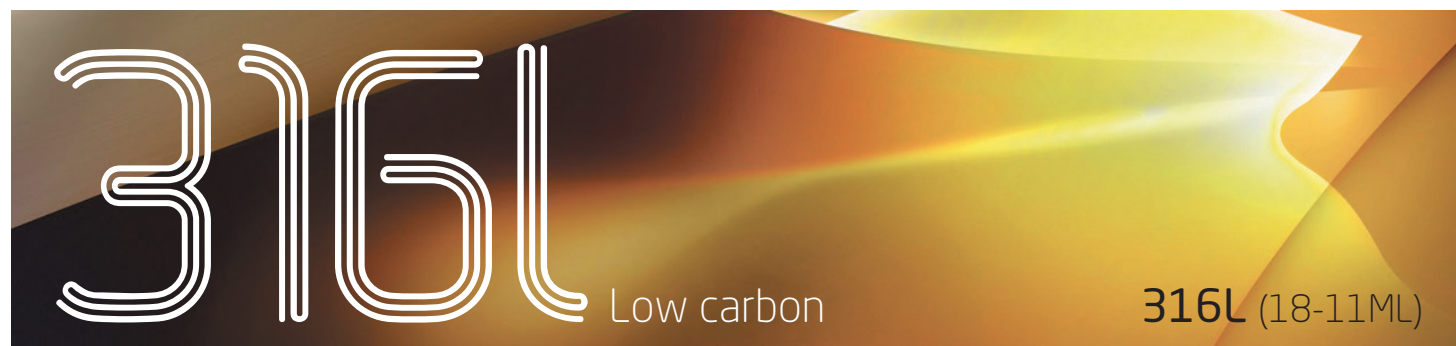


Austenitic Stainless steel offer grade **316L**



Chemical composition

Elements (%)	C	Si	Mn	Cr	Ni	Mo
316L (18-11ML)	0.025	0.40	1.20	16.80	10.10	2.10

Typical values

Grade designation	European designation	American designation	IMDS Nr
316L (18-11ML)	X5CrNiMo17-12-2 / 1.4401 ⁽¹⁾	UNS 31600 / Type 316 ⁽²⁾	336840014
	X2CrNiMo17-12-2 / 1.4404 ⁽¹⁾	UNS 31603 / Type 316L ⁽²⁾	

⁽¹⁾ According to EN 10088-2

⁽²⁾ According to ASTM A 240.

These grades comply with:

- > Stainless Europe Material Safety Data Sheet n°1 (European Directive 2001/58/EC).
- > European Directive 2000/53/EC on end-of-life vehicles and later modifications.
- > PED (Pressure Equipment Directive) according to EN 10028-7 and AD2000 Merkblatt W2 and W10 (TÜVWB494).
- > 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 FDA. (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/EEC and 89/109/EEC).
- > French regulatory paper dated 13 January 1976 relating to materials and articles made of stainless steel in contact with foodstuffs.
- > Italian Decree of 21st March 1973: 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".

General characteristics

The principal features of our grade 316L (18-11ML) are:

- > Very good resistance to corrosion in acids and chloride containing media
- > Very good resistance to pitting corrosion and crevice corrosion
- > Very good resistance to intergranular corrosion, even after welding
- > Excellent weldability
- > High ductility
- > Good drawability
- > Excellent polishing

Applications

- > Food industry equipment: tanks, tubes, pumps
- > Naval engineering
- > Road transport: IMO tanks, swap bodies and trailers
- > Building industry: architectural components, roofing, façade
- > Water industry
- > Chemical and pharmaceutical industry
- > Oil and gas industry
- > Paper industry

