Austenitic Stainless steel offer grade 304

Chemical composition

Elements (%)	C	Si	Mn	Cr	Ni
304 (18-9E)	0.05	0.40	1.10	18.20	8.05
304H (18-9H)	0.05*	0.40	1.10	18.20	8.05
304D (18-9ED)	0.04	0.40	1.20	18.20	8.10
304ED (18-9DDQ)	0.045	0.40	1.10	18.20	9.10

Typical values (*) C mini = 0.04

Grade designation	European designation	American designation	IMDS Nr
304 (18-9E) standard level grade	X5CrNi18-10 / 1.4301[1]	UNS 30400/ Type 304[2]	336812649
304H (18-9H)	X6CrNi18-10 / 1.4948[3]	UNS 30409/ Type 304[2]	369292367
304D (18-9ED) deep drawing grade	X5CrNi18-10 / 1.4301[1]	UNS 30400/ Type 304[2]	336812649
304ED (18-9DDQ) severe deep drawing grade	X5CrNi18-10 / 1.4301[1]	UNS 30400/ Type 304[2]	336812649

[1] According to EN 10088-2
[2] According to ASTM A 240
[3] Accordind to EN 10088-1, 2005 / EN10028-7, 2007

These grades comply with:

- Stainless Europe Material Safety Data Sheet n°1: stainless steels (European Directive 2001/58/EC).
- European Directive 2000/53/EC on end-of-life vehicles and later modifications.
- NFA 36 711 standard "Stainless steel intended for use in contact with foodstuffs, products and beverages for human and animal consumption (non packaging steel)".
- Requirements of NSF/ANSI 51 – 2009 edition International Standard for "Food Equipment Materials" and of the F.D.A. (United States Food and Drug Administration) regarding materials used for food contact.
- French Decree No.92-631 dated 8 July 1992 and Regulation No. 1935/2004 of the European Parliament and of the Council of 27 October 2004 on materials and articles intended to come into contact with food (and repealing Directives 80/590/EECand 9/109/EEC).
- French regulatory paper dated 13 January 1976 relating to materials and articles made of stainless steel in contact with foodstuffs.
- Italien Decree of 21st March 1973w: a list of stainless steel types appropriate to "Regulations on the hygiene of packaging, receptacles and tools intended to come into contact with substances for food use or with substances for personal use"
- PED (Pressure Equipment Directive) according to EN 10028-7and AD2000 Merkblatt W2 and W10 (TÜV W494).

General characteristics

The principal features of our grades 304 (304, 304H, 304D, 304ED) are:

- A general purpose grade
- Good resistance to pitting corrosion and crevice corrosion
- Good ductility
- Excellent weldability
- Good polish ability
- Very good drawability for 304D (18-9ED) and 304ED (18-9DDQ)

Applications

- Domestic appliances
- Sink units
- Metallic frames for the building industry
- Serving trays and cutlery
- Domestic cooking and catering equipment
- Dairy equipment
- Welded structures
- Decorative tubes
- Exhaust systems

Product range

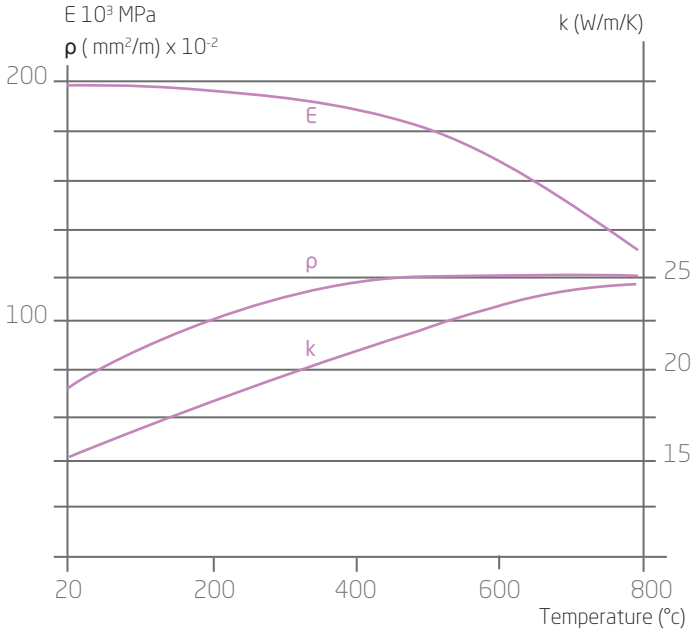
Forms: Sheets, blanks, coils, strips, tubes
Thicknesses: from 0.3 up to 13 mm
Width: up to 2000 mm according to thickness
Finishes: cold rolled, hot rolled, patterned (tear plate), according to thickness

Physical properties

Cold rolled and annealed sheet.

