Specification Sheet: Alloy 310/310S/310H
(UNS S31000, S31008, S31009) W. Nr. 1.4845

A Multi-Purpose Austenitic Heat Resistant Stainless Steel with Oxidation Resistance Under Mildly Cyclic Conditions to 2010°F (1100°C)

Alloy 310 (UNS S31000) is an austenitic stainless steel developed for use in high temperature corrosion resistant applications. The alloy resists oxidation up to 2010°F (1100°C) under mildly cyclic conditions.

Because of its high chromium and moderate nickel content, Alloy 310 is resistant to sulfidation and can also be used in moderately carburizing atmospheres. The more severe carburizing atmospheres of thermal process equipment usually require nickel alloys such as 330 (UNS N08330). Alloy 310 can be utilized in slightly oxidizing, nitriding, cementing and thermal cycling applications, albeit, the maximum service temperature must be reduced. Alloy 310 also finds usage in cryogenic applications with low magnetic permeability and toughness down to -450°F (-268°C).

When heated between 1202–1742°F (650–950°C) the alloy is subject to sigma phase precipitation. A solution annealing treatment at 2012–2102°F (1100–1150°C) will restore a degree of toughness.

310S (UNS S31008) is the low carbon version of the alloy. It is utilized for ease of fabrication. 310H (UNS S31009) is a high carbon modification developed for enhanced creep resistance. In most instances the grain size and carbon content of the plate can meet both the 310S and 310H requirements.

Alloy 310 can be easily welded and processed by standard shop fabrication practices.

Standards

ASTM ..... A 240
ASME ..... SA 240
AMS 5521

Applications

- Cryogenic Components
- Food Processing
- Furnaces — burners, doors, fans, piping and recuperators
- Fluidized Bed Furnaces — coal combustors, grids, piping, wind boxes
- Ore Processing/Steel Plants — smelter and steel melting equipment, continuous casting equipment
- Petroleum Refining — catalytic recovery systems, flares, recuperators, tube hangers
- Power Generation — coal gasifier internals, pulverized coal burners, tube hangers
- Sintering/Cement Plants — burners, burner shields, feeding and discharging systems, wind boxes
- Thermal Processing — annealing covers and boxes, burner grids, doors, fans, muffles and retorts, recuperators, walking beams

Chemical Analysis

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

Element	310	310S	310H
Chromium	24.0 min.–26.0 max.	24.0 min.–26.0 max.	24.0 min.–26.0 max.
Nickel	19.0 min.–22.0 max.	19.0 min.–22.0 max.	19.0 min.–22.0 max.
Carbon	0.25	0.08	0.04 min.–0.10 max.
Manganese	2.00	2.00	2.00
Phosphorus	0.045	0.045	0.045
Sulfur	0.030	0.030	0.030
Silicon	1.50	1.50	0.75
Iron	Balance	Balance	Balance

Physical Properties

Density
0.285 lbs/in^3
7.89 g/cm^3

Specific Heat
0.12 BTU/lb-°F (32–212°F)
502 J/kg-°K (0–100°C)

Electrical Resistivity
30.7 Microhm-in at 68°F
78.0 Microhm-cm at 20°C

Modulus of Elasticity
28.5 x 10^6 psi
196 GPa

Melting Range
2470–2555°F
1354–1402°C

Thermal Conductivity
8.0 BTU/hr/ft^2/ft/°F
10.8 W/m-°K

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Mechanical Properties

Typical Values at 68°F (20°C)

Yield Strength 0.2% Offset		Ultimate Tensile Strength		Elongation in 2 in.	Hardness
psi (min.)	(MPa)	psi (min.)	(MPa)	% (min.)	(max.)
35,000	245	80,000	550	45	217 Brinell

Corrosion Resistance

Wet Corrosion

Alloy 310 is not designed for service in wet corrosive environments. The high carbon content, which is present to enhance creep properties, has a detrimental effect on aqueous corrosion resistance. The alloy is prone to intergranular corrosion after long term exposure at high temperatures. However, due to its high chromium content (25%), Alloy 310 is more corrosion resistant than most heat resistant alloys.

High Temperature Corrosion

The high chromium (25%) and silicon (0.6%) content of Alloy 310 make it more resistant to high temperature corrosion in most in-service environments. Operating temperatures are listed below.

Oxidizing conditions (max sulfur content–2 g/m^3)
1922°F (1050°C) continuous service
2012°F (1100°C) peak temperature

Oxidizing conditions (max sulfur greater than 2 g/m^3)
1742°F (950°C) maximum temperature

Low oxygen atmosphere (max sulfur content–2 g/m^3)
1832°F (1000°C) maximum temperature

Nitriding or carburizing atmospheres
1562–1742°F (850–950°C) maximum

The alloy does not perform as well as Alloy 600 (UNS N06600) or Alloy 800 (UNS N08800) in reducing, nitriding or carburizing atmospheres, but it does outperform most heat resistant stainless steels in these conditions.

Creep Properties

Typical Creep Properties

Temperature		Creep Strain (MPa)			Creep Rupture (MPa)		
°C	°F	1000 H	10000 H	100000 H	1000 H	10000 H	100000 H
600	1112	120	100	40	200	140	80
700	1292	50	35	20	80	45	20
800	1472	20	10	8	35	20	8
900	1652	10	6	3	15	10	5
1000	1832	5	3	1.5	9	4	2

Fabrication Data

Alloy 310 can be easily welded and processed by standard shop fabrication practices.

Hot forming

Heat uniformly at 1742–2192°F (950–1200°C). After hot forming a final anneal at 1832–2101°F (1000–1150°C) followed by rapid quenching is recommended.

Cold forming

The alloy is quite ductile and forms in a manner very similar to 316. Cold forming of pieces with long-term exposure to high temperatures is not recommended since the alloy is subject to carbide precipitation and sigma phase precipitants.

Welding

Alloy 310 can be readily welded by most standard processes including TIG, PLASMA, MIG, SMAW, SAW and FCAW.

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