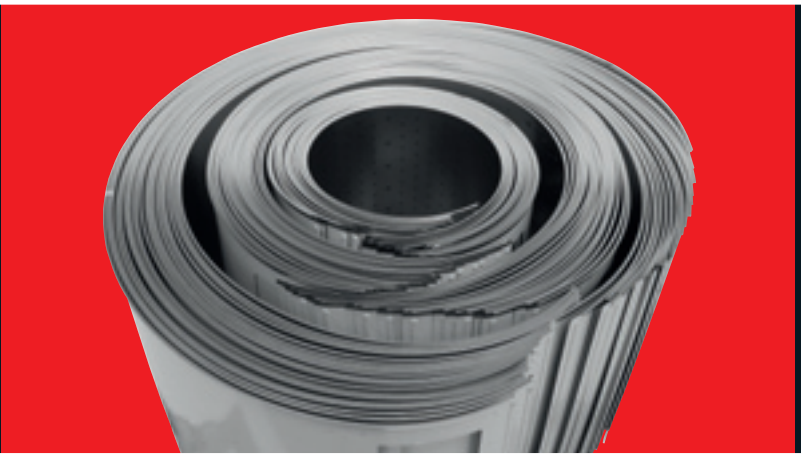
SPIROPACK

SINTRA



AIR DISTRIBUTION

PERFORATED METALLIC DUCTS WITH AN OPEN CIRCUMFERENCE

SELECTION CATALOGUE

SiNTRA

SISTEMI INNOVATIVI DI TRATTAMENTO ARIA

JULY 2023 EDITION

CHART

		GALVANIZED STEEL THICKNESS				INOX THICKNESS			ALUMINIUM THICKNESS	COPPER THICKNESS
Ø	EXPANSION	8/10	10/10	12/10	15/10	8/10	10/10	12/10	10/10	10/10
mm	mm	Kg	Kg	Kg	Kg	Kg	Kg	Kg	Kg	Kg
280	879	5,7	7,0	8,8	11,4	5,7	7,0	8,8	2,4	6,3
300	942	6,1	7,5	9,4	11,3	6,1	7,5	9,4	2,5	6,8
315	989	6,4	7,9	9,9	11,9	6,4	7,9	9,9	2,7	7,1
350	1.099	7,1	8,8	11,0	13,2	7,1	8,8	11,0	3,0	7,9
355	1.115	7,2	8,9	11,1	13,4	7,2	8,9	11,1	3,0	8,0
400	1.256	8,2	10,0	12,6	15,1	8,2	10,0	12,6	3,4	9,0
450	1.413	9,2	11,3	14,1	17,0	9,2	11,3	14,1	3,8	10,2
500	1.570	10,2	12,6	15,7	18,8	10,2	12,6	15,7	4,2	11,3
550	1.727	11,2	13,8	17,3	20,7	11,2	13,8	17,3	4,7	12,4
560	1.758	11,4	14,1	17,6	21,1	11,4	14,1	17,6	4,7	12,7
600	1.884	12,2	15,1	18,8	22,6	12,2	15,1	18,8	5,1	13,6
630	1.978	12,9	15,8	19,8	23,7	12,9	15,8	19,8	5,3	14,2
650	2.041	13,3	16,3	20,4	24,5	13,3	16,3	20,4	5,5	14,7
700	2.198	14,3	17,6	22,0	26,4	14,3	17,6	22,0	5,9	15,8
710	2.229	14,5	17,8	22,3	26,8	14,5	17,8	22,3	6,0	16,1
750	2.355	15,3	18,8	23,6	28,3	15,3	18,8	23,6	6,4	17,0
800	2.512	16,3	20,1	25,1	30,1	16,3	20,1	25,1	6,8	18,1
850	2.669	17,3	21,4	26,7	32,0	17,3	21,4	26,7	7,2	19,2
900	2.826	18,4	22,6	28,3	33,9	18,4	22,6	28,3	7,6	20,3
950	2.983	19,4	23,9	29,8	35,8	19,4	23,9	29,8	8,1	21,5
1.000	3.140	20,4	25,1	31,4	37,7	20,4	25,1	31,4	8,5	22,6
1.050	3.297	21,4	26,4	33,0	39,6	21,4	26,4	33,0	8,9	23,7
1.100	3.454	22,5	27,6	34,5	41,4	22,5	27,6	34,5	9,3	24,9
1.150	3.611	23,5	28,9	36,1	43,3	23,5	28,9	36,1	9,7	26,0
1.200	3.768	24,5	30,1	37,7	45,2	24,5	30,1	37,7	10,2	27,1
1.250	3.925	25,5	31,4	39,3	47,1	25,5	31,4	39,3	10,6	28,3
1.300	4.082	26,5	32,7	40,8	49,0	26,5	32,7	40,8	11,0	29,4
1.350	4.239	27,6	33,9	42,4	50,9	27,6	33,9	42,4	11,4	30,5
1.400	4.396	28,6	35,2	44,0	52,8	28,6	35,2	44,0	11,9	31,7
1.450	4.553	29,6	36,4	45,5	54,6	29,6	36,4	45,5	12,3	32,8
1.500	4.710	30,6	37,7	47,1	56,5	30,6	37,7	47,1	12,7	33,9
1.550	4.867	31,6	38,9	48,7	58,4	31,6	38,9	48,7	13,1	35,0
1.600	5.024	32,7	40,2	50,2	60,3	32,7	40,2	50,2	13,6	36,2

Suggested thickness

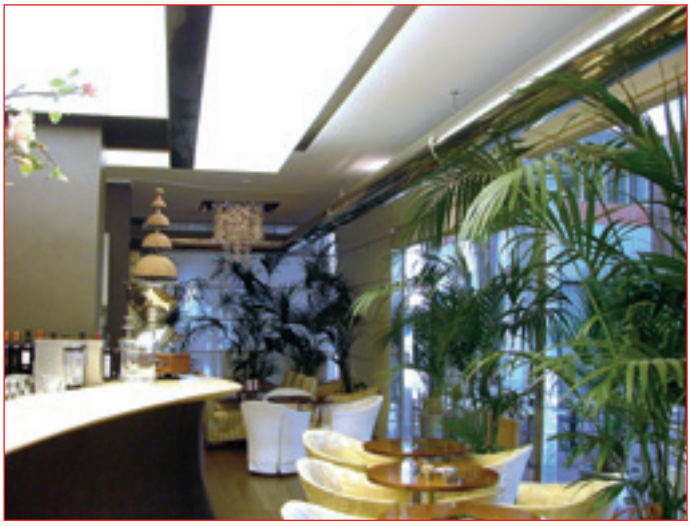
DIFFERENT MATERIALS

GALVANIZED STEEL CZn

PAINTED STEEL CEp

SATINIZED INOX Cinox/s

POLISHED INOX Cinox/L



ALUMINIUM CAl

COPPER CCu

S 250 GD + Z EN 10346

Sintra, for the construction of the metallic ducts with SPIROPACK™ technology, does not use classic DX51 galvanized steel, but only selected galvanized steel with qualities above standard.

This choice, which is necessary to allow the construction of the ducts following high quality standards, always allows a detailed control on the material's characteristics and as a consequence, a structural uniformity which is constant in time.