Product range

Forms : sheets, blanks, coils, strips, tubes

Thicknesses: from 0.3 up to 13 mm

Width: up to 2000 mm according to thickness

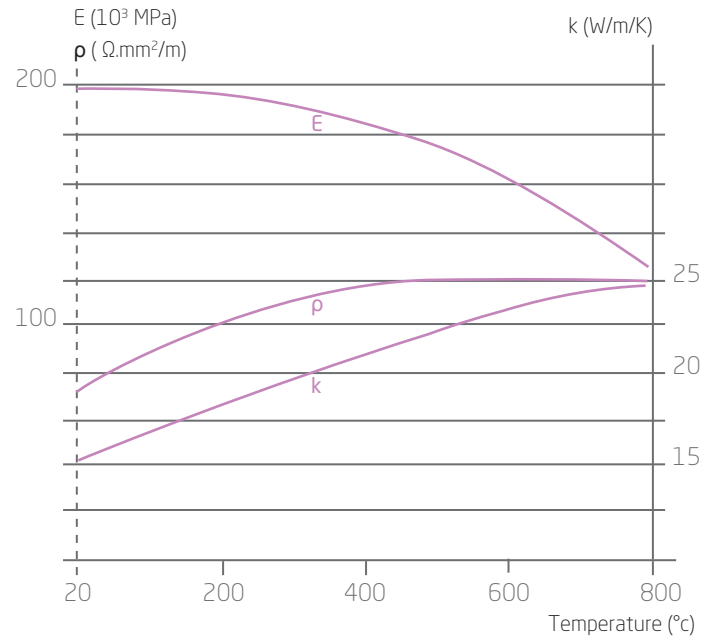
Finish: cold rolled, hot rolled, patterned/tear plate, according to thickness

Physical properties

Cold rolled and annealed sheet.

Density	d	kg/dm ³	20 °C	7.9
Melting Temperature		°C	Liquidus	1440
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 20-300 °C 20-500 °C	16.0 17.0 18.0
Electric resistivity	ρ	Ω mm ² /m	20 °C	0.75
Magnetic permeability	μ	at 0.8 kA/m DC or AC	20 °C	1.005
Young's Modulus	E	10 ³ .MPa	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

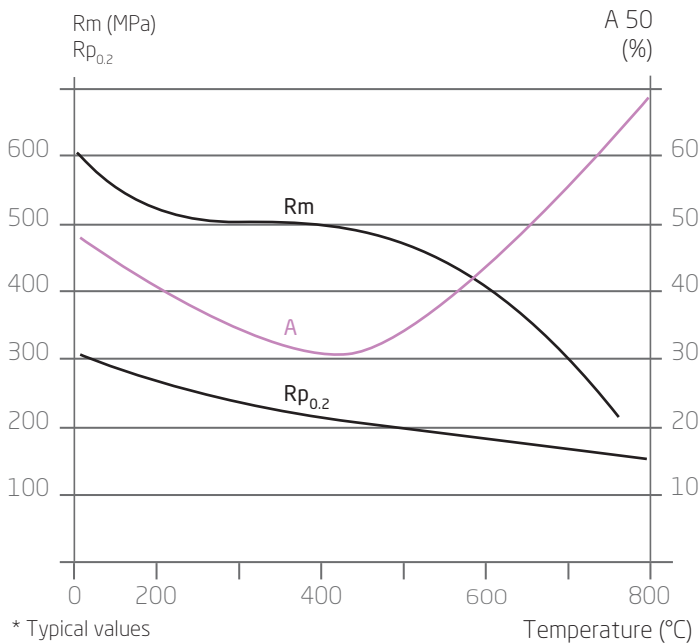
Length = 80 mm (thickness < 3 mm)
Length = 5.65 √ So (thickness ≥ 3 mm).
Cold rolled

Grades	European designation	ASTM A240	Rm ⁽¹⁾ (MPa)	Rp0.2 ⁽²⁾ (MPa)	A ⁽³⁾ %
316L (18-11ML)	1.4401/4404	316/316L	620	300	52
DX2205	1.4462	2205	840	620	29
K44	1.4521	444	520	370	29

1 MPa = 1 N/mm²

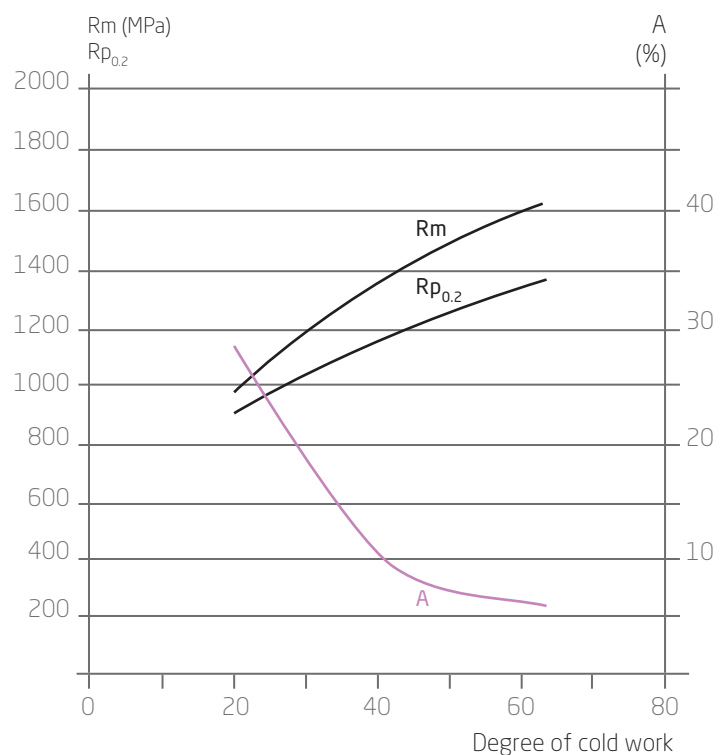
⁽¹⁾ Ultimate Tensile Strength (UTS), ⁽²⁾ Yield Strength (YS), ⁽³⁾ Elongation (A)

