North American Stainless

Flat Products Stainless Steel Grade Sheet

310S (S31008)/ EN 1.4845

Introduction:

SS310 is a highly alloyed austenitic stainless steel designed for elevated-temperature service. The high Cr and Ni contents enable this alloy to resist oxidation in continuous service at temperatures up to 1200°C provided reducing sulfur gases are not present. In intermittent service it can be used at temperatures up to 1030°C as it resists scaling and has a relatively low coefficient of expansion. This alloy has superior resistance to both SS304 and SS309 in carburizing and reducing environments.

SS310 types are used for their high-temperature oxidation resistance for applications such as furnace parts, mufflers, radiant tubes, ammonia converters, etc.

Product Range:

Product is available in Cold Rolled, Continuous Mill Plate and Plate Mill Plate form up to 60" wide in various thicknesses.

For inquiry about minimum quantity, specific thickness and tolerances, contact inside sales at NAS.

Certification:

ASTM A240, A480, A666, ASME SA240, SA480, SA666, ASTM A262, EN 10088-2, EN 10028-7.

Chemical Composition :

UNS/Euro	ASTM/Euro	Carbon	Manganese	Phosphorous	Sulfur	Silicon	Chromium	Nickel
S31008	310S	0.08 max	2 max	0.045 max	0.03 max	1.5 max	24-26	19-22

Mechanical Properties :

	Tensile Strength min	Yield Strength min	Elongation min	Hardness max
310S	75 ksi	30 ksi	40%	95 HRB

PROPERTIES AT ELEVATED TEMPERATURE

The properties quoted below are typical of annealed SS310S. These values are given as a guideline only, and should not be used for design purposes.

SHORT TIME ELEVATED TEMPERATURE TENSILE PROPERTIES

	Temperature (°C)								
	100	300	500	600	700	800	900	1 000	1 100
Tensile Strength (MPa)	600	530	475	420	315	215	135	85	45
0.2% Proof Stress (MPa)	265	225	175	155	130	110			
Elongation (% in 50mm)	41	35	35	38	31	30	45	54	57

MAXIMUM RECOMMENDED SERVICE TEMPERATURE

(In oxidising conditions)

Operating Conditions	Temperature (°C)
Continuous	1 200
Intermittent	1 030

REPRESENTATIVE CREEP & RUPTURE PROPERTIES

	Stress (MPa) to Produce 1% Strain		Stress (MPa) to Produce Rupture	
Temperature (°C)	10 000 hours	100 000 hours	1 000 hours	10 000 hours
450	180	115		
500	145	95		
550	115	75	240	205
600	85	60	150	130
650	55	40	90	75
700	35	25	60	50
750	20	15	45	35
800	10	10	35	25
850	5	5	25	20

Physical Properties:

Density	7 900kg/m³
Modulus of Elasticity in Tension	200GPa
Modulus of Elasticity in Torsion	70GPa
Poisson's Ratio	0.30
Specific Heat Capacity	500J/kgK
Thermal Conductivity: @ 100°C	14.2W/mK
@ 500°C	18.5W/mK
Electrical Resistivity	780ηým
Mean Co-efficient of Thermal Expansion: 0 – 100°C	15.9µm/mK
0 – 315°C	16.2µm/mK
0 – 540°C	17.0µm/mK
0 – 700°C	17.8µm/mK
0 – 1 000°C	18.9µm/mK
Melting Range	1 400–1 450°C
Relative Permeability	1.02
(**Note:** this grade remains non-magnetic even after cold working)	

THERMAL PROCESSING & FABRICATION

ANNEALING

Annealing is achieved by heating to between 1030°C and 1150°C for 90 minutes per 25mm thickness followed by water quenching. Annealing will ensure that any carbide precipitates are taken back into solution.

HOT WORKING

SS310 can be forged, hot headed and upset satisfactorily. Uniform heating of the steel in the range of 1150°C and 1250°C is required. The finishing temperatures should not be below 950°C. Forgings should be cooled rapidly in air or water. As precipitation of carbides can be harmful in corrosive environments, SS310S is recommended.

COLD WORKING

SS310 can be deep drawn, stamped, headed and upset without difficulty. Since SS310 work hardens, severe forming operations should be followed by annealing.

WELDING

SS310 can be satisfactorily welded and brazed by all methods, giving a tough weld. SS310S should be specified if carbide precipitation can have a detrimental effect on the performance of the steel under operating conditions.

Welding procedures for SS310 will have to be selected with care in order to avoid hot cracking due to the fully austenitic weld microstructure obtained from using matching filler metals.

CORROSION RESISTANCE

Because of the many possible variations involved—temperature, corrosive environment, alloy composition, time, operating practice, etc.—it is difficult to discuss every combination in detail. Thus, the following data should be used as a guideline.

OXIDATION

In many processes, isothermal (constant temperature) conditions are not maintained and process temperatures vary. Expansion differences between the base metal and the scale during heating and cooling can cause cracking and spalling of the protective scale.
This allows the oxidizing media to attack the exposed metal surface. The spalling resistance is greatly improved with the higher nickel content of SS310 because nickel reduces the expansion differential between the scale and the base metal.

EFFECT OF ATMOSPHERE

An increase in corrosion rate can be expected in the presence of water vapor for the traditional 18/8 type stainless steels. The increased nickel and chromium contents of SS310 provide good resistance to moist air at temperatures in excess of 980°C.

SULFUR VAPOR

Sulfur vapor readily attacks the austenitic grades. Typical corrosion rates for various stainless steels after 1300 hours exposure to flowing sulfur vapor at 570°C are shown below.

Type	Corrosion Rate (mm/yr)
CS310	0.48
CS309	0.57
CS304	0.69
CS316	0.79
CS321	1.39

FLUE GASES

It is extremely difficult to generalize corrosion rates in flue and process gases since gas composition and temperature may vary considerably within the same process unit.

Combustion gases normally contain sulfur compounds, as sulfur dioxide is present as an oxidizing gas, along with carbon dioxide, nitrogen, carbon monoxide and excess oxygen. Protective oxides are generally formed and, depending on exact conditions, the corrosion rate may be similar or slightly greater than for service in air.

Reducing flue gases contain varying amounts of hydrogen sulfide, hydrogen, carbon monoxide, carbon dioxide and nitrogen. The corrosion rates encountered in these environments are sensitive to hydrogen sulfide content and temperature, and satisfactory material selection often necessitates service testing. The high nickel content of SS310 may be deleterious in some instances due to sulfidation, in which case SS309 may be the preferred material.

CARBURISATION

High chromium and nickel contents result in a slower diffusion rate of carbon into the steel. SS310 therefore has good resistance to carburizing atmospheres.

AMMONIA AND NITROGEN

The high nickel content of CS310 ensures a good resistance to ammonia atmospheres at high temperatures. Typical corrosion rates for SS310 in an ammonia converter containing 5-6% NH3 after 30,000 hours at 500°C, are in the region of 0.003mm/yr.

Technical Service: For further information, email
qualitycontrol@northamericanstainless.com
For new product development requirements, contact sales@northamericanstainless.com.

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