BRAND CORRESPONDENCE

Structural steels

DIRECTION	THICKNESS (MM)	R_e(MPA)	R_m(MPA)	A80(%)	MP GUARANTEES (MONTHS)	R90	N90
	0.2 - 0.5			≥ 15			
L	0.5 - 0.7	≥ 250	≥ 330	≥ 17	< 1	—	—
	0.7 - 6			≥ 19			

Legenda

Re *= yield limit in N/mm²*

Rm *= mechanical resi stance to breaking in N/mm²*

A 80 % *= stretching percentage samples 80m mm*

MECHANICAL PROPERTIES

Structural steels

10142:1991	
DIN 17162/1	
NF A36-321	
BS 2989	Z25G
ASTM A653	SS GRADE 230
EN 10142:2000	
PN-89/H-92125:1989	
EN 10292:2007	
EN 10147:2000	S250GD+Z
EN 10326:2004	S250GD+Z
EN 10327:2004	
EN 10346:2009	S250GD+Z
EN 10147:1991	FEE250G
DIN 17162/2	STE 250-2Z
NF A36-322	C.250
OLD BRAND NAMES	S250GD+Z

DIMENSION

Structural steels

THICKNESS (MM)	S250GD+Z EN 10346 MAX WIDTH
0.25 ≤ TH ≤ 0.30	1250
0.30 ≤ TH ≤ 0.35	1290
0.35 ≤ TH ≤ 0.40	1350
0.40 ≤ TH ≤ 0.45	1450
0.45 ≤ TH ≤ 0.50	1560
0.50 ≤ TH ≤ 0.55	1640
0.55 ≤ TH ≤ 0.60	1730
0.60 ≤ TH ≤ 0.65	1840
0.65 ≤ TH ≤ 0.70	1860
0.70 ≤ TH ≤ 0.75	1970
0.75 ≤ TH ≤ 0.80	2060
0.80 ≤ TH ≤ 0.85	2060
0.85 ≤ TH ≤ 1.05	2060
1.05 ≤ TH ≤ 1.50	2060

THICKNESS (MM)	S250GD+Z EN 10346 MAX WIDTH
1.50 ≤ TH ≤ 1.75	2060
1.75 ≤ TH ≤ 1.80	2060
1.80 ≤ TH ≤ 1.85	2060
1.85 ≤ TH ≤ 1.90	1970
1.90 ≤ TH ≤ 1.95	1920
1.95 ≤ TH ≤ 2.00	1870
2.00 ≤ TH ≤ 2.05	1830
2.05 ≤ TH ≤ 2.10	1780
2.10 ≤ TH ≤ 2.15	1740
2.15 ≤ TH ≤ 2.20	1700
2.20 ≤ TH ≤ 2.25	1690
2.25 ≤ TH ≤ 2.30	1700
2.30 ≤ TH ≤ 2.35	1750

CHEMICAL COMPOSITION

Structural steels

C (%)	MN (%)	P (%)	S (%)	SI (%)	AL (%)	NB (%)	TI (%)
≤ 0.200	≤ 1.70	≤ 0.100	≤ 0.045	≤ 0.60	—	—	—

COATING PROPERTIES

DESIGNATION EN 10346	COATING WEIGHT DOUBLE SIDED (G/M²)	COATING THICKNESS (µM PER SIDE)
Z 140	140	10.0

AISI 430

Sintra, in order to give the ducts a more pleasant appearance without having to bear heavily on the costs, introduced the use of the AISI 430 stainless steel instead of the AISI 304 stainless steel, which can be used in all plants as a substitute for galvanized steel.

General characteristics

The main characteristics of the AISI 430 stainless steel for applications close to room temperature are:

- Resistance to corrosion with moderately aggressive media
- It can be readily cold formed by all standard processes (enhanced performance for K30D)
- Excellent aesthetical appearance

AISI 430 stainless steel also have a good resistance to oxidation due to high temperatures.

CHEMICAL COMPOSITION

This grade complies with:

- Stainless Europe material safety data sheet n° 1: stainless steel (European directive 2001/58/EC)
- European directive 2000/53/EC on end-of-life vehicles, and on the annex II dated 27 june 2002.
- 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 – 2007 international standard edition for “Food Equipment Materials” and of the FDA (United States Food and Drug Administration) regarding materials used for food contact
- French decree Nr. 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

GRADE DESIGNATION	INOX430D	INOX430D
ELEMENTS	%	%
C	0.05	0.035
Si	0.35	0.35
Mn	0.40	0.40
Cr	16.5	16.5

Typical values

INOX430	INOX430D
STANDARD LEVEL GRADE	ENHANCED FORMING PERFORMANCE GRADE

GRADE DESIGNATION		EUROPEAN DESIGNATION
X6Cr17	1.4016(1)	TYPE 430(2)

(1)According to EN 10088-2 (2)According to ASTM A 240

COLD FORMED METAL SHEET – STRENGTHENED

Our 430 stainless steel can be readily cold formed by all standard processes (bending, contour forming, drawing, deep drawing, flow turning and stretching).

The drawing operations which imply a considerable “stretching”, can be eased by the initial forming, by producing modules with a wide bending radius.

Stretching (Erichsen test)

GRADE DESIGNATION	EUROPEAN DESIGNATION	ASTM A 240	ERICHSEN DEFLECTION*
K30	1.4016	TYPE 430	MM 8.7

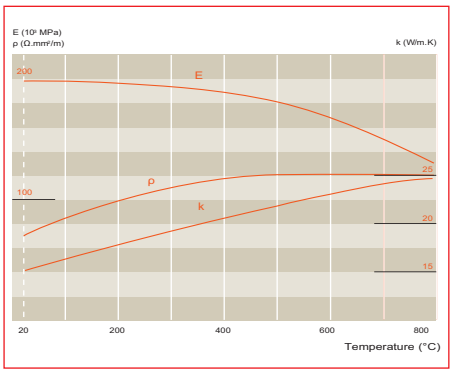
Deep drawing (Swift test)

GRADE DESIGNATION	EUROPEAN DESIGNATION	ASTM A 240	LDR* (MM)
K30	1.4016	TYPE 430	2.05-2.10

PHYSICAL PROPERTIES

Cold rolled sheet - annealed

DENSITY	D	KG/DM^3	20°C	7.7
FUSION TEMPERATURE		°C		1500
SPECIFIC HEAT	C	J/KG.K	20°C	460
			400°C	600
			800°C	800
THERMAL CONDUCTIVITY	K	W/M.K	20°C	25
MEAN COEFFICIENT OF THERMAL EXPANSION	A	10^{-6}/K	20-200°C	10.5
			20-400°C	11.5
			20-600°C	11.7
			20-600°C	12.5
ELECTRICAL RESISTIVITY	P	Ω MM^2/M	20°C	0.60
MAGNETIC PERMEABILITY	μ	AT 0.8 KA/M DC OR AC	20°C	1000
YOUNG MODULUS	E	MPA.10^3	20°C	220



AISI 430

MECHANICAL PROPRETIES

GRADE DESIGNATION	CONDITIONS	R_m (1) (MPa)	$R_{p0.2}$ (2) (MPa)	A (3) (%)	HV5
K30	COLD ROLLED**	510	340	26	155
K30D	COLD ROLLED**	490	320	29	150

1 MPa - 1 N/mm²

**Typical values

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

Annealed condition

According to EN 10002-1 (july 2001).

