Specification Sheet: Alloy 410
(UNS S41000) / W.Nr. 1.4006

General Purpose 12% Chromium Martensitic Stainless Steel Possessing High Strength and Hardness Combined with Good Corrosion Resistance

Alloy 410 (UNS S41000) is a 12% Chromium Martensitic stainless steel that can be heat treated to obtain a wide range of mechanical properties. The alloy has good corrosion resistance along with high strength and hardness. In the annealed condition 410 is ductile and may be formed. It remains magnetic in both the annealed and heat treated conditions.

Applications

- Cutlery
- Petroleum Refining and Petrochemical Processing Equipment
- Ore Processing
- Sugar Processing
- Gate Valves
- Press Plates

Standards

ASTM .....A 240
ASME.....SA 240
AMS 5504

Oxidation Resistance

Alloy 410 resists oxidation up to 1292°F (700°C) continuously, and up to 1500°F (816°C) on an intermittent basis.

Chemical Analysis

Weight % (all values are maximum unless a range is otherwise indicated)

Chromium	11.5 min.–13.5 max.	**Phosphorus**	0.04
Nickel	0.75	**Sulfur**	0.03
Carbon	0.08 min.–0.15 max.	**Silicon**	1.0
Manganese	1.0	**Iron**	Balance

Physical Properties

Density
0.280 lbs/in^3
7.75 g/cm^3

Specific Heat
0.11 BTU/lb-°F @ 70°F
460 J/kg-°C @ 20°C

Electrical Resistivity
29.5 Microhm-in at 75°F
75 Microhm-cm at 24°C

Modulus of Elasticity
28.5 x 10^6 psi
196 GPa

Melting Range
2560–2625°F
1404–1440°C

Thermal Conductivity 212°F (100°C)
10.6 BTU-in/ft^2–hr-°F
18.3 W/m-°C

Mechanical Properties

Typical Values at 68°F (20°C)

Yield Strength 0.2% Offset		Ultimate Tensile Strength		Elongation in 2 in.	Hardness
psi	(MPa)	psi	(MPa)	%	(max.)
42,000	290	74,000	510	34	96 Rb

Corrosion Resistance

Alloy 410 is resistant to atmospheric conditions, water and some chemicals. It can be used in environments containing weak or diluted acetic acid, naptha, nitric acid and sulfuric acid. The alloy is also resistant to acids contained in foods.

410 can also be used in slightly chlorinated and desaereted water. It performs well in oil and gas applications where desaereted and low hydrogen sulfide exist. However, the alloy is prone to chloride attack, particularly in oxidizing conditions.

410 operates well in environments requiring moderate corrosion resistance and high mechanical properties.

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Fabrication Data

Heat Treatment

Annealing—Heat slowly to 1500–1650°F (816–899°C), cool to 1100°F (593°C) in furnace, air cool

Process Annealing—Heat to 1350–1450°F (732–788°C), air cool

Hardening—Heat to 1700–1850°F (927–1010°C), air cool or oil quench. Follow by stress-relief or temper

Stress Relieving—Heat to 300–800°F (149–427°C) for 1 to 2 hours, air cool

Tempering—Heat to 1100–1400°F (593–760°C) for 1 to 4 hours, air cool

Cold Forming

The alloy can be cold worked with moderate forming in the annealed condition.

Hot Forming

It is typically done in the 1382–2102°F (750–1150°C) range followed by air cooling. For smaller plate deformation such as bending, preheating should be done in the 212–572°F (100–300°C) temperature range. If a plate undergoes substantial deformation it should undergo a re-anneal or stress-relieving treatment at about 1202°F (650°C).

Machining

Alloy 410 is best machined in the annealed condition at surface speeds of 60–80 feet (18.3–24.4m) per minute. Post machining decontamination and passivation are recommended.

Welding

Due to its martensitic structure, Alloy 410 has limited weldability because of its hardenability. A post weld heat treatment should be considered to assure the attainment of the required properties. When weld filler is needed, AWS E/ER 410, 410 NiMo and 309L are the most widely specified.

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