At elevated temperatures*



* Typical values

Work-hardened by cold rolling

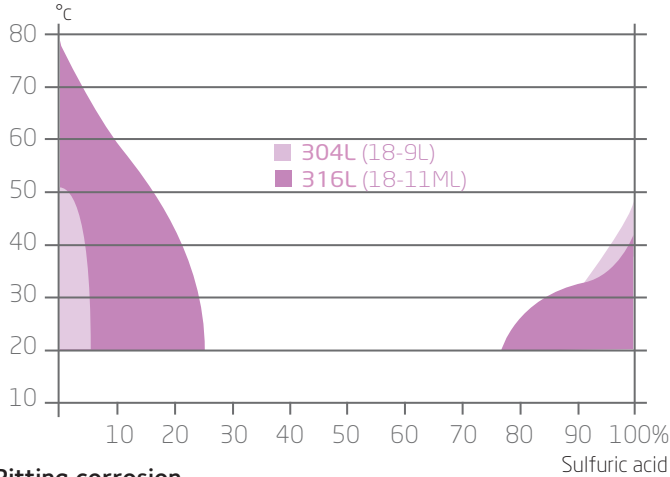


Corrosion resistance

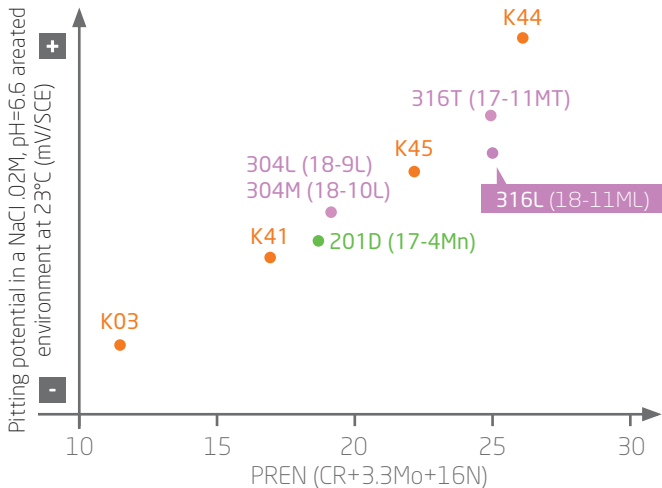
The 316L (18-11ML) has an excellent resistance in acid solutions and shows a good resistance in chloride containing media. This grade is therefore used for the manufacturing of parts that come into contact with seawater at low temperatures.

Generalized corrosion

Corrosion resistance of stainless steels in sulfuric acid (H_2SO_4)



Pitting corrosion



K44 and duplex DX2205 (1.4462) and DX2304 (1.4362) are alternatives of the 316L (18-11ML). Due to their higher corrosion resistance, duplex pitting potentials cannot be determined in such conditions of temperature (23°C) and chloride concentration (0.02M). To consider them, please report you to their specific technical data sheets.

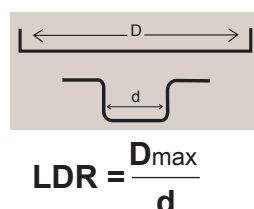
Forming

In the annealed condition our 316L (18-11ML) can be readily cold formed by all standard processes such as bending, contour forming, drawing, deep drawing, flow turning and stretching.

