North American Stainless

Flat Products Stainless Steel Grade Sheet

309S (S30908)/ EN1.4833

Introduction:

SS309 is a highly alloyed austenitic stainless steel used for its excellent oxidation resistance, high-temperature strength and creep resistance.

The lower nickel content of SS309 compared to SS310 improves resistance to hydrogen sulfide (H2S) attack at high temperatures. It is tough and ductile and can be readily fabricated and machined. SS309S is the low-carbon version of SS309 and is recommended for applications where sensitization and subsequent corrosion by high temperature gases or condensates during shutdown may pose a problem.

309S is used for its high-temperature oxidation resistance and/or resistance to H2S attack for applications such as furnace parts, firebox sheets, high-temperature containers, catalytic converters, exhaust systems, 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	ASTM/Euro	Carbon	Manganese	Phosphorous	Sulfur	Silicon	Chromium	Nickel
S30908	309S	0.08 max	2 max	0.045 max	0.03 max	0.75 max	22-24	12-16

Mechanical Properties :

	Tensile strength min	Yield Strength min	Elongation min	Hardness max
309S	75 ksi	30 ksi	40%	95 HRB

PROPERTIES AT ELEVATED TEMPERATURE

The properties quoted below are typical of annealed 309S. 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)	580	525	470	405	300	200	125	75	25
0.2% Proof Stress (MPa)	265	225	190	170	150	130			
Elongation (% in 50mm)	47	44	39	37	36	37	43	53	72

MAXIMUM RECOMMENDED SERVICE TEMPERATURE

(In oxidising conditions)

Operating Conditions	Temperature (°C)
Continuous	1 100
Intermittent	980

REPRESENTATIVE CREEP AND 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	210	145		
500	140	95	375	340
550	100	65	270	230
600	70	45	190	160
650	45	30	130	100
700	30	15	80	55
750	15	10	50	35
800	10	5	35	20
850	5		20	15

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	15.6W/mK
@ 500°C	18.7W/mK
Electrical Resistivity	780ηým
Mean Co-efficient of Thermal Expansion:0 – 100°C	15.9µm/mK
0 – 315°C	16.6µm/mK
0 – 540°C	17.2µm/mK
0 – 700°C	18.3µm/mK
0 – 1 000°C	19.5µm/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.

COLD WORKING

SS309 can be deep drawn, stamped, headed and upset without difficulty. Since SS309 work hardens, severe forming operations should be followed by annealing.

WELDING

SS309 can be satisfactorily welded and brazed by all methods, giving a tough weld. SS309S should be specified if carbide precipitation can have a detrimental effect on the performance of the steel under operating conditions.

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 only.

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 high chromium and nickel content of SS309 provides good resistance to high-temperature oxidation.

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 SS309 provide good resistance to moist air at temperatures in excess of 980°C. SS309 also has good scaling resistance to carbon dioxide and can be used at temperatures similar to those quoted for service in air.

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

HYDROGEN SUFIDE

The rate of corrosion in hydrogen sulfide depends on concentration, temperature, pressure and permeability of the scale. The presence of chromium in the steel helps to stabilize the scale and slow the diffusion process. At high pressure and temperature when hydrogen is present, the attack is more severe and alloys such as SS309 are more suited to these conditions.

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.

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

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