Technical Datasheet

CarTech® Ni-Cu 400

Identification

UNS Number

• N04400

Type Analysis

Single figures are nominal except where noted.

Carbon (Maximum)	0.30 %	**Manganese (Maximum)**	2.00 %
Sulfur (Maximum)	0.024 %	**Silicon (Maximum)**	0.50 %
Nickel	63.00 to 70.00 %	**Copper**	Balance
Iron (Maximum)	2.50 %		

General Information

Description

CarTech Ni-Cu 400 is a solid solution binary alloy combining high strength (comparable to structural steel) and toughness over a wide temperature range with excellent resistance to many corrosive environments.

CarTech Ni-Cu 400 has been used at temperatures up to 800°F (427°C) and as high as 1000°F (538°C) in sulfur-free oxidizing atmospheres. It also displays excellent mechanical properties at sub-zero temperatures since it does not undergo a ductile-to-brittle transition even at such temperatures.

This alloy is strengthened by cold work and is readily fabricated.

Applications

CarTech Ni-Cu 400 has been widely used in many applications. It has been found particularly useful in marine and chemical processing environments.

Typical applications have included valves and pumps, pump and propeller shafts, marine fixtures and fasteners, chemical processing equipment, gasoline and fresh water tanks, crude petroleum stills, process vessels and piping, boiler feedwater heaters, heat exchangers, and deaerating heaters.

Corrosion Resistance

Nickel-Copper 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.

Nickel-Copper 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.

Important Note: *The following 4-level rating scale is intended for comparative purposes only. Corrosion testing is recommended; factors which affect corrosion resistance include temperature, concentration, pH, impurities, aeration, velocity, crevices, deposits, metallurgical condition, stress, surface finish and dissimilar metal contact.*

Sodium Hydroxide	Excellent	Salt Spray (NaCl)	Moderate
Sea Water	Moderate	Sour Oil/Gas	Moderate
Humidity	Good		

Properties

Physical Properties

Specific Gravity	8.84	
Density	0.3190	lb/in³
Mean Specific Heat (32 to 212°F)	0.1020	Btu/lb/°F
Mean CTE (70 to 200°F)	7.70	x 10 -6 in/in/°F
Thermal Conductivity (68°F)	151.0	BTU-in/hr/ft²/°F
Modulus of Elasticity (E)		
In Tension (E)	26.0	x 10 3 ksi
In Torsion	10.0	x 10 3 ksi
Electrical Resistivity (68°F)	307.0	ohm-cir-mil/ft
Melting Range	2460	°F

Typical Mechanical Properties

Typical Room Temperature Mechanical Properties - Carpenter Nickel-Copper Alloy 400

Condition	0.2% Yield Strength		Ultimate Tensile Strength		% Elongation	% Reduction of Area	Hardness Rockwell B
	ksi	MPa	ksi	MPa			
Hot Rolled	43	297	82	565	52	83	77
Annealed, 0.312" rd.							
1600°F (871°C)/30 min.	30	207	75	517	55	86	64
1650°F (899°C)/30 min.	28	193	74	510	56	88	63
1700°F (927°C)/30 min.	27	186	70	483	41	85	60
1750°F (954°C)/30 min.	25	172	68	469	42	87	60
1800°F (982°C)/30 min.	23	159	65	448	41	90	59
Stress Relieved, 0.312" rd.							
1000°F (538°C)/1 hr.	43	297	82	565	53	82	75
1000°F (538°C)/2 hrs.	50	345	83	572	51	82	75
1050°F (566°C)/1 hr.	42	290	81	559	54	82	76
1050°F (566°C)/2 hrs.	43	297	81	559	52	83	76

Heat Treatment

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

Annealing

Heating should be done in a sulfur-free reducing atmosphere. The annealing range is 1300 to 1800°F (704 to 982°C), however 1600 to 1800°F (871 to 982°C) is most typical. The lower annealing temperatures (e.g. 1300 to 1500°F [740 to 816°C]) 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 (538/566°C) for one to two hours will relieve strains in either hot or cold worked products.

Workability

Hot Working

Nickel-Copper 400 is readily hot worked from 1700°F (927°C) to 2150°F (1177°C). Optimum working temperature is approximately 2000°F (1093°C). Finished fabrications can be produced to a rather wide range of mechanical properties by proper control of the amount of hot and/or cold work and by the selection of proper thermal treatments.

Cold Working

Nickel-Copper 400 is readily cold worked. Finished fabrications can be produced to a rather wide range of mechanical properties by proper control of the amount cold work and by the selection of proper thermal treatments.

Effect of Cold Work on Room Temperature Tensile Properties - Carpenter Nickel-Copper Alloy 400

% Cold Worked	0.2% Yield Strength		Ultimate Tensile Strength		% Elongation	% Reduction of Area
	ksi	MPa	ksi	MPa		
Starting material: 0.250" rd., unannealed						
0	40	276	82	565	54	80
5	80	552	89	614	39	79
10	85	586	95	655	35	80
15	95	655	103	710	25	78
20	101	696	110	758	20	79
30	116	800	121	834	21	73
40	126	869	131	903	18	72
Starting material: 0.250" rd., annealed 1733 F (945 C) 30 min. W.Q., reducing atmosphere						
0	25	172	72	496	57	82
5	69	476	81	559	42	79
10	74	510	83	572	37	82
15	85	586	90	621	30	83
20	92	634	99	683	23	86
30	105	724	111	765	21	82
40	112	772	117	807	19	79

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 close to neutral (on the reducing side), and the work must be done rapidly without rewelding.

Other Information

Applicable Specifications

- AMS 7233C
- ASTM B164
- QQ-N-281D

Forms Manufactured

- Bar-Rounds
- Billet
- Wire

Technical Articles

- A Guide to Etching Specialty Alloys for Microstructural Evaluation
- Alloy Selection for Cold Forming (Part I)
- Alloy Selection for Cold Forming (Part II)
- How to Select the Right Stainless Steel or High Temperature Alloy for Heading
- Selecting Alloys for Severely Corrosive Environments

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