

Heat Resisting Austenitic Stainless Steel

Aperam 309

Chemical Composition

Elements (%)	C	Si	Mn	Cr	Ni
309	0.05	1.60	1.35	19.30	11.40

Typical values

European designation

X15CrNiSi20-12/1.4828⁽¹⁾

⁽¹⁾ According to EN 10088-2

This grade complies with:

- > Aperam Stainless Europe Material Safety Data Sheet n°1: stainless steels (European Directive 2001/58/EC)
- > European Commission Directive 2000/53/EC for end-of-life vehicles, and to Annex II dated 27 June 2002

Key features

- > Maximum in-service temperature of 1,000°C
- > Very good resistance to carburizing
- > Good weldability and formability
- > Excellent resistance to corrosion and oxidation

Our 309S grade is ideal For use in sulphating atmospheres at temperatures exceeding 850°C.

Applications

- > Industrial furnace and boiler components
- > Tubes and expansions bellows
- > Electrical heating elements
- > Aeronautical engineering
- > Automotive exhaust systems

Product Range

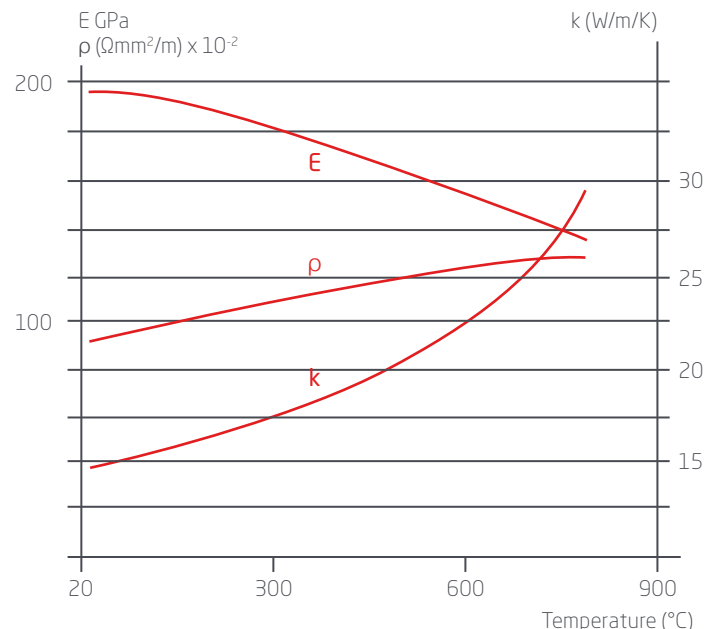
	Coils	Sheets / Blanks	Precision Strip	Precision Sheet
Thickness (mm)	0.40 up to 14	0.40 up to 14	0.06 up to 2.5	0.20 up to 2.5
Width (mm)	up to 2,000	up to 2,000	3 up to 700	40 up to 670
Finish	2R / 2B / 2D / 1D	2R / 2B / 2D / 1D	2R / 2B / 2D / 2H / 2F	2R / 2B / 2D / 2H / 2F

Physical Properties

Cold rolled and annealed sheet

Density	d	kg/dm ³	20°C	7.9
Melting temperature		°C		1,380
Specific heat	c	J/kg.K	20°C	500
Thermal conductivity	k	W/m.K	20°C 500°C	15 21
Mean thermal expansion coefficient	α	10 ⁻⁶ /K	20-200°C 20-400°C 20-600°C 20-800°C 20-1,000°C	16.5 17.5 18.0 18.5 19.5
Electric resistivity	ρ	Ω mm ² /m	20°C	0.85
Magnetic resistivity	μ	at 0.8 kA/m DC or AC	20°C	1.05
Young's modulus	E	GPa	20°C	195

Poisson's coefficient: 0.30



Mechanical Properties

Test piece

Length = 80 mm (thickness < 3 mm)

Length = $5.65 \sqrt{S_0}$ (thickness \geq 3 mm)

Grades	European designation	R _m ⁽¹⁾ (MPa)	R _{p0.2} ⁽²⁾ (MPa)	A ⁽³⁾ %
309	1.4828	640	310	52