Density	d	kg/dm³	20 °C	7.9
Melting Temperature		°C	Liquidus	1450
Specific heat	c	J/kg.K	20 °C	500
Thermal conductivity	k	W/m.K	20 °C	15
Mean coefficient of thermal expansion	α	10^{-6}/K	20-100 °C 20-200 °C 20-400 °C 20-600 °C 20-800 °C	16.0 16.5 17.0 17.5 18.0
Electric resistivity	ρ	Ω mm²/m	20 °C	0.73
Magnetic resistivity	μ	at 0.8 kA/m DC or AC	20 °C	1.02
Young's Modulus	E	MPa.10^3	20 °C	200

Poisson's coefficient: 0.30



Mechanical properties

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

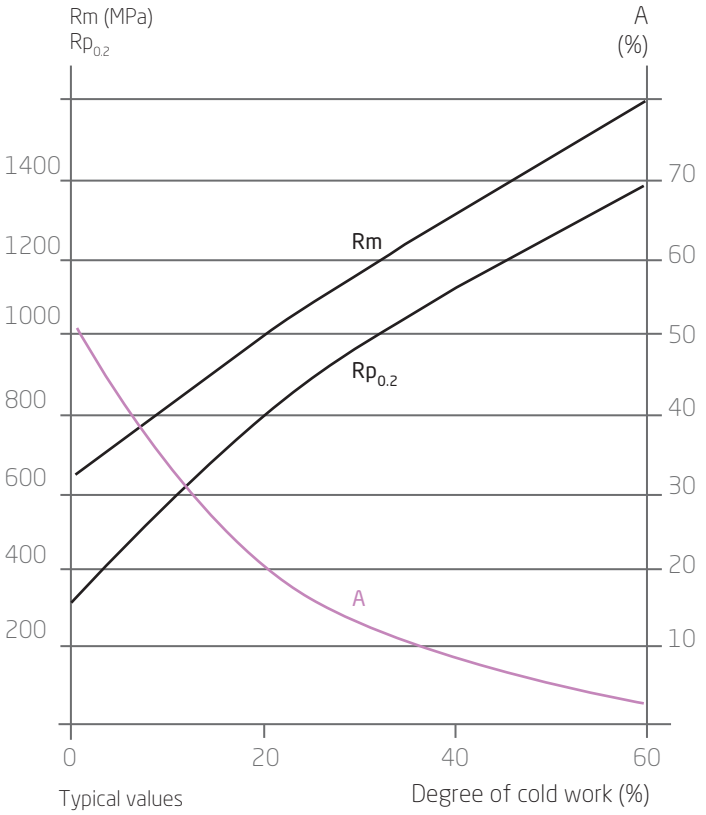
Test piece
Length = 80 mm (thickness < 3 mm)
Length = 5.65 √ S_o (thickness ≥ 3 mm)
Cold rolled

Grades	European designation	ASTM A240	Rm(1) (MPa)	Rp0.2(2) (MPa)	A(3) %
304 (18-9E)	1.4301	304	650	300	54
304H (18-9H)	1.4948	304	670	320	52
304D (18-9ED)	1.4301	304	630	285	57
304ED (18-9DDQ)	1.4301	304	610	270	57
201D (17-4Mn)	1.4618	201.1	665	320	52
K41	1.4509	441(a)	480	310	30
K45	1.4621(b)	445(a)	510	360	29

