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TECHNICAL DATA SHEET

ALLOY 400

UNS N04400 / W.Nr. 2.4360 & 2.4361

Description

Alloy 400 is a single phase, solid-solution nickel-copper alloy that offers superior resistance to many corrosive environments over temperatures ranging from sub-zero to 800°F. This alloy is only hardenable through cold working, rather than heat treatment. The Curie Temperature of this alloy lies in the ambient temperature range and is affected by variations in the alloy's chemical composition. Caution is advised in applications where strong nonmagnetic characteristics are desired. The ratio of copper to nickel in alloy 400 is almost identical to that found in the ore the metal is derived from. This alloy was first patented over 100 years ago, and it continues to be one of the most commonly used corrosion resistant alloys commercially produced.

Industries and Applications

Alloy 400 has been widely used in a variety of industries, and has been particularly useful in the marine industry and chemical processing industry. Typical applications include pumps and valves, propeller shafts, marine fixtures and fasteners, electronic components, springs, chemical processing equipment, fresh and salt water tanks, process vessels and piping, boiler feedwater heaters and other heat exchangers.

Resistance to Corrosion

Alloy 400 exhibits resistance to corrosion by many reducing media. It is one of the few alloys that can be used in contact with fluorine, hydrofluoric acid, hydrogen fluoride or their derivatives. Exceptional resistance has been proven in hydrofluoric acid in all concentrations up to the boiling point. Alloy 400 is also resistant to many forms of sulfuric and hydrochloric acids under reducing conditions. Corrosion resistance behavior in seawater is excellent.

Fabrication and Heat Treatment

Typical shaping, forming, machining and joining operations can be used when fabricating alloy 400. Hot working operations should be performed between 1200°F and 2150°F. For heavy reductions a temperature between 1700°F and 2150°F should be used. Cold working should be performed on annealed material. Heat treatments available to alloy 400 are stress equalizing, stress relieving and annealing depending on the mechanical properties desired. Stress equalizing is performed at a temperature of 575°F for a period of 3 hours followed by a rapid quench. This causes an increase in yield strength with no effects on other properties. Stress relieving is achieved at a temperature between 1000°F and 1050°F for a period of 1 to 2 hours followed by slow cooling. This will reduce stresses without producing a recrystallized grain structure and is recommended to obtain minimum distortion after metal removal. Annealing will completely soften work hardened material and is performed by holding at temperatures between 1600°F and 1800°F for 2 to 10 minutes followed by rapid quench.

The information contained in this technical data sheet is intended to be used as a guide and may be revised at any time without prior notice. The information is believed to be reliable and accurate, however Corrosion Materials does not make any warranty or assume any legal liability with respect to the accuracy, completeness or usefulness of the information.

Chemical Composition (%)

(Ni) Nickel[1]	63.0 to 70.0
(Cu) Copper	Remainder
(Fe) Iron	2.50 max
(Mn) Manganese	2.0 max
(Si) Silicon	0.50 max
(Al) Aluminum	0.50 max
(C) Carbon	0.30 max
(S) Sulfur[2]	0.015 max

[1]Cobalt counting as nickel.
[2]From QQ-N-281.

Physical Properties

Density @ Room Temp.	0.318 lb/in.^{3}
Elastic Modulus @ Room Temp.	26.0 x 10^3 ksi
Melting Range	2370°F to 2460°F
Specific Heat[1] @ Room Temp.	0.102 Btu/lb/°F
Thermal Conductivity[1] @ Room Temp.	151 Btu•in/ft^2•h•°F
Electrical Resistivity[1] @ Room Temp.	0.511 µΩ•m
Curie Temperature	70 to 120°F

[1]Material annealed prior to test.