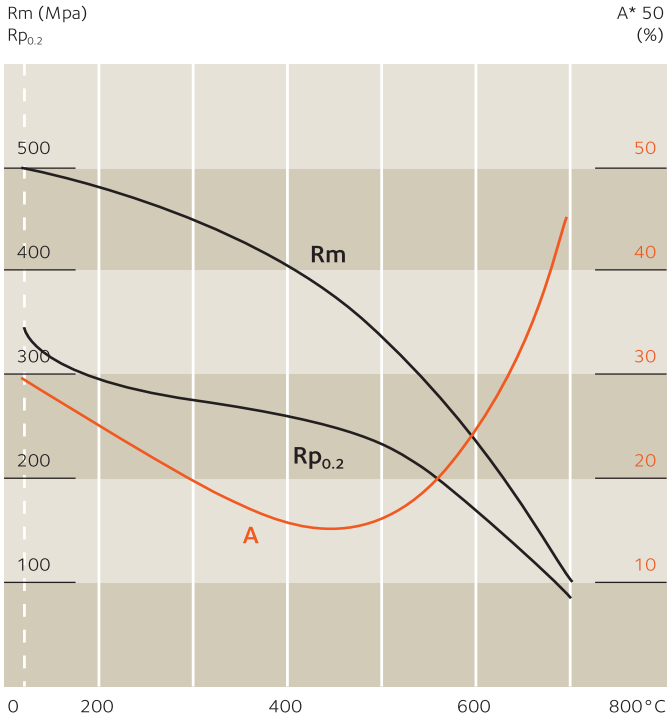
Specimen perpendicular to the rolling direction

Specimen

Lo = 80 mm (thickness < 3 mm)

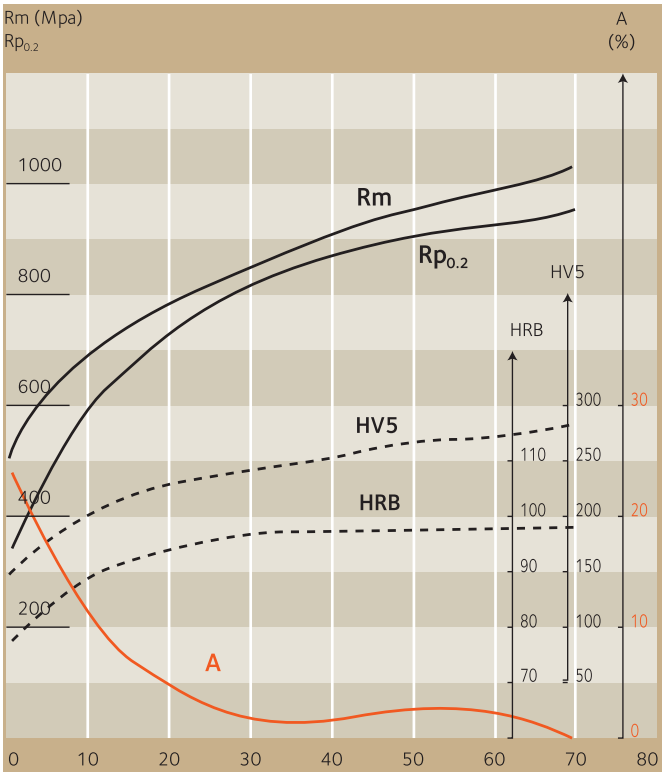
Lo = 5.65 √So (thickness ≥ 3 mm)

At high temperatures (K30)



Typical values.
* based from specimen 20x50 mm

Effect of cold rolling (K30)



CREEP PROPERTIES

Mean stresses (Mpa) for different rupture levels according to temperature

TEMPERATURE (°C)	100 H	10000 H	100000 H
400	400	340	300
500	180	140	120
600	60	45	30
700	20	13	7

Typical values

Mean stresses (Mpa) for 1% elongation at different times according to temperature

TEMPERATURE (°C)	1000 H	10000 H	100000 H
400	340	280	210
500	130	90	60
600	50	35	20

Typical values

HEAT TREATMENT AND FINISHING

Annealed at 800 °C after cold forming.

For what concerns the polishing, brushing, buffing, satin finishing there are no particular difficulties encountered.

Pickling

Nitric-hydrofluoric acid mixture (10% HNO3 + 2% HF)

De-scaling paste for welded areas

Passivation

HNO3 solution at 20-25% (36° Baumé) at 20°C.

Passivating paste for welded areas

AISI 430

CORROSION RESISTANCE

430 stainless steel has a good corrosion resistance in a large number of applications:

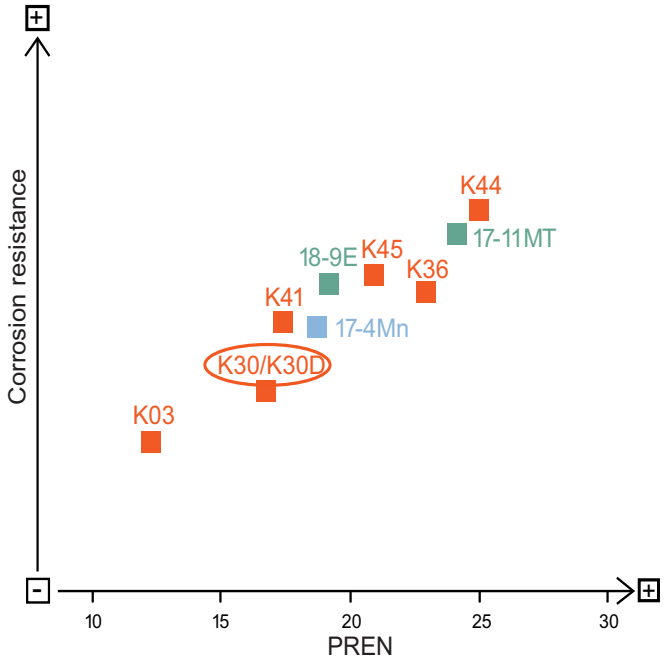
- domestic environments;
- domestic handling of foodstuffs
- soaps and detergents
- alkaline solutions at room temperature
- certain diluted organic acids at room temperature
- neutral and alkaline salt solutions other than those containing halides (chlorides, fluorides, bromides, iodides)
- numerous organic substances
- Oxidation limits the continuous service temperature of 430 stainless steel to 800°C

Localised corrosion resistance

Grade designations	Standards		
	ASTM Designations		EN
	Type	UNS	
K03		S41003	1.4003
K30/K30D	430	S43000	1.4016
K41	441 (1)	S43932	1.4509
K45	445 (1)	S44500	1.4621 (2)
K36	436	S43600	1.4526
K44	444	S44400	1.4521
17-4Mn	201.1	S20100 (3)	1.4618 (2)
18-9 E	304	S30400	1.4301
17-11 MT	316Ti	S31635	1.4571

(1) Common designation.
(2) Pending update of the standard.
(3) With copper addition and 201.1 «rich side» properties per ASTM A240

Typical values of pitting corrosion potential in NaCl 0.02M, 23°C, pH6.6 as a function of PREN (%Cr+3.3%Mo+16%N).



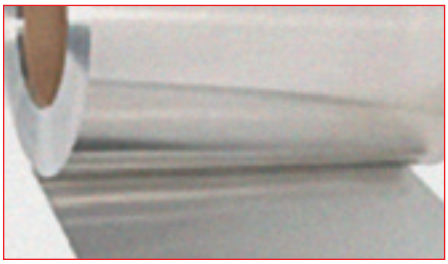
WELDING

In general 430 stainless steel is poorly suited to welding operations, since it readily forms martensite in the weld, leading to brittle and relatively undeformable joints.
However, satisfactory results can be obtained without having to resort to post-weld treatments, providing that the welding process employed forges the weld sufficiently and that the welding power is not too high.
430 stainless steel is not recommended for heavy gage welded structures, due to the brittleness of the non-forged weld joints.
There is no thermal treatment required after the welding.
Welding points must be mechanically or chemically descaled, then passivated.

