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ALLOY 20
UNS N08020 / W.Nr. 2.4660

Description

Alloy 20 is a nickel-iron-chromium based, austenitic alloy with excellent corrosion resistance in chemical environments containing sulfuric acid and many other aggressive media. This alloy is stabilized with niobium to resist intergranular corrosion. Alloy 20 may provide potential cost savings when carefully compared to higher nickel-based alloys, while out performing standard stainless steels.

Industries and Applications

Alloy 20 is used in a variety of industries, including chemical processing, petrochemical and refining, marine, pharmaceutical and food processing. End use applications include storage tanks, mixing tanks, agitators, pump and valve parts, food processing equipment, fasteners and fittings. Applications are limited to a maximum temperature of 1000°F per ASME. It is also important to determine if the necessary corrosion resistance can be achieved within the given environment.

Resistance to Corrosion

Alloy 20 has very good resistance to sulfuric acid. This alloy also shows suitable resistance in phosphoric acid, nitric acid and aqueous salt solutions. Alloy 20 is an excellent option when chloride stress corrosion cracking is an issue, as it resists pitting and crevice corrosion. Caution should be taken in chloride ion containing environments because the corrosion rate can increase significantly.

Fabrication and Heat Treatment

Alloy 20 can be formed by either hot-working or cold-work using traditional methods. Hot forged material should be heated between 2100°F and 2250°F with careful temperature control insuring that the material not fall below 1800°F prior to forging. After hot working, anneal the material by heating to 1725°F and 1850°F for a minimum of 30 minutes per inch of thickness followed by water quench.

When stress relieving is desired, heat to a temperature below 1000°F followed by water quench after the desired time at temperature has been established. Annealing Alloy 20 should be between 1725°F and 1850°F for 30 minutes at temperature per inch of thickness. A lower hardness can be obtained by heating to 2100°F but his may have a negative effect on the stabilization of the alloy.

Welding alloy 20 is commonly performed via, TIG, MIG as well as submerged arc welding (SAW) using either the matching filler metal, ER320LR for TIG and MIG and E320LR for SAW. When welding to dissimilar alloys such as 316 or higher alloys such as C-276 and alloy 22, AWS ERNiCrMo-3 can be used for TIG and MIG while using ENiCrMo-3 for SAW.

Chemical Composition (%)

(Fe) Iron	Remainder
(Ni) Nickel	32.00 to 38.00
(Cr) Chromium	19.00 to 21.00
(Cu) Copper	3.00 to 4.00
(Mo) Molybdenum	2.00 to 3.00
(Mn) Manganese	2.00 max
(Nb+Ta) Niobium* + Tantalum	(8 x C) to 1.00
(Si) Silicon	1.00 max
(C) Carbon	0.07 max
(P) Phosphorus	0.045 max
(S) Sulfur	0.035 max

**Niobium (Nb) formerly classified as Columbium (Cb).*

Mechanical Properties

Product Form	Tensile (min. ksi)	0.2% Yield (min. ksi)	Elongation (min. %)
Bar (hot or cold finished)[1]	80	35	30
Plate & Sheet[2]	80	35	30
Pipe & Tube[3]	80	35	30

[1]Reduction of Area is 50% min for bar per ASTM specification.
[2]Maximum allowable hardness, 217 Brinell (95 Rockwell B scale).
[3]Seamless and Welded.

All properties in this table are for material in the solution annealed condition and are from the governing ASTM specification.

Physical Properties

Density @ Room Temp.	0.292 lb/in.^{3}
Poisson's Ratio	0.31
Elastic Modulus @ Room Temp.	28.0 X 10^3 ksi
Modulus of Rigidity	11.0 X 10^3 ksi
Melting Range	2520-2600°F
Specific Heat @ Room Temp.	0.12 Btu/lb•°F
Electrical Resistivity @ Room Temp.	1.08 μΩ•m
Magnetic Permeability (Annealed)	1.002 @ 200 Oerstead

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Coefficient of Thermal Expansion

Temperature (°F)	Coefficient (µin./in.°F)
77 to 212	8.16
77 to 302	8.27
77 to 392	8.37
77 to 662	8.71
77 to 842	8.84
77 to 932	8.91
77 to 1652	9.53

Thermal Conductivity @ 68°F

Temperature (°F)	Conductivity (Btu•in/ft²•h•°F)
122	84.6
212	90.8
392	103.0
572	114.0
752	126.0

Aqueous Corrosion Data [1]

Media	Common Name	Corrosion Rate (mpy)
10% H_2SO_4	Sulfuric Acid	13.2
20% H_2SO_4	Sulfuric Acid	8.4
40% H_2SO_4	Sulfuric Acid	6.0
70% H_2SO_4 @ 167°F	Sulfuric Acid	5
90% H_2SO_4 @ 140°F	Sulfuric Acid	4
90% H_2SO_4 @ 185°F	Sulfuric Acid	15
90% H_2SO_4 @ 203°F	Sulfuric Acid	27
10% H_3NO_3S	Sulfamic Acid	9.6
1% HCl	Hydrochloric Acid	39.6
20% $C_2H_4O_2$	Acetic Acid	0.0
45% CH_2O_2	Formic Acid	8.4
10% $C_2H_2O_4$	Oxalic Acid	31.2
50% NaOH	Sodium Hydroxide	7.2
10% $NaHSO_4$	Sodium Bisulfate	7.2
20% H_3PO_3	Phosphoric Acid	0.2

[1]All solutions at boiling during testing unless specified.

Applicable Specifications*

Form	ASTM	ASME
Bar	B473	SB473
Sheet & Plate	B463	SB463
Seamless Pipe & Tube	B729	SB729
Welded Pipe	B464, B474[1]	SB464, SB474
Welded Tube	B468	SB468

**EN 10204 Type 3.1 applies to all product forms.*
[1]Electric fusion welded pipe material only.

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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CM027-19, Rev 0.