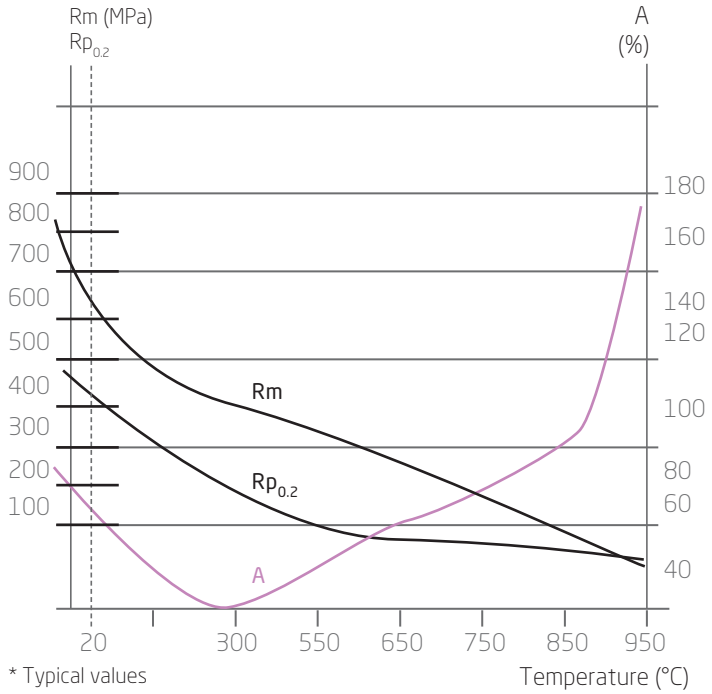
1 MPa = 1 N/mm². * Typical values.

(1) Ultimate Tensile Strength (UTS). (2) Yield Strength (YS). (3) Elongation (A).
(a) Common designation (b) Pending update of the standard

Work hardened condition 304 (18-9E)



At high temperatures* 304ED (18-9DDQ)



Creep properties

Creep is defined by a slow deformation of the metal as a result from a long term exposure to a certain level of stress below the yield strength. Together with the duration, the temperature is a significant factor to determine the mean stress (MPa) for rupture.

Temperature (°C)	100 h	10 000 h	100 000 h
400	240	185	135
500	185	130	90
650	125	85	55

Typical values for 304 (18-9E) - MPa

Corrosion resistance

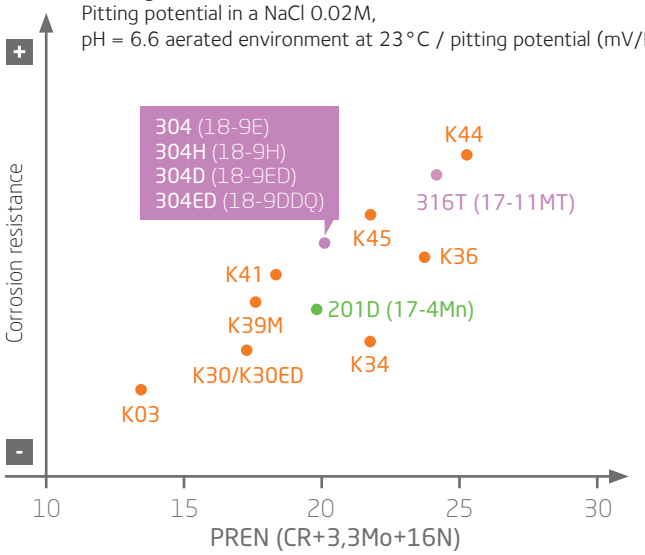
Our grades **304, 304H, 304D, 304ED** (18-9E/H/ED/DDQ) steels have good resistance to the common corrosive media, but are not recommended where there is a risk of intergranular corrosion. They are well adapted for exposure in fresh water and urban and rural atmospheres. In all cases, regular cleaning of exposed external surfaces is necessary to conserve their original appearance. Our grades **304, 304H, 304D, 304ED** (18-9E/H/ED/DDQ) 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.

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

Pitting corrosion

Pitting potential in a NaCl 0.02M,
pH = 6.6 aerated environment at 23°C / pitting potential (mV/ECS)