1 MPa = 1 N/mm² - Typical values

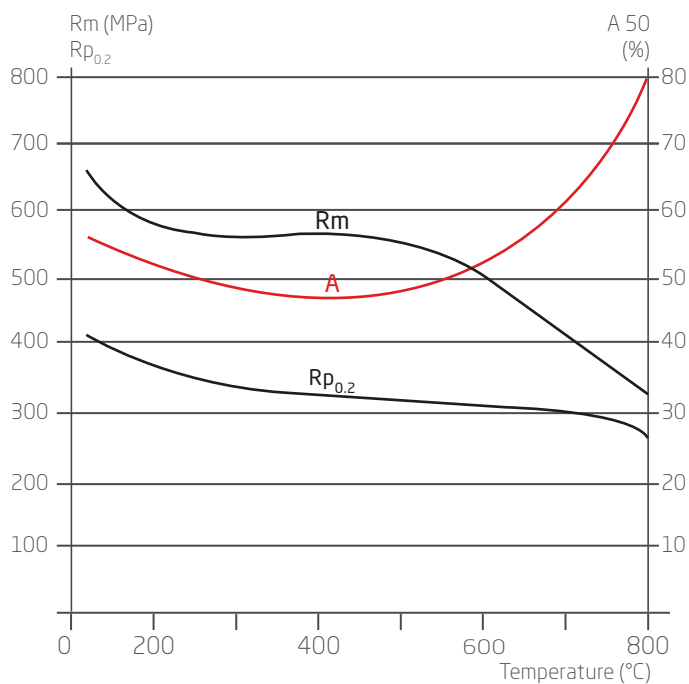
⁽¹⁾ Ultimate Tensile Strength (UTS) - ⁽²⁾ Yield Strength (YS) - ⁽³⁾ Elongation (A)

In the annealed condition

In accordance with ISO 6892-1, part 1

Test piece perpendicular to rolling direction

At high temperatures (typical values)



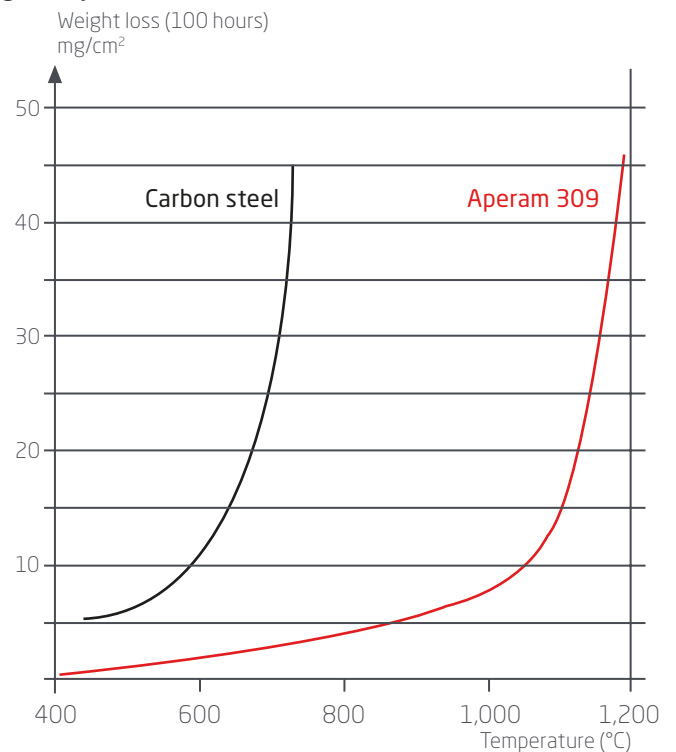
Corrosion Resistance

Our 309 grade has very good general resistance to wet corrosion and excellent resistance to hot corrosion. The maximum temperature for continuous service with respect to oxidation is 1,000°C.

In practice, the maximum operating temperature is determined by the exact composition of the atmosphere, together with the mechanical loading conditions.

Our 309S grade is ideal for use in sulphating atmospheres at temperatures exceeding 850°C.

High temperature oxidation



Creep Properties

Mean stress rupture strength (MPa) as a function of temperature and time to failure.

Temperature (°C)	100 h	10,000 h	100,000 h
600	190	120	65
700	75	36	16
800	35	18	7.5
900	15	8.5	3

Typical values

Mean stress (MPa) to produce 1% elongation (creep strength) as a function of temperature and time to failure.

Temperature (°C)	100 h	10,000 h	100,000 h
600	120	80	50
700	50	25	17
800	20	10	4
900	8	4	1

Prolonged holding between 650°C and 850°C decreases low temperature ductility, which can be regenerated by annealing at 1,000°C.

Forming

In the annealed condition, our grade 309 can be readily formed by all standard processes such as bending, contour forming, drawing, etc.

The chemical composition of our 309 grade has been balanced to limit structural changes in the heat affected zone. As a result, there is no need to control minimal welding heat inputs. Neither preheating nor postheating is required. Maximal interpass temperature of 150°C is advised.

