ALLOY 400 TECHNICAL DATA

Type Analysis

Element	Min	Max
Carbon	--	0.3
Nickel	63.0	70.0
Iron	--	2.5
Silicon	--	0.5
Manganese	--	2.00
Sulfur	--	0.024
Copper	28.0	34.0

Description

Alloy 400 is a nickel-copper solid solution strengthened alloy. The alloy is characterized by moderate strength, good weldability, good general corrosion resistance and toughness. It is useful at temperatures up to 1000°F (538°C). Alloy 400 has excellent resistance to rapidly flowing brackish or seawater where cavitation and erosion resistance is necessary. It is particularly resistant to hydrochloric and hydrofluoric acids when they are de-aerated. Alloy 400 is slightly magnetic at room temperature.

Applications

Some typical applications for alloy 400 are:
• Chlorinated solvents
• Crude oil distillation towers
• Ethyl chloride purification
• HF alkylation
• HF reboilers
• Marine components
• Marine splash zone sheathing
• MEA reboilers
• Oil well recovery pumps
• Salt production
• Salt residual compounds
• Shafting
• Wire netting for insulation

Corrosion Resistance

Alloy 400 is virtually immune to chloride ion stress corrosion cracking in typical environments. Generally, its corrosion resistance is very good in reducing environments, but poor in oxidizing conditions.
Alloy 400 is resistant to most alkalis, salts, waters (including saline or brackish), food products, organic substances and atmospheric conditions at normal and elevated temperatures.
This alloy is not useful in highly oxidizing acids, such as nitric and nitrous. It is resistant to sulfuric acid in concentrations to 80% and in hydrochloric solutions in concentrations to 20%.
Oxidizing impurities such as ferric chloride, ferric sulfate, chromates, nitrates, peroxides, and cupric salts, can cause attack in a medium which would otherwise be relatively mild for the alloy.

Average Physical Properties

Physical Property	Temp.,°F	British Units	Temp.,°C	Metric Units
Density	Room	0.319 lb./in.³	Room	8.83 g/cm³
Electrical Resistivity	70 200 400 600 800	20.1 microhm-in. 20.9 microhm-in. 22.0 microhm-in. 22.4 microhm-in. 23.2 microhm-in.	21 93 204 316 427	0.51 microhm-m 0.53 microhm-m 0.56 microhm-m 0.57 microhm-m 0.59 microhm-m
Mean Coefficient of Thermal Expansion	70-200 70-400 70-600 70-800	7.7 microin./in.-°F 8.6 microin./in.-°F 8.8 microin./in.-°F 8.9 microin./in.-°F	21-93 21-204 21-316 21-427	13.9 X 10(-6)m/m-K 15.5 X 10(-6)m/m-K 15.8 X 10(-6)m/m-K 16.0 X 10(-6)m/m-K
Thermal Conductivity	70 200 400 600 800	151 Btu-in/ft²-hr-°F 167 Btu-in/ft²-hr-°F 193 Btu-in/ft²-hr-°F 215 Btu-in/ft²-hr-°F 238 Btu-in/ft²-hr-°F	21 93 204 316 427	21.8 W/m-K 24.1 W/m-K 27.8 W/m-K 31.0 W/m-K 34.3 W/m-K
Modulus of Elasticity	Room	26.0 X 10(6) psi	Room	179 GPa

Workability

Hot Working/Cold Working
Alloy 400 is readily hot or cold worked. The hot working range is 1700°F to 2150°F. Optimum working temperature is appoximately 2000°F. Finished fabrications can be produced to a rather wide range of mechanical properities by proper control of the amount of hot and/or cold work and by the selection of proper thermal treatments.

Machinability
The alloy can be machined at satisfactory rates with machine tools generally employed by industry. Generally, cold drawn or cold drawn-stress relieved material is suggested for best machinability and smoothest finish.

Joining
The alloy can be welded, brazed or soldered. Gas or electric welding methods can be employed. When gas welding, the flame must be closed to neutral (on the reducing side), and the work must be done rapidly without rewelding.

Heat Treatment

Both cold worked and hot worked Alloy 400 may be annealed or stress relieved for the desired combination of strength and ductility and to minimized distortion during subsequent machining.

Annealing
Heating should be done in a sulfur-free reducing atmosphere. The annealing range is 1300 to 1800°F, however 1600 to 1800°F is most typical. The lower annealing temperatures (e.g. 1300 to 1500°F) can be utilized with longer times at temperature to minimize grain coarsening.

Stress Relieving
Stress relieving will reduce stresses without recrystallizing the grain structure. Heating to 1000/1050°F for 1 to 2 hours will relieve strains in either hot or cold worked products.

Mechanical Properties

Minimum Room Temperature Tensile Data

Form	Condition	Ultimate Tensile Strength ksi(MPa)	Yield Strength at 0.2% offset, ksi(MPa)	Elongation in 2" or 4D, percent
Sheet, Plate, Strip	Annealed	70.0 (480)	28.0 (195)	35
Bar	Annealed	70.0 (480)	25.0 (170)	35

Applicable Specifications

QQ-N-281
AMS 4544