



Austenitic stainless steels

18-9 E 18-9ED

18-9DDQ

Austenitic stainless steels

European designation ⁽¹⁾
X5CrNi18-10
1.4301
American designation ⁽²⁾
AISI 304

(1) According to NF EN 10095

(2) According to ASTM A 240

18-9E	Basic grade
18-9ED	Deep drawing grade
18-9DDQ	Severe deep drawing grade

These grades are in accordance with:

- 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.
- PED (Pressure Equipment Directive) according to EN 10028-7 and AD2000 Merkblatt W2 and W10
- NFA 36 711 Standard «Stainless steel intended for use in contact with foodstuffs, products and beverages for human and animal consumption» (non packaging steel).

Chemical composition

Mean values
(weight %)

Elements	C	Si	Mn	Cr	Ni
18-9E	0.05	0.50	1.10	18.20	8.05
18-9ED	0.04	0.50	1.20	18.20	8.10
18-9DDQ	0.04	0.50	1.10	18.20	9.10

Tensile properties

Annealed condition

According to NF EN 10002-1 (July 2001),
specimen perpendicular to the rolling direction

Specimen

Lo = 80 mm (thickness < 3 mm)
Lo = 5,65 √ So (thickness ≥ 3 mm)

1 MPa = 1 N/mm²

Condition		R _m ⁽¹⁾ (MPa)	R _{p0,2} ⁽²⁾ (MPa)	A ⁽³⁾ (%)
Annealed	18-9E	670	320	50
	18-9ED	630	300	55
	18-9DDQ	610	270	57

Mean values

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

18-9 E
 18-9 ED
 18-9 DDQ



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General characteristics

The principal features of the **18-9** stainless steels are:

- good general resistance to corrosion
- good ductility
- excellent weldability
- good polishability
- very good drawability for the **18-9ED** and **18-9DDQ** grades.

Typical applications

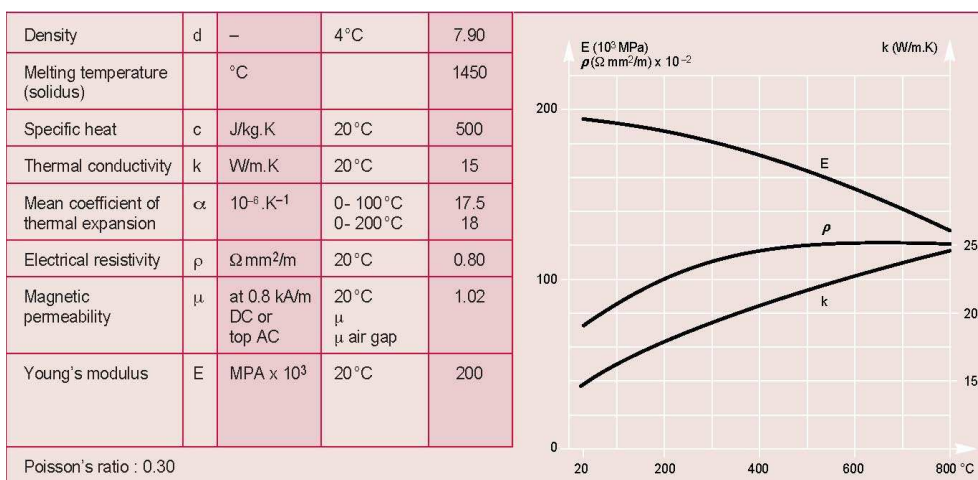
- Domestic appliances
- Sinks units
- Metallic frames for the building industry
- Platters and cutlery
- Domestic cooking and collective catering equipment
- Dairy equipment, welded structures
- Tubes

Product range

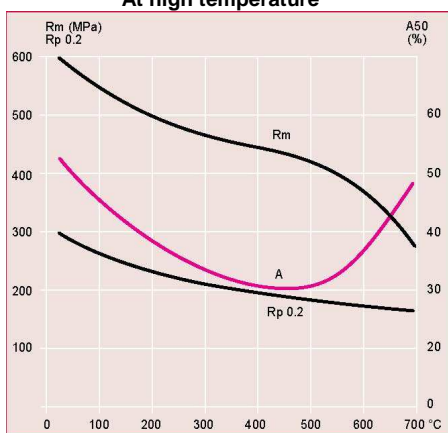
Forms: sheets, blanks, coils, strips, circles
 Thicknesses: 0.3 to 14 mm, depending on grades
 Width: according to grades and thickness max 2000mm , consult us
 Finish: cold rolled or hot rolled, depending on the thickness