WELDING PROCESS	NO FILLER METAL TYPICAL THICKNESSES	WITH FILLER METAL THICKNESSES	FILLER METAL ROD	FILLER METAL WIRE	SHIELDING GAS*
RESISTANCE: SPOT, SEAM	≤ 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(2)		> 0.8 MM		W.N° 1.4370 ER 309 L (Si) ER 316 L (Si)	ARGON + 2% CO ARGON + 2% O
S.A.W(2)		> 2 MM		ER 309 L ER 316 L	
ELECTRODE		REPAIRS	ER 309 L ER 316 L		
LASER	< 5 MM				HELIUM

(1)The S.A.W. process is not recommended, due to the high power input.
(2)Pulsed MIG welding preferred, due to the lower power input.

AISI 304



General characteristics

The main characteristics of the 304 stainless steel are:

- Good resistance to corrosion in acids and chlorides 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

CHEMICAL COMPOSITION

This 304 stainless steel complies with:

- Stainless Europe material safety data sheet n° 1: stainless steel (European directive 2001/58/EC)
- European directive 2000/53/EC on end-of-life vehicles, and on the annex II dated 27 June 2002.
- 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 International edition for "Collective Restoration Materials" and of FDA (United States Food and Drug Administration) for what concerns materials used for contact with foodstuffs
- French decree Nr. 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 dated 21 March1973: a list of steel kinds appropriate to the “rules for the hygiene of packaging, and instruments destined to come in contact with foodstuffs or with substances for personal use”
- PED (Pressure Equipment Directive) according to EN 10028-7 and AD2000 Merkblatt and W2 and W10 (TÜV WB494).

TEMPERATURE (°C)	100 H	10000 H	100000 H
400	400	340	300
500	180	140	120
600	60	45	30
700	20	13	7

Typical values

TEMPERATURE (°C)	100 H	10000 H	100000 H
400	400	340	300
500	180	140	120
600	60	45	30
700	20	13	7

Typical values

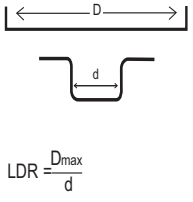
COLD FORMING

In the strengthened condition, 304 stainless steel can be readily cold formed by all standard processes (bending, contour forming, drawing, deep drawing, flow turning and stretching). Some forming operations are easier when performed hot. Subsequent pickling is necessary.

Deep drawing (Swift test)

The Swift test is a method used to determinate 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 can be performed successfully in one step.

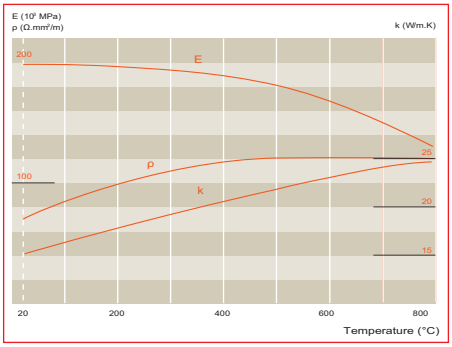
Grade designation	LDR* (mm)
18-9E	1.96
18-9ED	1.98
18-9DDQ	2.02
17-4Mn	1.92
K41	2.29
K45	2.28



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

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	ά	10^{-6}/K	20-100 °C	16.0
			20-200 °C	16.5
			20-400 °C	17.0
			20-600 °C	17.5
			20-800 °C	18.0
ELECTRICAL RESISTIVITY	ρ	Ω MM²/M	20 °C	0.73
MAGNETIC PERMEABILITY	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

AISI 304

MECHANICAL PROPRETIES

GRADE DESIGNATION	EUROPEAN DESIGNATION	ASTM A240	R_m[1] (MPa)	$R_{p0.2}$[2] (MPa)	A[3] (%)
1B-9E	1.4301	304	670	320	50
18-9ED	1.4301	304	630	300	55
18-9DDQ	1.4301	304	610	270	57
17-4Mn	1.4618	201.1	650	330	50
K41	1.4509	441(a)	480	310	30
K41	1.4621(b)	445(a)	510	360	29

1 MPa - 1 N/mn^2 Typical values

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

(a)Common designation (b)Pending update of the standard

According to EN 10002-1 (July 2001), test piece perpendicular to rolling direction.

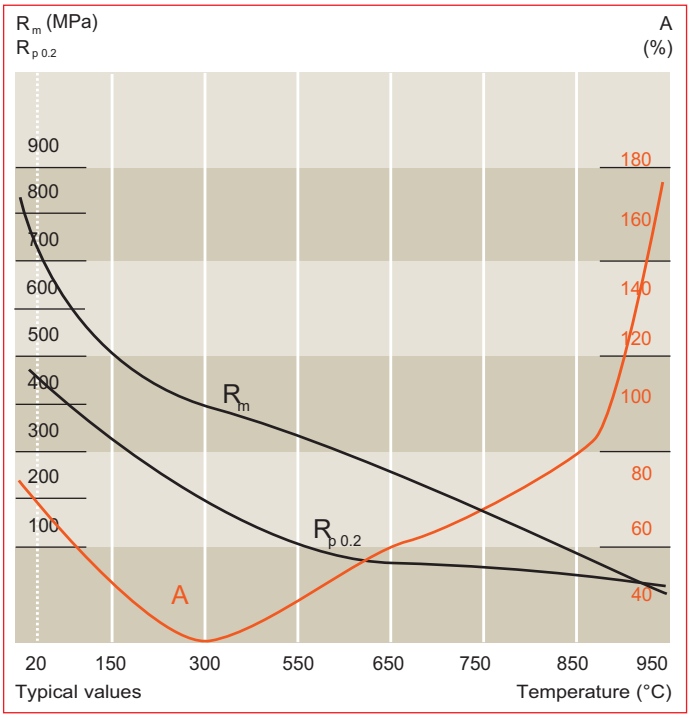
Test piece

Length = 80 mm (thickness < 3 mm)

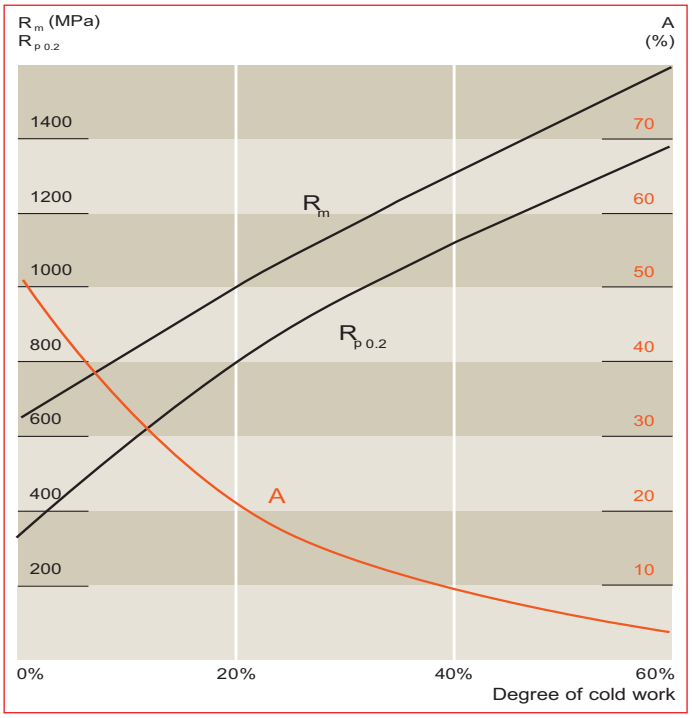
Length = 5.65 √So (thickness ≥ 3 mm)

