

309 / 309S

STAINLESS STEEL



Boiler Baffles

Furnace Parts

Heat Exchangers

Kiln Liners



TYPES 309 AND 309S are austenitic, chromium-nickel stainless steels that provide excellent corrosion resistance and heat resistance plus good strength at room and elevated temperatures. Type 309S is identical to Type 309 except for a lower carbon content that minimizes carbide precipitation and improves weldability. They are essentially non-magnetic as annealed and become slightly magnetic when cold worked.

Typical uses include furnace parts, heating elements, aircraft and jet engine parts, heat exchangers, carburizing-annealing boxes, sulfite liquor handling equipment, kiln liners, boiler baffles, refinery and chemical processing equipment, and auto exhaust parts.

309 / 309S STAINLESS STEEL

Product Description

SPECIFICATIONS

Type 309 and 309S is covered by the following specifications:

Type 309	Type 309S
ASTM A167	AMS 5523 ASTM A240

METRIC PRACTICE

Values shown in this bulletin were established in U.S. customary units. The metric equivalents may be approximate.

Composition	Type 309 (wt %)	Type 309S (wt %)
Carbon (C)	0.20 max.	0.08 max.
Manganese (Mn)	2.00 max.	2.00 max.
Phosphorus (P)	0.045 max.	0.045 max.
Sulfur (S)	0.030 max.	0.030 max.
Silicon (Si)	0.75 max.	0.75 max.
Chromium (Cr)	22.0 – 24.0	22.0 – 24.0
Nickel (Ni)	12.00 – 15.00	12.00 – 15.00
Iron (Fe)	Balance	Balance

AVAILABLE FORMS

Cleveland-Cliffs produces Type 309 and 309S in thicknesses from 0.01 – 0.1874 in. (0.25 – 4.76 mm) and widths up to 48 in. (1219 mm). For other thicknesses and widths, contact your Cleveland-Cliffs sales representative.

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PHYSICAL PROPERTIES

Density, lbs/in. ³ (g/cm ³)	0.29 (8.03)
Electrical Resistivity, $\mu\Omega \cdot \text{in.}$ ($\mu\Omega \cdot \text{cm}$) 68 °F (20 °C)	39.8 (78)
Thermal Conductivity, BTU/hr./ft. ² /°F W/(m·K)	
212 °F (100 °C)	9.0 (15.6)
932 °F (500 °C)	10.8 (18.7)
Coefficient of Thermal Expansion, in./in./°F ($\mu\text{m}/\text{m}/\text{K}$)	
32 – 212 °F (0 – 100 °C)	8.3×10^{-6} (14.9)
32 – 600 °F (0 – 315 °C)	9.3×10^{-6} (16.7)
32 – 1000 °F (0 – 538 °C)	9.6×10^{-6} (17.3)
32 – 1200 °F (0 – 649 °C)	10.0×10^{-6} (18.0)
Modulus of Elasticity, ksi. (MPa)	29.0×10^3 (200×10^3)
Magnetic Permeability Annealed, (H/m at 200 Oersteds)	1.02 max.
Specific Heat, BTU/lbs./°F (kJ/kg/K)	
32 – 212 °F (0 – 100 °C)	0.12 (0.50)
Melting Range, °F °C	2550 – 2650 (1399 – 1454)

TABLE 1 – TYPICAL ROOM TEMPERATURE MECHANICAL PROPERTIES

UTS, ksi. (MPa)	0.2% YS, ksi. (MPa)	Elongation % in 2 in. (50.8 mm)	Rockwell Hardness, B
95 (655)	50 (345)	45	85

TABLE 2 – IMPACT ENERGY

Izod V-Notch Rockwell, ft. • lbs (J)	110 (140)
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TABLE 3 – FULL-HARD SHEET ELEVATED TEMPERATURE MECHANICAL PROPERTIES

Temperature, °F (°C)	UTS, ksi. (MPa)	0.2% YS, ksi. (MPa)	Elongation % in 2 in. (50.8 mm)
400 (204)	79 (545)	38 (262)	46
600 (316)	75 (517)	35 (238)	43
800 (427)	71 (490)	32 (221)	40
1000 (538)	64 (441)	29 (200)	38
1200 (649)	52 (359)	25 (172)	37
1400 (760)	35 (241)	22 (148)	39
1600 (871)	21 (145)	18 (120)	50
1800 (982)	11 (72)	—	—

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CORROSION RESISTANCE

Types 309 and 309S provide excellent general corrosion resistance. They are more resistant to marine atmosphere than Type 304. They exhibit high resistance to sulfite liquors and are useful for handling nitric acid, nitric-sulfuric acid mixtures, and acetic, citric, and lactic acids.

These materials are generally considered heat-resisting alloys. Their destructive scaling temperature is about 2000 °F (1093 °C). They exhibit good scaling resistance in both continuous and intermittent service, but the alloys should not be used above 1800 °F (982 °C) for intermittent service.

FORMABILITY

Types 309 and 309S can be roll-formed, stamped and drawn readily. In-process annealing is sometimes required to reduce hardness and restore ductility. Type 309 is extremely stable and will remain nonmagnetic when cold worked. Its lower elongation makes this grade somewhat more difficult to form than other 300 series austenitic grades.

WELDABILITY

The austenitic class of stainless steels is generally considered to be weldable by the common fusion and resistance techniques. Special consideration is required to compensate for a higher coefficient of thermal expansion to avoid warping and distortion. Type 309 is generally considered to have weldability.

HEAT TREATMENT

These alloys are not hardenable by heat treatment.

Annealing: Anneal at 1900 – 2050 °F (1038 – 1121 °C), then water quench or rapidly air cool.

About Cleveland-Cliffs Inc.

Cleveland-Cliffs is the largest flat-rolled steel producer in North America. Founded in 1847 as a mine operator, Cliffs also is the largest manufacturer of iron ore pellets in North America. The Company is vertically integrated from mined raw materials and direct reduced iron to primary steelmaking and downstream finishing, stamping, tooling, and tubing. The Company serves a diverse range of markets due to its comprehensive offering of flat-rolled steel products and is the largest steel supplier to the automotive industry in North America. Headquartered in Cleveland, Ohio, Cleveland-Cliffs employs approximately 25,000 people across its mining, steel and downstream manufacturing operations in the United States and Canada.



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