High Temperature Properties | Annealed

Temperature (°F)	Tensile (ksi)	0.2% Yield (ksi)
200	61	21.9
400	56	19.6
600	55	18.9
800	52	18.9

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Mechanical Properties

Product Form	Condition	Tensile (min. ksi)	0.2% Yield (min. ksi)	Elongation (min. %)	Hardness (HRB)[2]
Bar	Stress Relieved[1] (cold worked)	84-87*	50-60*	10-20*	85-100
Bar	Stress Relieved[1] (hot worked)	75-80*	40	30	-
Bar	Annealed (hot or cold worked)	70	25	35	60-80
Plate	Annealed (hot rolled)	70	28	35	60-76
Sheet	Annealed (hot rolled)	70	28	35	65-80
Sheet	Annealed (cold rolled)	70-85*	28	35	-
Seamless Tube & Pipe	Annealed[1]	70	25-28*	35	75
Welded Tube & Pipe	Annealed[1]	70	25-28*	35	-

*[1]Dependent on diameter. [2]For information purposes only. *Minimum values vary depending on diameter/thickness.*

Aqueous Corrosion Data

Media	Common Name	Temp. °F (°C)	Corrosion Rate (mpy)
$C_2H_4O_2$ - All Concentrations	Acetic Acid	70 (21)	<4
4% NaOH	Caustic	68 (20)	0.16
23% NaOH	Caustic	220 (104)	0.2
50% NaOH	Caustic	Boiling	<1
75% NaOH	Caustic	275 (135)	1.7
40% CH_2O_2	Formic Acid	Boiling	2.7
0.5% HCl - No Aeration	Hydrochloric Acid	Boiling	29
1% HCl - No Aeration	Hydrochloric Acid	Boiling	42
5% HCl - No Aeration	Hydrochloric Acid	Boiling	44
Up to 10% HCl	Hydrochloric Acid	86 (30)	<10
12% HF	Hydrochloric Acid	182 (83)	22
25% HF - Saturated w/Air	Hydrochloric Acid	86 (30)	37
25% HF - Purged w/Nitrogen	Hydrochloric Acid	86 (30)	0.2
50% HF - Saturated w/Air	Hydrochloric Acid	176 (80)	39
50% HF - Purged w/Nitrogen	Hydrochloric Acid	176 (80)	0.5
Anhydrous HF	Hydrochloric Acid	80 (27)	3.2
Anhydrous HF	Hydrochloric Acid	200 (88)	4.7
HF	Hydrogen Flouride Gas	1112 (600)	13
H_3PO_4 - All Concentrations	Phosphoric Acid	To 176 (80)	<10
KOH	Potash Liquor	235 (113)	0.6
5% H_2SO_4	Sulfuric Acid	214 (101)	3.4
9% H_2SO_4	Sulfuric Acid	219 (104)	7.5
50% H_2SO_4	Sulfuric Acid	253 (123)	650
96% H_2SO_4	Sulfuric Acid	560 (293)	3300

Applicable Specifications*

Form	ASTM	ASME	Federal Specification	Other
Bar	B164, B564[1]	SB164, SB564[1]	QQ-N-281[2]	-
Plate & Sheet	B127	SB127	QQ-N-281[3,4]	-
Seamless Tube & Pipe	B165	SB165	-	Mil-T-1368
Welded Pipe	B725	SB725	-	-
Welded Tube	B730	SB730	-	-

[1]On diameters above 3.5", B564/SB564 is dual certified. [2]Class A Form 1 Amend. II [3]Class A Form 6 Amend. II [4]Class A Form 4 Amend. II
**EN10204 3.1 applies to all product forms.*

Please contact Corrosion Materials for a complete list of items available from our extensive inventory, as well as our value-added processing services.

We supply a complete range of items in many alloys, including C-276, 22, B-2, B-3®, 200/201, 400, 405, K-500, 625, 600, 800H/HT®, 20, F255, 6B, Titanium Gr. 2 and Titanium Gr. 5.

Our machine shop, welding shop and processing departments are equipped with state-of-the-art manufacturing equipment allowing Corrosion Materials the ability to provide the service you desire along with the economic and technical advantages you need and deserve.

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