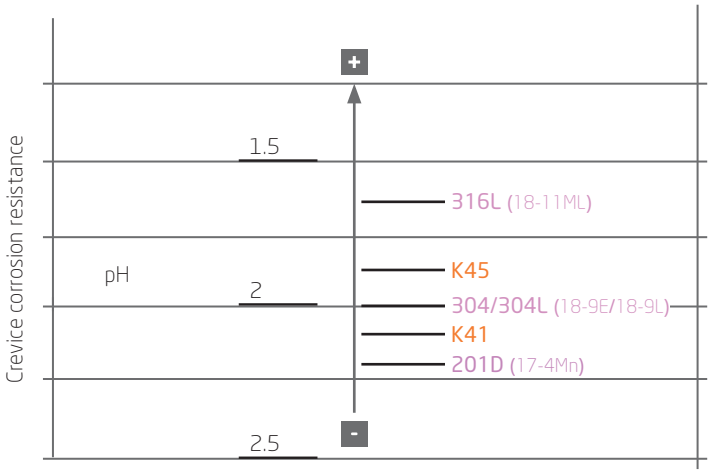
Pitting potential in variations following the temperature and the chloride concentration

Grades	NaCl 0.02/23°C	NaCl 0.02/50°C	NaCl 0.05/23°C	NaCl 0.02/50°C
304 (18-9E) 304H (18-9H) 304D (18-9ED) 304ED (18-9DDQ)	540 mV	385 mV	305 mV	175 mV

Typical values

Crevice corrosion

Depassivation pH in a deaerated NaCl 2M environment at 23°C



Crevice corrosion is a type of corrosion that can be divided in two processes. During the first process, called initiation, discrete pits are formed within the crevice region when locally the pH is below the depassivation pH of the grade. The propagation is the second process and is involved in the dissolution of metal. To slow down this process, molybdenum and nickel containing grades are to be preferred since both these elements have a positive effect on decreasing the speed of propagation.

Forming

In the annealed condition our **304, 304H, 304D, 304ED** (18-9E/H/ED/DDQ) can be readily cold formed by all standard processes such as bending, contour forming, drawing, flow turning, etc.
Some forming operations are more readily performed hot.
Subsequent pickling is necessary. For severe forming operations, our grades **304, 304H, 304D, 304ED** (18-9E/H/ED/DDQ) are to be preferred.

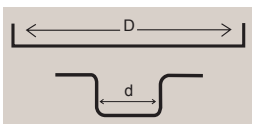
Deep drawing (Swift test)

The Swift test is a method to determine the Limiting Drawing Ration (LDR). This LDR is defined by the maximum ratio between the blank diameter (variable) and the punch diameter (fixed) for which drawing can be performed successfully in one step.

Grades	European designation	ASTM A240	LDR*
304 (18-9E)	1.4301	304	1.96
304D (18-9ED)	1.4301	304	1.98
304ED (18-9DDQ)	1.4301	304	2.02
201D (17-4Mn)	1.4618	201.1	1.92
K41	1.4509	441	2.29
K45	1.4621	445	2.28

* Limiting Drawing Ratio - Lubricant = Mobilux EP00
Typical values tests done on 0.8mm thick.

$$LDR = \frac{D_{max}}{d}$$



Stretching (Erichsen test)

The stretching behaviour is characterized by the dome height (h) of the Erichsen test which is also known as Index ' EI '.

Bending

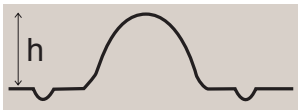
Our grades 304, **304H, 304D, 304ED** (18-9E/H/ED/DDQ) have a good bending capacity up to 180°, with very small bending radii for thicknesses below 0.8 mm. For thicker gauges, a bending radius of at least half the thickness of the sheet is recommended. When bending the material, the elastic springback always has to be taken into consideration.

Flow turning

Our grades **304, 304H, 304D, 304ED** (18-9E/H/ED/DDQ-1.4301) are the most suitable for this application.

Grades	European designation	ASTM A240	EI* (mm)
304 (18-9E)	1.4301	304	11.6
304D (18-9ED)	1.4301	304	11.8
304ED (18-9DDQ)	1.4301	304	12.0
201D (17-4Mn)	1.4618	201.1	11.9
K41	1.4509	441	9.4
K45	1.4621	445	9.5

* Erichsen Index – Lubricant = Mobilux EP00
Typical values tests done on 0.8mm thick.



