induced stress-corrosion cracking, a wide range of oxidizing and non-oxidizing acids, and harsh marine environments including seawater and brines.

Heat Treatment: Alloy 625 is typically supplied in the annealed condition.

- Solution annealing: ~2000°F (1093°C)
- No precipitation-hardening required (strength is inherent to the solid-solution matrix).

Welding:

- **Machining**: difficult to machine due to its high strength and rapid work-hardening, requiring rigid tooling, slow speeds, heavy feeds, and sharp carbide tools. Despite challenging machinability, it maintains excellent corrosion resistance even after significant cold work.
- **Forming**: excellent formability in both cold and hot conditions, allowing deep drawing, bending, and rolling with low cracking risk. Because it work-hardens quickly, intermediate anneals may be needed, and hot-formed parts are typically solution-annealed to restore full performance.
- **Welding**: outstanding weldability, producing welds resistant to intergranular corrosion and chloride stress-corrosion cracking. It is compatible with common filler metals like ER625 (AMS 5837) and performs well in all major processes, including GTAW, GMAW, SMAW, and FCAW.
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The list of applications for this general-purpose grade is very extensive and includes:

- heat-exchanger
- bellows, springs, subsea hardware
- jet engine exhaust systems
- transfer piping
- distillation columns
- anti-corrosion tubing & fasteners
- reaction vessels
- furnace hardware
- seawater components

A.I.S.I. Analysis	Grade	Cr	Ni	Mo	Nb + Ta	Fe	Mn	Si
	625	20.0 – 23.0	Balance	8.0 – 10.0	3.15 – 4.15	5.0 max	0.5 max	0.5 max

Typical Mechanical Properties - Annealed	Yield Strength .2% Offset (psi)	Ultimate Strength (psi)	Elongation % in 2″
	55,100	110,200	35

Other Properties	Specific Heat (BTU/lb-°F)	Electrical Resistivity at 68°F (μΩ-cm)	Thermal Conductivity (32–212°F) (BTU./ft.$_2$/hr./°F/ft)	Thermal Expansion 32° – 212°F (In/In/°F×10^{-6})
	0.098	126	112	9.0×10^{-6}