Cold rolled

At high temperatures (18-9DDQ)

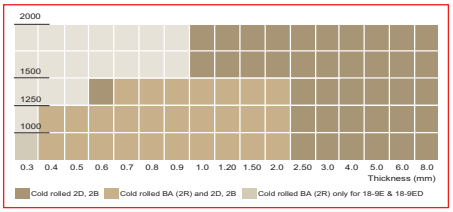


Work hardened condition (18-9E)

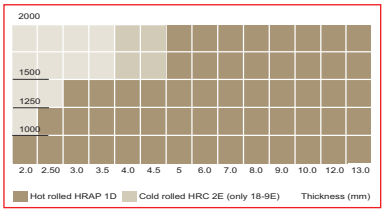


Size Range

Cold Rolled (width (mm))



Hot Rolled and HRC



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

Heat treatment and finishing

Temperature

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 (recrystallization 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 room temperature or up to 60°C

Sulfuric-nitric acid mixture (10% H2So4 + 0,5% HNO3) at 60°C

Descaling paste for welded areas

Passivation

20-25% HNO3 solution(36° Baumé) at 20°C - passivating paste for the welded areas

Polishing

The surface of the 304 stainless steel is indicated for all kinds of polishing (grit, scotch-brite, electropolishing)

AISI 304

CORROSION RESISTANCE

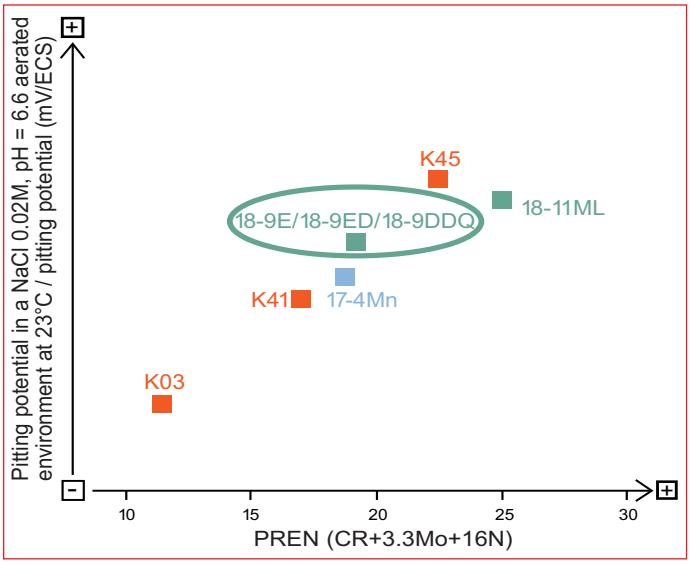
304 stainless steel have a good resistance to the common corrosive media, but are not recommended where there is a risk of intergranular corrosion. They are will adapted for exposure in fresh water and urban and rural atmospheres. In all cases, regular cleaning of exposed external surfaces is necessary to conserve their original appearance.

304 stainless steel has a good resistance to various acids:

- phosphoric acid in all concentrations at room 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.

Pitting corrosion



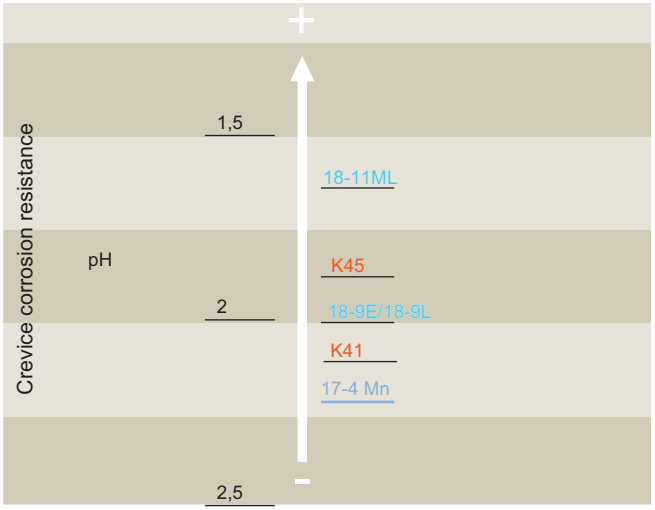
Pitting potential in various solutions of temperature and chloride concentration (mV).

GRADE DESIGNATION	NaCl 0.02/23°C	NaCl 0.02/50°C	NaCl 0.05/23°C	NaCl 0.02/50°C
18-9E/ED/DDQ	540	385	305	175

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 local grade.

Propagation is the second process and it consists in the dissolution of the metal.

WELDING

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 chemically descaled and passivated. If there is a risk of intergranular corrosion, a treatment with annealing solution at 1075 ± 25°C must be carried out.

WELDING PROCESS	NO FILLER METAL: TYPICAL THICKNESSES	WITH FILLER METAL: THICKNESSES	FILLER METAL: ROD	FILLER METAL: WIRE	SHIELDING GAS*
Resistance: Spot, Seam	< 2 mm				
TIG	< 1.5 mm	> 0.5 mm	ER 308 L(1) ER 347 L(2)	ER 308 L(1) ER 347 L(2)	Argon Argon+5%Hydrogen Argon + Helium
PLASMA	< 1.5 mm	> 0.5 mm		ER 308 L(1) ER 347 L(2)	Argon Argon+5%Hydrogen Argon + Helium
MIG(2)		> 0.8 mm		ER 308 L(1) ER 347 L(2)	Argon + 2% CO_2 Argon + 2% O_2 Argon + 2% CO_2+1% H_2 Argon + Helium
S.A.W(2)		> 2 mm		ER 308 L(1)	
Electrode		Repairs	ER 308 ER 308 L(1) ER 347 L(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)E347 (AWS A5.4) = E 19 9 Nb (EN1600)

AISI 316/316L

The main characteristics of the 304 stainless steel are:

- Good resistance to corrosion in acids and chlorides 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

CHEMICAL COMPOSITION

This 316/316L stainless steel complies with:

- Stainless Europe material safety data sheet n° 1: stainless steel (European directive 2001/58/EC)
- European directive 2000/53/EC on end-of-life vehicles, and on the annex II dated 27 June 2002.
- PED (pressure equipment directive) according to EN 10028-7 andAD2000 Merkblatt W2 e W10 (TUV WB494)
- 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 International edition for "Collective Restoration Materials" and of FDA (United States Food and Drug Administration) for what concerns materials used for contact with foodstuffs
- French decree Nr. 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 dated 21 March1973: a list of steel kinds appropriate to the “rules for the hygiene of packaging, and instruments destined to come in contact with foodstuffs or with substances for personal use”

ELEMENTS%	C	SI	MN	CR	NI	MO
18-11ML	≤ 0.02	0.40	1.20	16.70	10.05	2.05

Typical values

GRADE DESIGNATION	EUROPEAN DESIGNATION	AMERICAN DESIGNATION	IMDS NR
18-11ML	X5CRNIMO 17-12-2/1.4401(1)	UNS 31600/ TYPE 316(2)	2934460
18-11ML	X5CRNIMO 17-12-2/1.4404(1)	UNS 31603/ TYPE 316L(2)	2934460

(1)According to EN 10088-2
(2)According to ASTM A240

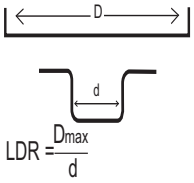
COLD FORMING

In the strengthened condition, 316/316L stainless steel can be readily cold formed by all standard processes (bending, contour forming, drawing, deep drawing, flow turning and stretching).

