

# Alloy 400

**Alloy 400 (UNS N04400)** is a nickel-copper alloy with high strength and excellent resistance to a range of media including seawater, dilute hydrofluoric and sulfuric acids, and alkalis.

## Specification

NiWire's production follows:

ASTM B 127 (plate, sheet, and strip), B 163 (condenser and heat exchanger tube), B 164 (rod, bar, and wire), B 165 (seamless pipe and tube), B 366 (welding fittings), B 564 (forgings), B 725 (welded pipe), B 730 (welded tube), B 751 (welded tube, general requirements), B 775 (welded pipe, general requirements), B 829 (seamless pipe and tube, general requirements)

AMS 4544 (sheet, strip, plate), 4675 (bar, forging), 4730 (wire), 4731 (wire, ribbon), 4574 (seamless tubing)

## Chemical Composition

*Composition limits.* 63.0 to 70.0 Ni + Co; 0.30 max C; 2.0 max Mn; 2.5 max Fe; 0.24 max S; 0.50 max Si; bal Cu

## Applications

*Typical uses:* Valve and pump parts, propeller shafts, marine fixtures and fasteners, electronic components, chemical processing equipment, gasoline and freshwater tanks, petroleum processing equipment, boiler feedwater heaters and other heat exchangers

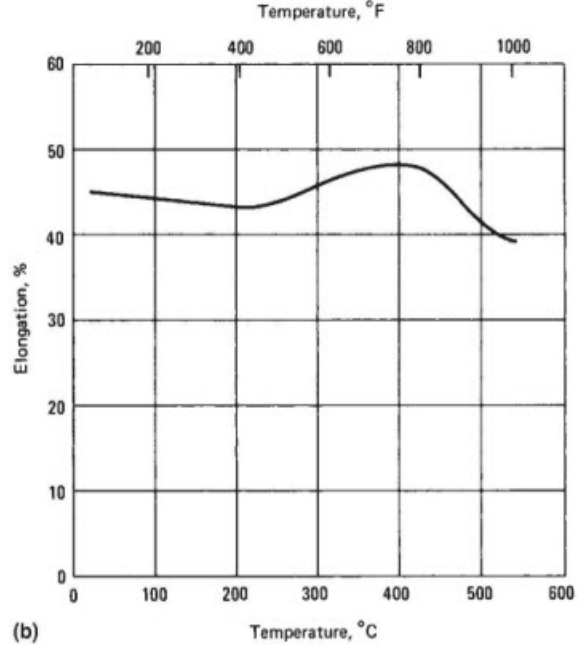
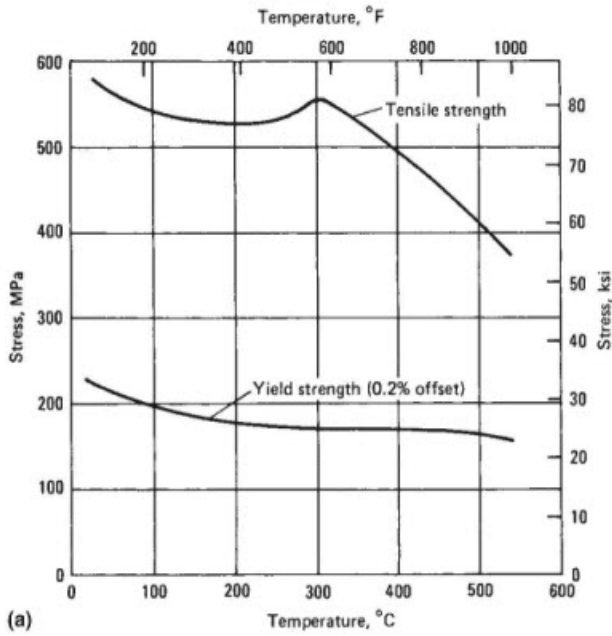
## Mechanical Properties

Tensile properties of Alloy 400:

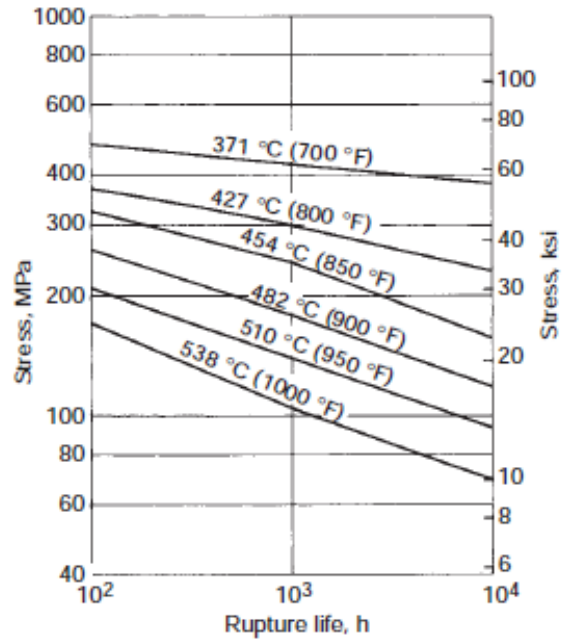
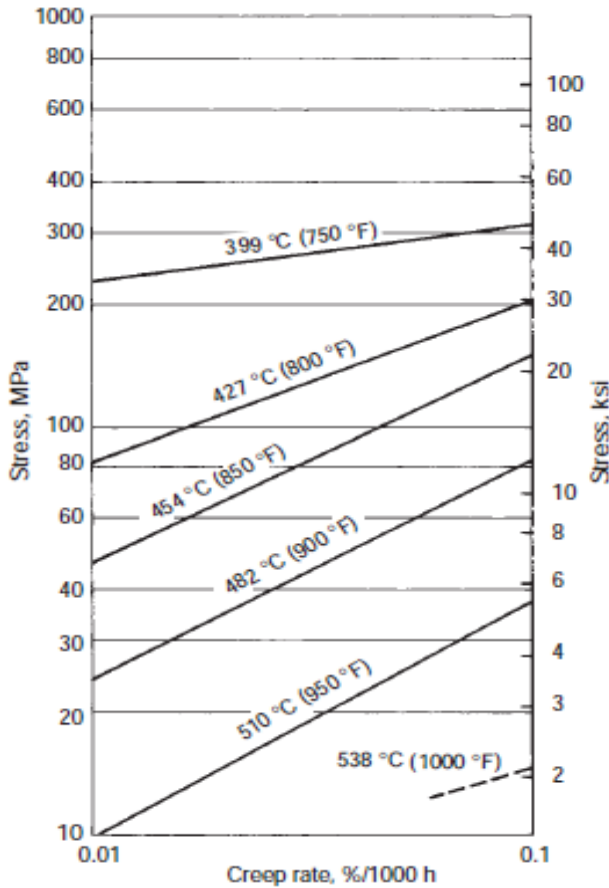
Form and condition	Tensile strength		Yield Strength (0.2% offset)		Elongation %
	MPa	Ksi	Mpa	Ksi	
<b>Rod and bar</b>					
Annealed	517–621	75–90	172–345	25–50	60–35
Hot finished	552–758	80–110	276–690	40–100	60–30
Cold drawn	579–827	84–120	379–690	55–100	40–22
<b>Plate</b>					
Hot rolled	517–655	75–95	276–517	40–75	45–30
Annealed	483–586	70–85	193–345	28–50	50–35
<b>Sheet</b>					
Annealed	483–586	70–85	172–310	25–45	50–35
Hard	690–827	100–120	621–758	90–110	15–2
<b>Strip</b>					
Annealed	483–586	70–85	172–310	25–45	55–35
Spring temper	690–965	100–140	621–896	90–130	15–2
<b>Tubing, cold drawn</b>					
Annealed	483–586	70–85	172–310	25–45	50–35
Stress relieved	586–827	85–120	379–690	55–100	35–15
<b>Wire</b>					
Annealed	483–655	70–95	207–379	30–55	45–25
Spring temper	1000–1241	145–180	862–1172	125–170	5–2