Physical properties

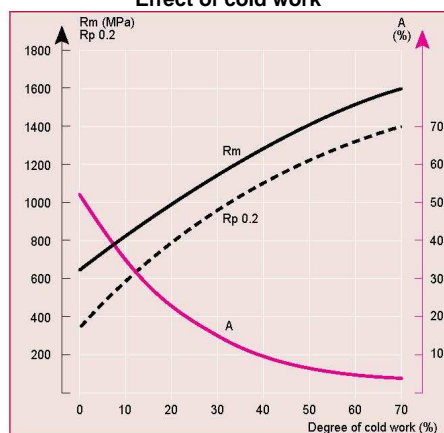
(cold rolled sheet - annealed)



At high temperature



Effect of cold work



Creep properties (MPa)

Mean stresses (MPa) for different rupture lives as a function of temperature for 18-9.

(typical values)

Temperature (°C)	100 h	10 000 h	100 000 h
550	240	185	135
500	185	130	90
650	125	85	55

Corrosion resistance

The **18-9** steels have good resistance to the common corrosive media, but are not recommended where there is a risk of intergranular corrosion. They are well adapted for exposure in fresh water and urban and rural atmospheres.

In all cases, regular cleaning of exposed external surfaces is necessary to conserve their original appearance.

The **18-9** grades have good resistance to various acids:

- phosphoric acid in all concentrations at ambient temperature
- nitric acid up to 65% (40°Baumé), between 20 and 50°C
- formic and lactic acids at room temperature
- acetic acid between 20 and 50°C.

They are recommended for use in contact with cold or hot foodstuffs, such as wine, beer, milk (curdled or otherwise), natural fruit juices, syrups, molasses, etc..

Welding

No heat treatment is normally necessary after welding.

However, where there is a risk of intergranular corrosion, annealing should be performed at 1050-1100°C. An 18-9L low carbon grade or an 18-10T stabilized grade is to be preferred in this case.

The welds must be mechanically or chemically descaled, then passivated and decontaminated.

Welding process	No filler metal	With filler metal		Shielding gas*	
	Typical thicknesses	Thickness	Filler metal		*Hydrogen and nitrogen forbidden in all cases
			Rod	Wire	
Resistance Spot Seam	≤ 2 mm ≤ 2 mm				
TIG	< 1.5 mm	> 0.5 mm	W.N°1.4370 ER 309 L (Si) ER 316 L (Si)	W.N°1.4370 ER 309 L (Si) ER 316 L (Si)	Argon
PLASMA	< 1.5 mm	> 0.5 mm		W.N°1.4370 ER 309 L (Si) ER 316 L (Si)	Argon
MIG		> 0.8 mm		W.N°1.4370 ER 309 L Si ER 316 L Si	Argon + 2% CO2 Argon + 2% O2
S.A.W		> 2 mm		ER 309 L ER 316 L	
Electrode		Repairs	E 309 L E 316 L		
Laser	< 5 mm				Helium

18-9 E
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18-9 DDQ



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Forming

The **18-9E** and **18-9D** grades can be readily cold formed by all standard processes (bending, contour forming, drawing, flow turning etc.). The **18-9DDQ** grade is to be preferred for severe forming operations. Some forming operations, such as bending, drawing and flow turning, are more readily performed hot. Subsequent pickling is then necessary.

Erichsen test
(expansion)

Grade	European designation	AISI	Erichsen deflection* (mm)
18-9E	1.4301	304	11.5
18-9ED	1.4301	304	11.8
18-9DDQ	1.4301	304	12

* 0.8 mm thick sheet

Swift test
(drawing)

Grade	European designation	AISI	LDR* (mm)
18-9E	1.4301	304	1.95-2.00
18-9ED	1.4301	304	1.95-2.00
18-9DDQ	1.4301	304	2.00-2.05

* Limiting Drawing Ratio - 0.8 mm thick sheet

Bending

Good 180° bendability, with very small bending radii for thicknesses less than 0.8 mm, whereas a radius not less than half the thickness is recommended for thicker sheets.

Flow turning

The **18-9DDQ** grade is best suited for this application.

Heat treatment and finishing

Annealing

Annealing for a few minutes at 1075°C ± 25°C, followed by air cooling, to regenerate the microstructure by recrystallization and solutioning of carbides and to relieve internal stresses, should be carried out after cold forming operations and after welding (risk of intergranular corrosion in the weld).

After annealing, pickling and passivation treatments are necessary.

Pickling

Nitric-hydrofluoric acid mixture (10% HNO₃ + 2% HF), at RT or 60°C.
Sulphuric-nitric acid mixture (10% H₂SO₄ + 0,5% HNO₃) at 60°C.
Descaling pastes for weld zones.

Passivation

20-25 % HNO₃ solution (36°Baumé) at 20°C
Passivating pastes for weld zones.

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