Heat resisting Stainless steel offer grade 309

Chemical composition

Elements*	C	Si	Mn	Cr	Ni
309 (R20-12)	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 is in accordance 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.

General characteristics

The principal features of **309** (R20-12) are:

- Maximum temperature of 1000°C in service in the air
- Very good resistance to carburizing
- Good weldability and formability
- Excellent resistance to corrosion and oxidation

For use in sulphating atmospheres at temperatures exceeding 850°C, the R24-13S grade should be preferred.

Applications

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

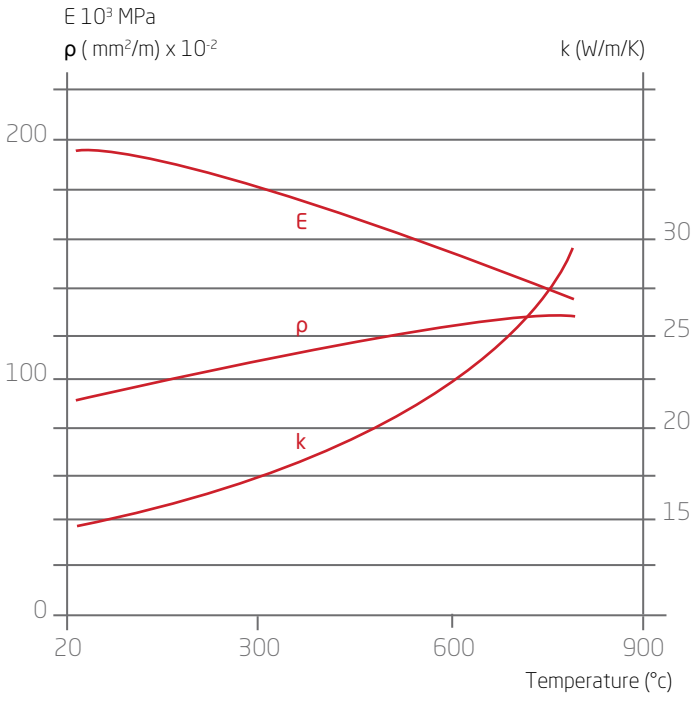
Product range

Forms: Sheets, blanks, coils, strips, discs
Thicknesses: from 0.60 up to 13 mm
Width: up to 2000mm according to thickness
Finish: cold rolled or hot rolled, according to thickness

Physical properties

Cold rolled and annealed sheet.

Density	d	kg/dm³	20°C	7.9
Melting Temperature		°C		1380
Specific heat	c	J/kg.K	20 °C	500
Thermal conductivity	k	W/m.K	20 °C 500 °C	15 21
Mean coefficient of thermal expansion	α	10^{-6}/K	20 - 200°C 20 - 400°C 20 - 600°C 20 - 800°C 20 - 1000°C	16.5 17.5 18.0 18.5 19.5
Electric resistivity	ρ	Ω mm²/m	20°C	0.85
Magnetic resistivity	μ	at 0.8 kA/m DC or AC	20 °C	1.05
Young's Modulus	E	MPa.10³	20 °C	195



Mechanical properties

In the annealed condition
In accordance with ISO 6892-1, part 1
Test piece perpendicular to rolling direction.

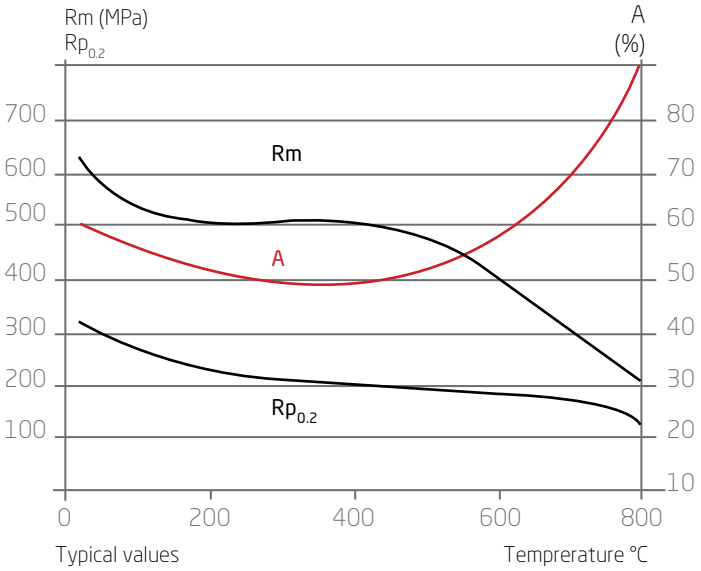
Test piece
Length = 80 mm (thickness < 3 mm)
Length = 5.65 √ S_0 (thickness ≥ 3 mm)

Grades	European designation	Rm[1] (MPa)	Rp0.2[2] (MPa)	A[3] %
309 (R20-12)	1.4828	640	310	52

1 MPa = 1 N/mm². * Typical values.

[1] Ultimate Tensile Strength (UTS). [2] Yield Strength (YS). [3] Elongation (A).

At elevated temperatures Aperam 309 (R20-12)



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 and 850°C decreases the low temperature ductility, which can be regenerated by annealing at 1000°C.

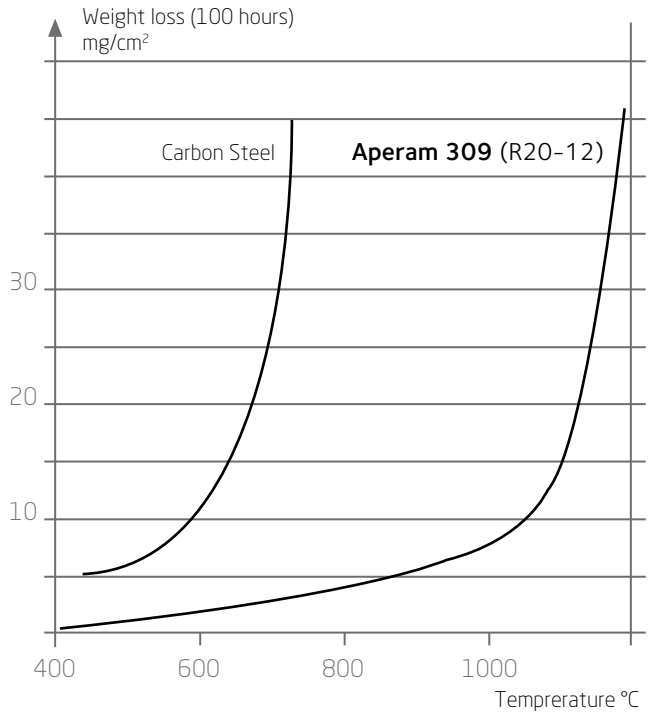
Corrosion resistance

309 (R20-12) has a very good general resistance to wet corrosion and excellent hot corrosion resistance. The maximum temperature for continuous service with respect to oxidation is 1000°C.

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

For use in sulphating atmospheres at temperatures exceeding 850°C, the R24-13S grade should be preferred.

High temperature oxidation:



Forming

In the annealed condition, **309** (R20-12) can be readily formed by all standard processes such as bending, contour forming, drawing, etc.

Welding

The chemical composition of our **309** (R20-12) has been balanced to limit structural changes in the heat affected zone. Therefore 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 process	No filler material	With filler material			Shielding gas
	Typical thicknesses	Thicknesses	Filler material		*Hydrogen and nitrogen forbidden in all cases
			Rod	Wire	
Resistance: spot, seam	< 2 mm < 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)	Argon Argon + 5% H_2 Argon + Helium
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)	Argon Argon + 5% H_2 Argon + Helium
MIG		> 0.8 mm		ER 309 L (Si) ER 308 L (Si) (1) W.N° 1.4370 (1) ER Ni Cr 3 (1)	Argon + 2% CO_2 Argon + 2% O_2 Argon + 3% CO_2 + 1%H_2 Argon + 2% CO_2 + Helium
S.A.W.		> 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				Helium under certain circumstances: Argon & Nitrogen

(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 after welding, an annealing treatment for a couple of minutes at 1050°C ± 25°C, followed by air cooling or water quenching, restores the microstructure (recrystallisation and dissolution of carbides) and eliminates internal stresses.

Pickling

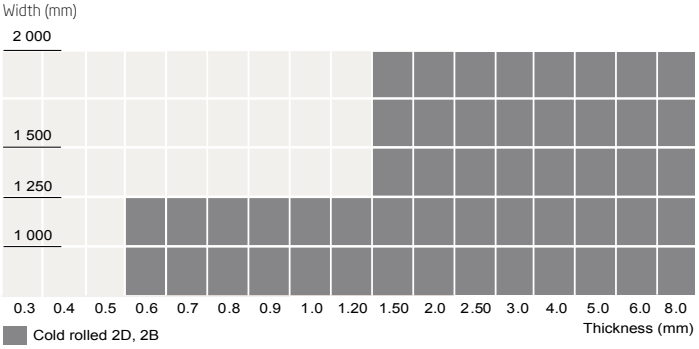
- Nitric-Hydrofluoric acid mixture (10%HNO_3 + 2% HF) at ambient temperature or up to 60°C.
- Sulfuric-nitric acid mixture (10% $H2SO_4$ + 0.5% HNO_3) at 60°C.
- Descaling pastes for weld areas.

Passivation

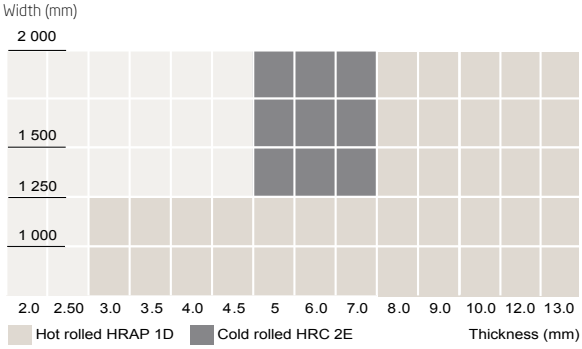
- 20-25% HNO_3 solution (36° Baumé) at 20°C.
- Passivating pastes for weld zones.

Size range

Cold Rolled



Hot-Rolled and HRC



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