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High-temperature tensile properties of annealed Alloy 400:  
(a) Tensile and yield strength. (b) Elongation



Creep and stress-rupture properties:



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## Physical Properties

*Density:* 8.83 g/cm<sup>3</sup> (0.319 lb/in.<sup>3</sup>) at 20 °C (68 °F)

*Liquidus temperature:* 1349 °C (2460 °F)

*Solidus temperature:* 1299 °C (2370 °F)

*Specific heat:* 427 J/kg·K (0.099 Btu/lb·°F) at 21 °C (70 °F)

*Electrical conductivity:* Volumetric, 3.4% IACS at 21 °C (70 °F)

*Magnetic properties versus treatment:* The Curie temperature of Alloy 400 is near room temperature and is affected by normal variations in chemical composition. Therefore some lots of material may be magnetic at room temperature and others may not.

*Curie temperature:* -7 to +10 °C (20-50 °F)

Thermal and electrical properties of Alloy 400:

Temperature		Mean linear expansion(a)		Thermal conductivity		Electrical resistivity, nΩ · m
°C	°F	μm/m · K	μin./in. · °F	W/m·K	Btu/ft· h · °F	
-196	-320	...	...	...	...	341
-184	-300	11.0	6.1	16.3	9.4	...
-129	-200	11.5	6.4	18.8	10.9	...
-73	-100	12.1	6.7	20.0	11.6	...
21	70	...	...	21.8	12.6	510
93	200	13.9	7.7	24.1	14.0	535
204	400	15.5	8.6	27.8	16.1	560
316	600	15.8	8.8	31.0	18.9	575
427	800	16.0	8.9	34.3	19.8	590
538	1000	16.4	9.1	38.1	22.0	610
649	1200	16.7	9.3	41.4	23.9	630
760	1400	17.3	9.6	44.9	25.9	650
871	1600	17.6	9.8	48.3	27.9	670
982	1800	18.0	10.0	51.9	30.0	690
1093	2000	18.5	10.3	...	...	710

(a) From 21 °C (70 °F) to temperature shown

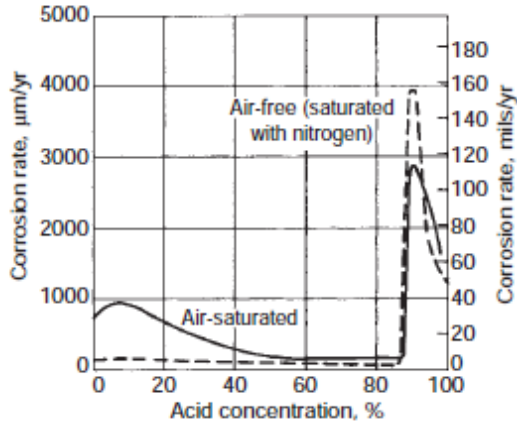
## Chemical Properties

*General corrosion behavior:* Alloy 400, a nickel-copper alloy, is more resistant than nickel to corrosion under reducing conditions and more resistant than copper under oxidizing conditions. An important characteristic of the alloy is its general freedom from stress- corrosion cracking. It is highly resistant to seawater or brackish water, chlorinated solvents, glass-etching agents, many acids including sulfuric and hydrochloric, and nearly all alkalis.

*Resistance to specific corroding agents:* Corrosion rates in strongly agitated and aerated seawater usually do not exceed 25.4 μm (1 mil) per year.

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Corrosion of Alloy 400 in sulfuric acid (temperature 66 °C, or 151°F, velocity, 8.6 mm/s, or 17 ft/min)



Effect of temperature on corrosion of Alloy 400 in 5% hydrochloric acid:

