

Specification Sheet: Alloy 410S

(UNS S41008) W. Nr. 1.4000

Restricted Carbon Modification of 410 that Prevents Hardening and Cracking when Exposed to High Temperatures or Welding

Alloy 410S (UNS S41008) is a low carbon, non-hardening modification of Alloy 410 (UNS S41000) the general purpose 12% chromium martensitic stainless steel. The low carbon and a small alloy addition minimize austenite formation at high temperatures which restricts the alloys ability to harden. 410S remains soft and ductile even when rapidly cooled from above the critical temperature. This non-hardening characteristic helps prevent cracking when the alloy is exposed to high temperatures or welded. 410S is completely ferritic in the annealed condition. It exhibits adequate corrosion resistance similar to 410 and good oxidation resistance.

Applications

- Petroleum Refining and Petrochemical Processing
 - Columns
 - Distillation trays
 - Heat exchangers
 - Towers
- Ore Processing
 - Mining machinery
- Thermal Processing
 - Annealing boxes
 - Partitions
 - Quenching racks
- Gate valves
- Press plates

Standards

ASTM A 240

ASME SA 240

Chemical Analysis

Typical analysis (Weight %)

Cr	Ni	C	Mn
11.5 min. - 14.5 max.	0.60 max.	0.08 max.	1.00 max.
P	S	Si	Fe
0.040 max.	0.030 max.	1.00 max.	Balance*

*Alloy predominates remaining composition. Other elements may be present only in minimal quantities.

Physical Properties

Density

0.28 lb/in³
7.73 g/cm³

Magnetic Permeability

Ferromagnetic

Modulus of Elasticity

29 x 10⁶ psi
200 GPa

Thermal Conductivity 212°F (100°C)

187 Btu-in/hr-ft²-°F
26.9 W/m-°K

Specific Heat

0.11 BTU/lb-°F (32-212°F)
0.46 KJ/kg-°K (0-100°C)

Electrical Resistivity

23.7 Microhm-in at 68°F
60 Microhm-cm at 20°C

Melting Range

2700 – 2790°F
1480 – 1530°C

Linear Mean Coefficient of Thermal Expansion

	In/in°F	um/m-°K
32 – 212°F (0 – 100°C)	6.0 x 10 ⁻⁶	10.8
32 – 600°F (0 – 315°C)	6.4 x 10 ⁻⁶	11.5
32 – 1000°F (0 – 538°C)	6.7 x 10 ⁻⁶	12.2
32 – 1200°F (0 – 649°C)	7.5 x 10 ⁻⁶	13.5

Mechanical Properties

Typical Room Temperature Mechanical Properties, Mill Annealed

0.2% Offset Yield Strength psi (MPa)	Ultimate Tensile Strength psi (MPa)	Elongation percent in 2" (50mm)	Reduction percent of area	Hardness Rockwell B
42,000 (290)	64,400 (444)	33	65	75



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Corrosion Resistance

The corrosion resistance of Sandmeyer Steel 410S stainless steel is similar to type 410. It resists corrosion in atmospheric conditions, fresh water, mild organic and mineral acids, alkalis and some chemicals. Its exposure to chlorides in everyday activities (e.g., food preparation, sports activities, etc.) is generally satisfactory when proper cleaning is performed after exposure to use.

General Corrosion Behavior Compared With Other Non-austenitic Stainless Steels*

5% Test Solution at 120°F (49°C)	Corrosion Rate in Mils per Year and Millimeters per Year (mm/a)					
	Alloy 409	Alloy 410S	Alloy 420	Alloy 425 Mod	Alloy 440A	Alloy 430
Acetic Acid	0.88 (0.022)	0.079 (0.002)	1.11 (0.028)	4.79 (0.122)	2.31 (0.0586)	0.025 (0.0006)
Phosphoric Acid	0.059 (0.002)	0.062 (0.002)	0.068 (0.002)	0.593 (0.015)	0.350 (0.009)	0.029 (0.001)

*Hardened martensitic grades were tested after tempering at 400°F (204°C)

As shown in the above table, 410S has good corrosion resistance to low concentrations of mild organic and mineral acids.

Oxidation Resistance

The oxidation resistance of 410S stainless steel is good. It can be used in continuous service up to 1300°F (705°C). Scaling becomes excessive above 1500°F (811°C) in intermittent service.

Fabrication Data

Formability

410S stainless steel can be easily formed by spinning, bending and roll forming.

Heat Treatment

The alloy can not be hardened by heat treatment. It is annealed in the 1600 – 1650°F (871 – 899°C) range and then air cooled to relieve cold working stresses. 410S should not be exposed to temperatures of 2000°F (1093°C) or above due to embrittlement. If excessive large grains are encountered after annealing mildly cold-worked material, the annealing temperature should be decreased to a range of 1200 – 1350°F (649 – 732°C) range.

Machining

Alloy 410S should be machined in the annealed condition using surface speeds of 60 to 80 feet (18.3 – 24.4 m) per minute.

Surface Preparation

For maximum corrosion resistance to chemical environments, it is essential that the 410S surface be free of all heat tint or oxide formed during annealing or hot working. All surfaces must be ground or polished to remove any traces of oxide and surface decarburization. The parts should then be immersed in a warm solution of 10-20% nitric acid followed by a water rinse to remove any residual iron.

Welding

410S is generally considered to be weldable by the common fusion and resistance techniques. Special consideration should be given to avoid brittle weld fractures during fabrication by minimizing discontinuities, maintaining low weld heat input and occasionally warming the part somewhat before forming. 410S is generally considered to have slightly poorer weldability than the most common ferritic stainless steel grade 409. A major difference can be attributed to the alloy addition to control hardening which results in the need for higher heat input to achieve penetration during arc welding. When a weld filler is required, AWS E/ER 309L or 430 filler material is most often specified.

This technical data and information represents our best knowledge at the time of printing. However, it may be subject to some slight variations due to our ongoing research program on corrosion resistant grades.

We, therefore, suggest that information be verified at time of inquiry or order. Furthermore, in service, real conditions are specific for each application. The data presented here is only for the purpose of description and may only be considered as guarantees when our Company has given written formal approval.



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