Welding

Welding process	No filler material	With filler metal			Shielding gas*
	Typical thicknesses	Thicknesses	Filler material		* Hydrogen and nitrogen forbidden in all cases
			Rod	Wire	
Resistance: spot, seam	< 2 mm				
TIG	< 1.5 mm	> 0.5 mm	ER 308 L[1] ER 347L [1] [2]	ER 308 L[1] ER 347L [1] [2]	Argon Argon + 5% Hydrogen Argon + Helium
PLASMA	< 1.5 mm	> 0.5 mm		ER 308 L[1] ER 347L [1] [2]	Argon Argon + 5% Hydrogen Argon + Helium
MIG		> 0.8 mm		ER 308 L[1] ER 347L [1] [2]	Argon + 2% CO_2 Argon + 2% O_2 Argon + 2% CO_2 +1% H_2 Argon + Helium
S.A.W.		> 2 mm		ER 308 L[1]	
Electrode		Repairs	E 308 L[1] E 308L E 347[1] [2]		
Laser	< 5 mm				Helium Under certain circumstances: Argon Nitrogen

[1]ER 308L (AWS A5.9) = G 19 9 L (NF EN ISO 14343) [2] ER 347 (AWS A5.9) = G 19 9 Nb (NF EN ISO 14343) [3] E308L (AWS A5.4) = E 19 9 L (EN1600) [4] 4 E347 (AWS A5.4) = E 19 9 Nb (EN1600)

In general heat treatment is not required after welding. However in order to fully restore the corrosion resistance of the metal, the welds must be mechanically or chemically descaled, then passivated and decontaminated. If there is a risk of intergranular corrosion, a solution annealing treatment at 1075 ± 25°C must be carried out. However, in this case a low carbon grade such as our 304 (18-9L) (1.4307, Type 304L) or titanium stabilized grades such as our 321 (18-10T) (1.4541, Type 321) are recommended.

Heat treatment and finishing

Annealing

After cold forming (work hardening) and after welding (risk of intergranular corrosion in the weld joint), an annealing treatment for a couple of minutes at 1075 ± 25°C followed by air cooling restores the microstructure (recrystallisation and dissolution of carbides) and eliminates internal stresses. After annealing, pickling followed by passivation is necessary.

Pickling

- Nitric-Hydrofluoric acid mixture (10%HNO_3 + 2% HF) at ambient temperature or up to 60°C.
- Sulfuric-nitric acid mixture (10% H_2SO_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.

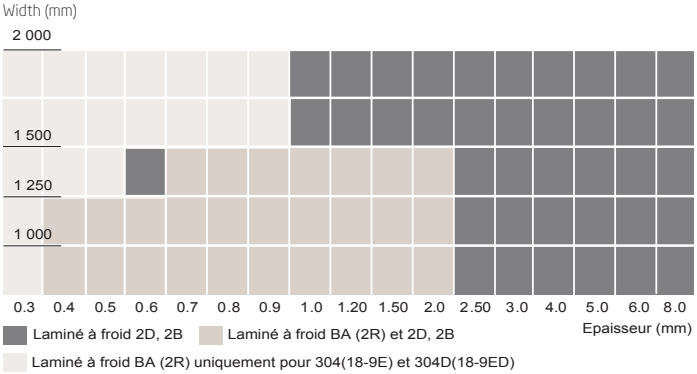
Polishing

The surface of our 304ED (18-9DDQ) is suitable for all kinds of polishing (grit, scotch-brite, electro polishing).

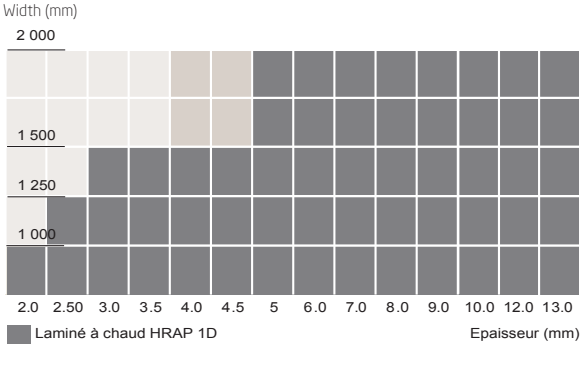
Size range

Our size range is based on our production capabilities. For the latest information per grades on our offer, please consult us.

Cold Rolled



Hot-Rolled and HRC



For 2.00mm thick under 1,000 wide: only available for 304(18-9E) and 304D(18-9ED), not for 304ED(18-9DDQ). For > 1500mm wide: only available for 304(18-9E)

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