Alloy 400

Alloy 400 commonly known as MONEL® 400, is a nickel–copper solid-solution alloy offering high strength, excellent toughness, and exceptional resistance to many corrosive environments. It performs reliably across a wide temperature range and is especially valued in marine, chemical, and hydrocarbon processing applications.

Standards & Designations

- **UNS**: N04400
- **EN / W. Nr.**: 2.4360 / 2.4361
- **ASTM/ASME**: B127 (plate/sheet/strip), B163 & B165 (pipe/tube), B164 (bar), B564 (forgings)

Corrosion Resistance: Alloy 400 provides strong corrosion immunity across a broad spectrum of service environments. It is highly resistant to seawater, steam, and brackish water, including rapidly flowing warm seawater. It performs well in non-oxidizing mineral acids, alkaline solutions, and chloride environments, and shows notable resistance to hydrochloric and hydrofluoric acids when de-aerated.

Heat Treatment: Alloy 400 cannot be strengthened by heat treatment and is hardened only through cold work, as it is a solid-solution nickel–copper alloy. Its primary thermal treatment is annealing, which is used to restore ductility after cold work.

Welding:

- **Machining**: Because Alloy 400 work-hardens rapidly, machining requires rigid tooling, heavy feeds, and sharp cutting edges. Its behavior is similar to that of other high-nickel alloys. The more machinable alternative, Alloy R405, is sometimes chosen when extensive machining is required.
- **Forming**: highly ductile and can be readily formed using standard cold- and hot-working operations. As a solid-solution alloy, it hardens only by cold work, which can be used strategically to increase strength. It offers good workability across plate, sheet, strip, and long products, and is supplied in tempers that allow adjustments to required strength levels.
- **Welding**: Alloy 400 exhibits good weldability, making it suitable for fabrication using most conventional welding processes. Welds maintain strong resistance to general corrosion and are fully compatible with the alloy's performance in marine and chemical environments.

The list of applications for this general-purpose grade is very extensive and includes:

- heat-exchanger
- seawater equipment
- pumps, valves, and propeller shafts
- marine fixtures
- refinery transfer piping
- steam generator tubing
- distillation towers
- press plates
- petroleum stills

A.I.S.I. Analysis	Grade	Ni-Co	Cu	Fe	Mn	Si	C	S
	400	63.0-70.0	28.0–34.0	2.5 max	2.0 max	0.5 max	0.3 max	.024 max

Typical Mechanical Properties - Annealed	Yield Strength .2% Offset psi	Ultimate Strength psi	Elongation % in 2"	Hardness (Rb)
	25,000 – 55,000	70,000 – 90,000	35-60	85

Other Properties	Specific Heat (BTU/lb-°F)	Electrical Resistivity at 68^0F (μΩ-cm)	Poisson's Ratio	Specific Gravity	Thermal Expansion 70^0 - 200^0F (In/In/^{0}F×10^{-6})	Thermal Conductivity (BTU./ft.$_2$/hr./^{0}F/ft)
	0.10	51	0.32	8.83	7.7×10^{-6} /K	14.0 (at 200^0F)