Deep drawing (Swift test)

The Swift test is a method used to determinate 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 can be performed successfully in one step.

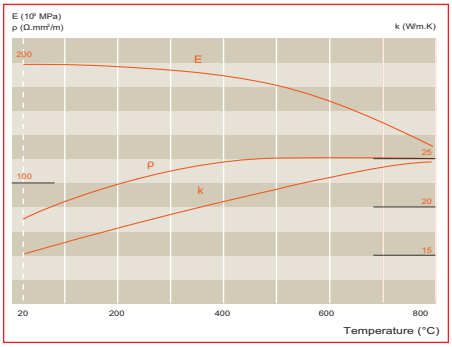
Grade designation	LDR*
18-11ML	2.01
DX22-05	1.9 – 1.95
K44	2.10 - 2.15



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

PHYSICAL PROPERTIES

Cold rolled sheet - annealed



DENSITY	D	KG/DM³	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 THERMAL EXPANSION	ά	10⁻⁶/K	20-100 °C 20-300 °C 20-500 °C	16.0 17.0 18.0
ELECTRICAL RESISTIVITY	ρ	Ω MM²/M	20 °C	0.75
MAGNETIC PERMEABILITY	μ	AT 0.8 KA/M DC OR AC	20 °C	1005
YOUNG'S MODULUS	E	MPA.10³	20 °C	200

AISI 316/316L

MECHANICAL PROPRETIES

GRADE DESIGNATION	EUROPEAN DESIGNATION	ASTM A240	R_m (1) (MPa)	$R_{p0.2}$ (2) (MPa)	A (3) (%)
18-11ML	1.4001/4404	316/316L	620	310	48
22-05	1.4462	2205	840	620	29
K44	1.4521	444	520	380	28

1 MPa - 1 N/mn^2 Typical values

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

In the annealed condition. In accordance EN 10002-1 (July 2001), test piece perpendicular to rolling direction.

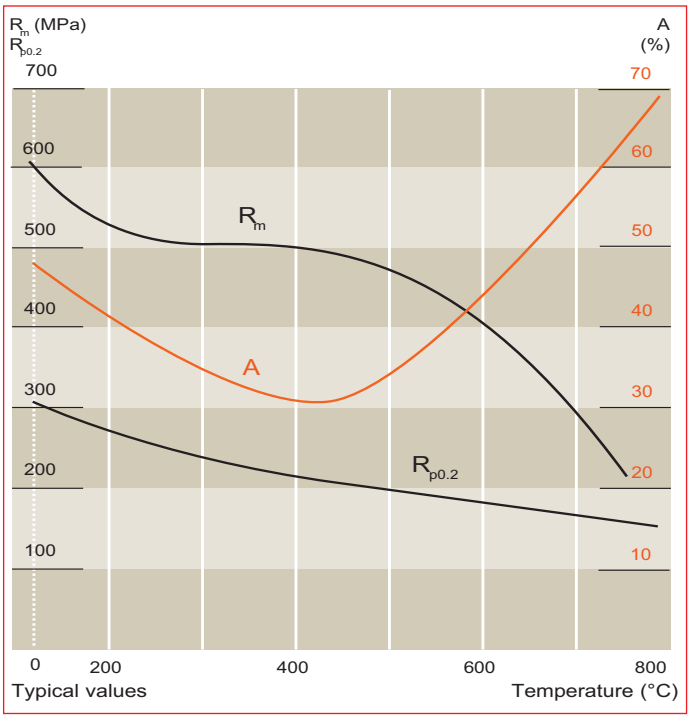
Test piece

Length = 80 mm (thickness < 3 mm)

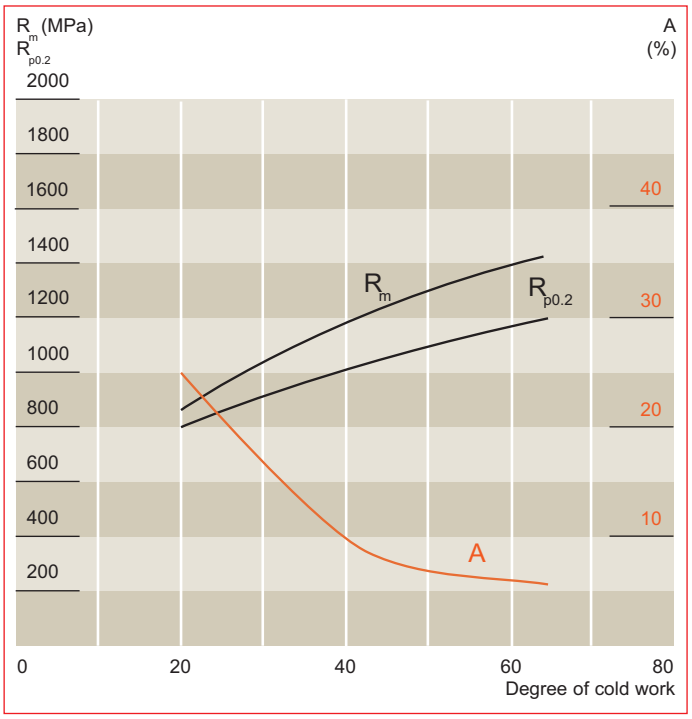
Length = 5.65 √So (thickness ≥ 3 mm)

Cold rolled

At elevated temperatures



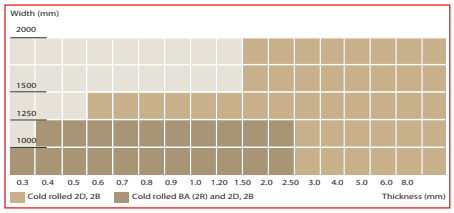
Work hardened condition



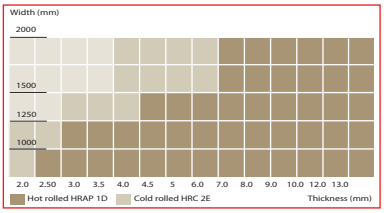
Size Range

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

Cold Rolled



Hot Rolled and HRC



Heat treatment and finishing

Temperature

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 (recrystallization 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) st room temperature or up to 60°C

Sulfuric-nitric acid mixture (10% H2So4 + 0,5% HNO3) at 60°C

Descaling paste for welded areas

Passivation

20-25% HNO3 solution (36° Baumé) at 20°C - passivating paste for the welded areas

Polishing

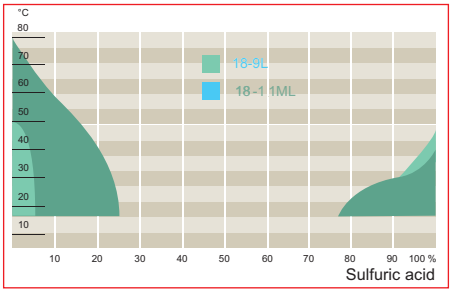
The surface of the 316/316L stainless steel is indicated for all kinds of polishing (grit, scotch-brite, electropolishing)

