

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/in³
7.89 g/cm³

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 10⁶ psi
196 GPa

Melting Range

2470–2555°F
1354–1402°C

Thermal Conductivity

8.0 BTU/hr/ft²/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/m³)
 - 1922°F (1050°C) continuous service
 - 2012°F (1100°C) peak temperature
- Oxidizing conditions (max sulfur greater than 2 g/m³)
 - 1742°F (950°C) maximum temperature
- Low oxygen atmosphere (max sulfur content—2 g/m³)
 - 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.

The information and data in this product data sheet are accurate to the best of our knowledge and belief, but are intended for informational purposes only, and may be revised at any time without notice. Applications suggested for the materials are described only to help readers make their own evaluations and decisions, and are neither guarantees nor to be construed as express or implied warranties of suitability for these or other applications.



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