Welding

Welding process	No filler material Typical thicknesses	Thicknesses	With filler metal		Shielding gas* * Hydrogen and nitrogen forbidden in all cases
			Filler material		
			Rod	Wire	
Resistance: spot, seam	< 2 mm				
TIG	< 1.5 mm	> 0.5 mm	ER 309 L (Si) ER 308 L (Si) ⁽¹⁾ W.N° 1.4370 ⁽¹⁾ ER Ni Cr 3 ⁽¹⁾	ER 309 L (Si) ER 308 L (Si) ⁽¹⁾ W.N° 1.4370 ⁽¹⁾ ER Ni Cr 3 ⁽¹⁾	Ar Ar + 5% H Ar + He
PLASMA	< 1.5 mm	> 0.5 mm		ER 309 L (Si) ER 308 L (Si) ⁽¹⁾ W.N° 1.4370 ⁽¹⁾ ER Ni Cr 3 ⁽¹⁾	Ar Ar + 5% H Ar + He
MIG		> 0.8 mm		ER 309 L (Si) ER 308 L (Si) ⁽¹⁾ W.N° 1.4370 ⁽¹⁾ ER Ni Cr 3 ⁽¹⁾	Ar + 2% CO ₂ Ar + 2% O ₂ Ar + 2% CO ₂ + 1% H + He
SAW		> 2 mm		ER 309 L ER 308 L W.N° 1.4370 ⁽¹⁾ ER Ni Cr 3 ⁽¹⁾	
Electrode		Repairs	E 309 L E 316 L		
Laser	< 5 mm				He Under certain circumstances: Ar

⁽¹⁾ For service temperature between 550°C and 900°C

No heat treatment is necessary after welding. The welds must be mechanically or chemically descaled, then passivated and decontaminated.

Heat Treatment and Finishing

Annealing

After cold forming (work hardening) and welding, using an annealing treatment for a couple of minutes at 1,050°C ±25°C, followed by air cooling or water quenching, restores the microstructure (recrystallisation and dissolution of carbides) and eliminates internal stresses.

Pickling

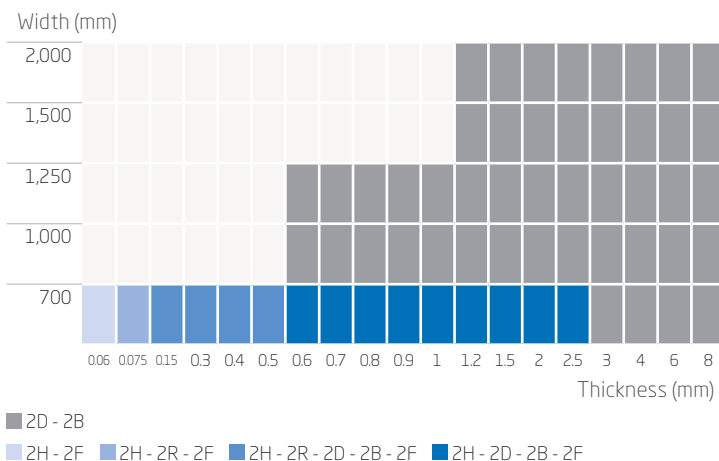
- > Nitric-Hydrofluoric acid mixture (10% HNO₃ + 2% HF) at ambient temperature or up to 60°C
- > Sulfuric-nitric acid mixture (10% H₂SO₄ + 0.5% HNO₃) at 60°C
- > Use descaling pastes for weld areas

Passivation

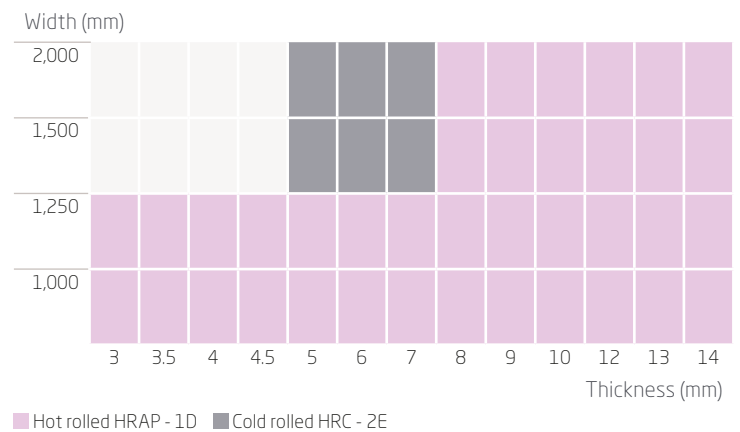
- > 20-25% HNO₃ solution (36° Baumé) at 20°C
- > Use passivating pastes for weld zones

Size Range

Cold Rolled



Hot Rolled and HRC



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