Deep drawing (Swift test)

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

Grades	LDR*
316L (18-11ML)	2.01
DX2205	1.9 - 1.95
K44	2.10 - 2.15



* Limiting Drawing Ratio - Lubricant = Mobilux EP00
0.8 mm thick sheet

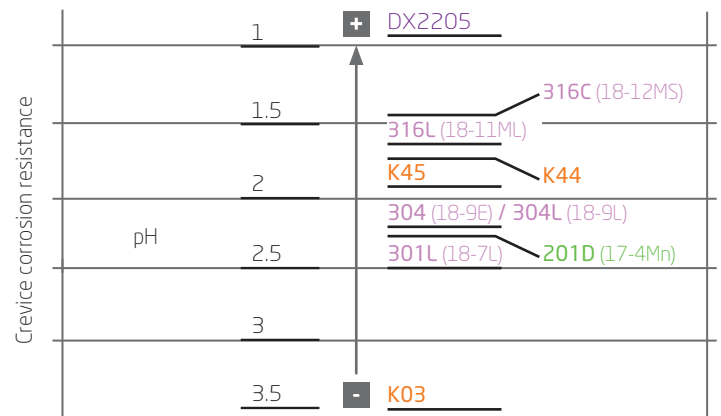
Pitting potential in various solutions of temperature and chloride concentration (mV)

Grades	Pitting potential			
	NaCl 0.02/23°C	NaCl 0.02/50°C	NaCl 0.05/23°C	NaCl 0.05/50°C
316L (18-11ML)	630	500	455	270

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 into processes. During the first process, called initiation, discrete pits are formed within the crevice region if the pH is below the depassivation pH of the grade locally. Propagation is the second process and involves 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 propagation rate.

Intergranular corrosion

The grade is also recommended where there is a risk of intergranular corrosion by meeting the following requirements of the standard intergranular corrosion tests: EN ISO 3651-2 (sensitizing treatments T1 and T2), ASTM A 262, ex DIN 50914.

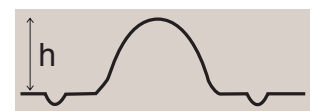
Bending

Our grade 316L (18-11ML) has got a good bending capacity up to 180°, with very small bending radii for thicknesses below 0.8mm. 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.

Stretching

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

Grades	EI* (mm)
316L (18-11ML)	11.5
DX2205	9.5
K44	8.6



* 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		
			Rod	Wire	
Resistance: spot, seam	≤ 2 mm				
TIG	< 1.5 mm	> 0.5 mm	ER 316 L ⁽¹⁾	ER 316 L ⁽¹⁾	Argon Argon + 5% Hydrogen Argon + Helium
PLASMA	< 1.5 mm	> 0.5 mm		ER 316 L ⁽¹⁾	Argon Argon + 5% Hydrogen Argon + Helium
MIG		> 0.8 mm		ER 316 L Si ⁽¹⁾	Argon + 2% CO ₂ Argon + 2% O ₂ Argon + 2% CO ₂ +1% H ₂ Argon + 2% CO ₂ +Helium
S.A.W.		> 2 mm		ER 316 L ⁽¹⁾	
Electrode		Repairs	E 316 L ⁽²⁾		
Laser	< 5 mm				Helium Under certain conditions: Argon

⁽¹⁾ ER 316L (AWS A5.9) = G 19 12 3 L (EN 14343) (2) E 316L (AWS A5.4) = E 19 12 3 L (EN 1600)

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 and passivated. In case of applications at temperatures above 500°C, a specific filler material has to be used to guarantee a ferrite level below 8% in the weld.

Heat treatment and finishing

Annealing

After cold forming (work hardening) and after welding an annealing treatment for a couple of minutes at 1050 ± 25°C followed by air cooling or water quenching 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% HNO₃ + 2% HF) at ambient temperature or up to 60°C.

- > Sulfuric-nitric acid mixture (10% H₂SO₄ + 0,5% HNO₃) at 60°C.
- > Descaling pastes for weld areas.
- > Passivation Heat treatment and finishing
- > 20-25% HNO₃ solution (36° Baumé) at 20°C.
- > Passivating pastes for weld zones.

Polishing

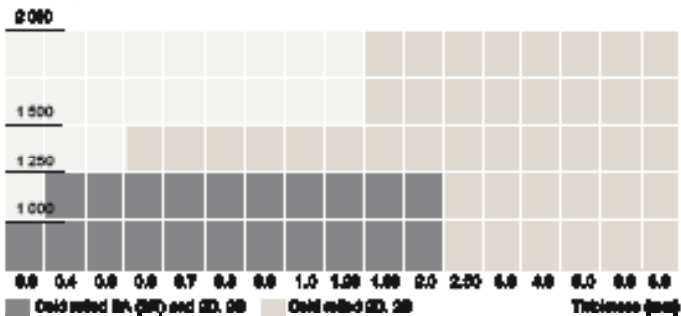
The surface of our 316L (18-11ML) is suitable for all kinds of polishing (grit, scotch-brite, electro polishing).

Size range

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

Cold Rolled

Width (mm)



Hot-Rolled and HRC

Width (mm)