AISI 316/316L

CORROSION RESISTANCE

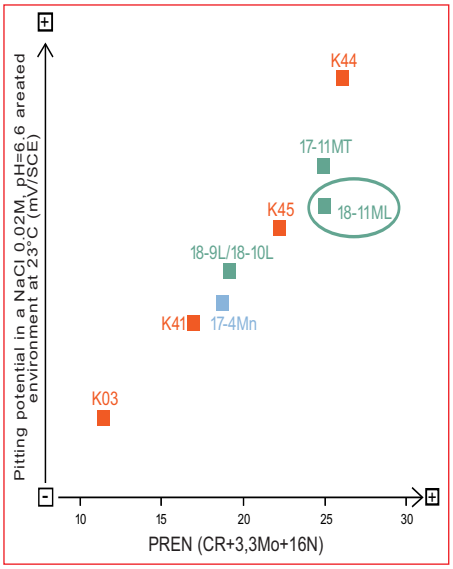
AISI 316/316L stainless steel has an excellent resistance in acid solutions and shows a good resistance in chloride-containing media. This steel is then used for the production of parts which come into contact with low temperature salt water.

Intergranular corrosion



This steel 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 T1and T2), ASTM A 262, ex DIN 50914.

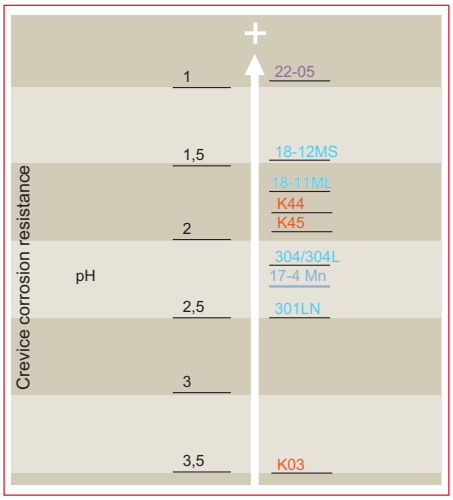
Pitting corrosion



K44 and double DX2205 (1.4462) and DX2304 (1.4362) are alternatives for 8-11ML. Thanks to their higher resistance to corrosion, duplex pitting potentials cannot be determined in such conditions of temperature (23°C) and chloride concentration (0.02M). To consider them, please report to their specific data sheets.

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 local grade.

Propagation is the second process and it consists in the dissolution of the metal.

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

GRADE DESIGNATION	NaCl 0.02/23°C	NaCl 0.02/50°C	NaCl 0.05/23°C	NaCl 0.02/50°C
18-11ML	630	500	455	270
Typical values				

WELDING

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.

WELDING PROCESS	NO FILLER METAL	WITH FILLER METAL			
	TYPICAL THICKNESSES	THICKNESSES	FILLER METAL ROD	FILLER METAL WIRE	SHIELDING GAS*
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 + HELIUM
S.A.W		> 2 MM		ER 316 L(1)	
ELECTRODE		REPAIRS	ER 316 L(1)		
LASER	< 5 MM				HELIUM UNDER CERTAIN CIRCUMSTANCES ARGON NITROGEN

(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)

STAINLESS STEEL

AISI 304

Indicative correspondance

EN 10088/3	W.	JIS	AISI
10088/3 (European rules) X 5 Cr Ni 18-10	(Germany) 1.4301	(Japan) SUS 304	(U.S.A.) 304

Description

It is the most popular between stainless steels.
Austenitic stainless steel, non-magnetic at the annealed state, slightly magnetic if cold rolled.
Hardenable through cold forming.
Good mechanical characteristics, not too elevated when at room temperature but excellent at very low temperatures, particularly for what concerns resilience as well as the high resistance to effort with little sensitivity to incisions.

Physical characteristics

Elasticity module:	200.000 [N/mm2]
Thermal conductivity:	15 [W/mK]
Specific heat:	500 [J/KgK]
Coefficients of thermal expansion:	(20°-200°C) 16.5 [10^{-6} K^{-1}] (20°- 400°C) 17.5 [10^{-6} K^{-1}] (20°- 600°C) 18.5 [10^{-6} K^{-1}]

Mechanical characteristics at room temperature

Yield stress:	RP O.2 ≥ 190 [N/mm2]
Tensile strength:	Rm 500 ÷ 700 [N/mm2]
Stretching:	A 5% ≥ 45
Brinell stretching test:	HB ≤ 215

Indicative analisys %

C	MnMax	PMax	SMax	SiMax	Cr	Ni	Mo	Altri elementi
0,045MAX	2	0.045	0.015(A)	0.45	17.8 ÷ 18.5	8 ÷ 10	-	N ≤ 0.11

AISI 316

Indicative correspondance

EN 10088/3	W.	JIS	AISI
10088/3 (European rules) X 5 Cr Ni Mb17-12-2	(Germany) 1.4401 1	(Japan) SUS 316	(U.S.A.) 304

Description

Austenitic stainless steel, non-magnetic at the annealed state, slightly magnetic if cold rolled.
Hardenable through cold forming. It has a resistance to corrosion higher than the 304 steel, for what concerns pitting caused by chloride ions and corrosion under tension.

Physical characteristics

Elasticity module:	200.000 [N/mm2]
hermal conductivity:	15 [W/mK]
Specific heat:	500 [J/KgK]
Coefficients of thermal expansion:	(20°-200°C) 16.5 [10^{-6} K^{-1}] (20°- 400°C) 17.5 [10^{-6} K^{-1}] (20°- 600°C) 19.0 [10^{-6} K^{-1}]

Mechanical characteristics at room temperature

Yield stress:	RP O.2 ≥ 190 [N/mm2]
Tensile strength:	Rm 500 ÷ 700 [N/mm2]
Stretching:	A 5% ≥ 40
Brinell stretching test:	HB ≤ 215

Indicative analisys %

C	MnMax	PMax	SMax	SiMax	Cr	Ni	Mo	Altri elementi
0,02MAX	1.2	0.045	0.015(A)	0.4	16.5 ÷ 17.5	10 ÷ 11	2 ÷ 2.1	N ≤ 0.11

STAINLESS STEEL

AISI 316L

Indicative correspondance

EN 10088/3	W.	JIS	AISI
EN 10088/3 (European rules) X 2 Cr Ni 17-12-2	(Germany) 1.4404	(Japan) SUS 316L	(U.S.A.) 316L

Description

Austenitic stainless steel, non-magnetic at the annealed state, slightly magnetic if cold rolled. Hardenable through cold forming.
Resistance to corrosion and to pitting caused by chloride ions. Compared to AISI 316, it has a lower carbon content.

Resistance to corrosion

Very good in atmosphere and in a wide variety of salts, organic acids and foodstuffs, discrete towards solutions with low in reducing acids and towards halides and sea water. 316L stainless steel, thanks to the very low carbon content, is virtually insensible to intercrystalline corrosion.

Physical characteristics

Elasticity module:	200.000 [N/mm2]
Thermal conductivity:	15 [W/mK]
Specific heat:	500 [J/KgK]
Coefficients of thermal expansion:	(20°-200°C) 16.5 [10^{-6} K^{-1}] (20°- 400°C) 17.5 [10^{-6} K^{-1}] (20°- 600°C) 18.8 [10^{-6} K^{-1}]

Mechanical characteristics at room temperature

Yield stress:	RP O.2 ≥ 190 [N/mm2]
Tensile strength:	Rm 500 ÷ 700 [N/mm2]
Stretching:	A 5% ≥ 40
Brinell stretching test:	HB ≤ 215

Indicative analisys %

C	MnMax	PMax	SMax	SiMax	Cr	Ni	Mo	Altri elementi
0,045	2	0.045	0.015(A)	0.45	17.8 ÷ 18.5	10 ÷ 13(B)	2 ÷ 2.5	N ≤ 0.11

AISI 430

Indicative correspondance

EN 10088/3	W.	JIS	AISI
10088/3 (European rules) X 6 Cr 17	(Germany) 1.4016	(Japan) SUS 430	(U.S.A.) 430

Description

Ferritic and ferromagnetic stainless steel. Hardenable through cold forming.

Physical characteristics

Elasticity module:	220.000 [N/mm2]
Thermal conductivity:	25 [W/mK]
Specific heat:	460 [J/KgK]
Coefficients of thermal expansion:	(20°-200°C) 10.0 [10^{-6} K^{-1}] (20°- 400°C) 10.5 [10^{-6} K^{-1}] (20°- 600°C) 12.0 [10^{-6} K^{-1}]

Mechanical characteristics at room temperature

Yield stress:	RP O.2 ≥ 240 [N/mm2]
Tensile strength:	Rm 460 ÷ 630 [N/mm2]
Stretching:	A 5% ≥ 20
Brinell stretching test:	HB ≤ 205

Indicative analisys %

C	MnMax	PMax	SMax	SiMax	Cr	Ni	Mo	Altri elementi
0.035 ÷ 0.05	0.4	0.045	0.015(A)	0.35	16.0 ÷ 17.0	-	-	-

AGGRESSIVE ENVIRONMENTS

The definition of this metal has been given when its prerogatives were still not well-known, seen as steel can actually OXYDIZE, and the causes which can trigger the corrosive phenomenons can be many:

- Thermal alterations such as welding or laser cut
- Contaminations with traces of iron (coming from the use of non-dedicated utensils, or from promiscuous processing with steel and iron)
- Uneven surfaces where the stagnation of polluting elements is possible
- Surface finishings which entail a roughness increase, such as glazing, flourishing or sanding, which can caus eth einclusion of polluting elements
- Aggressive environments, such as marine environments or environments with the presence of chlorine
- Sanding carried out with sand which is not perfectly clean, or is contaminated with ferrous materials

And many more.

In order guarantee the stainlessness of the steel, it is indispensable to have a work cycle constituted by:

De-greasing, de-contamination, deoxydizing: consisting in the elimination of traces of oil, greases and other contaminants due to the processing

Pickling: (removal of the de-chromed area): it is the base treatment in order to eliminate the oxide traces due to chemical alterations. The removal of the de-chromed area has the function to take off the impoverished chrome layer, which is a critical area for the corrosive attack.

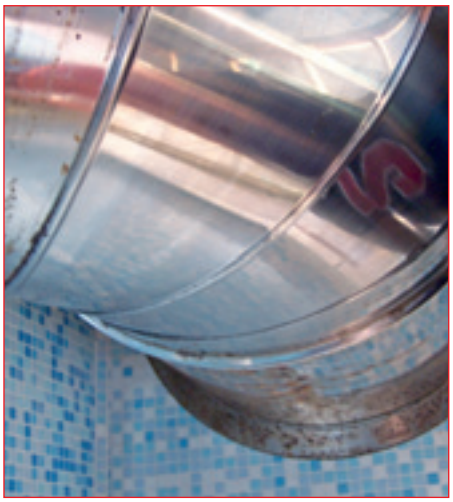
Restoration of the chrome oxide film: after having de-contaminated and de-oxydized the manufactured product from possible polluting agents, stainless steel can remain with no protection, and therefore exposed to eventual external aggressive attacks. It is fundamental to restore the chrome oxide layer on the surface. It is an indispensable process in order to be able to guarantee the stainlessness of the stainless steel.

SWIMMING POOL WITH AISI 316L stainless steel ducts, correctly pickled

SWIMMING POOL WITH AISI 316L stainless steel ducts, correctly pickled

SWIMMING POOL WITH AISI 316L non-pickled

The chlorine evaporation due to the water's thermal treatment when the ventilation plant was off, allowed the condensation of the duct's surface, which has been then corroded in a significant way as a result of the incorrect pickling process.



AGGRESSIVE ENVIRONMENTS

Following the considerations developed for the use of stainless steel in environments with an oxydation and corrosion risk, we suggest the use of galvanized steel painted with expoxy powders

PRODUCT DESCRIPTION

SINTRA uses a range of powder paints formulated for the coating of aluminium and galvanized steel.
These paints are available in a wide range of colours and they have been specifically chosen between those that do not contain TGIC. Also, they offer an excellent external durability and an optimal colour retention in compliance with the characteristics required by all major standard European specifications for architecture.
All the powders used fully comply with the rules di BS6496:1984, BS6497:1984, Qualicoat Class1 and GSB.

POWDER'S CHARACTERISTICS

Chemical nature:	Polyester
Shine:	0 - 30 % (60°)
Granulometry:	Suitable for electrostatic applications
Specific weight:	1.2 - 1.9 g/cm3 (depending on the color)
Storage:	Keep in a dry environment not above 35°C and in a closed box
Durability:	12 months
Cooking times:	15 minutes at 190°C
(object's temperature)	10 minutes at 200°C
	9 minutes at 205°C

APPLICATIVE CONDITIONS

The following results are based on mechanical and chemical tests which, except for different indications, have been carried out in laboratory and are purely indicatives. The effective performance will depend on the product's applicative conditions.

Substrate:	Aluminium
Pre-treatment:	Chromate-based conversion
Thickness of the paint film:	60 microns
Cooking:	10 minutes at 200°C (object's temperature)

MECHANICAL TESTS

Flexibility:	BS 3900 - E11 (conical mandrel) Passes 3mm ISO 1519/73 (E) (cylindrical mandrel) Passes 3/16"
Adherence:	ISO 2409 (Comb 2mm) : class 0
	DIN 53151 (Comb 2mm) : GT0>95%
Deep drawing:	ISO 1520 : Passes > 7mm
Hardness:	ISO 2815 (4000gr): Passes - (does not penetrate into the substrate)
	ASTM D 3363/74(pencils) : Passes H - 2H
Impact resistance:	ECCA T5: Passes 3 joules D/R
	UNI 8901: Passes 30Kg x cm D/R

CHEMICAL TESTS FOR DURABILITY

Aluminium and bronze/copper based metal products, even if keeping the general protective and anti-corrosive characteristics of the powder paints, show a quick loss of the metallic finishing when subject to the following tests:

Saline fog:	ISO 1456 : passes at 1000 hours - no corrosion area over 3mm from the incision's edge
Acetic saline fog:	ISO 9227 : passes at 1000 hours - < 16mm2 corrosion /10cm
Humidity cycle:	DIN 50017 : Passes at 1000 hours - no blistering or shine loss
Sulfur dioxide:	ISO 3231 (Kesternich) : Passes - no blistering or shine loss / fading after 30 cycles
Chemical resistance:	Generally it has a good resistance to most acids and of diluted alkals to oils at room temperature of 25°C

SiNTRA

SISTEMI INNOVATIVI DI TRATTAMENTO ARIA

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