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KARA ferritic stainless steel offer: grade K41

18% chromium
titanium and
niobium stabilized

Chemical composition

Elements	C	Si	Mn	Cr	Ti+Nb
%	0.015	0.60	0.30	17.80	0.65

Typical values

European designation

X2CrTiNb18 1. 4509 (1)

(1) According to EN 10088-2

American designation

S43932 / S43940, type 441 (2)

(2) According to ASTM A 240.

This grade complies with:

- Stainless Europe Materials Safety Data Sheet No. 1: stainless steels (European Directive 2001/58/EC).
- European Directive 2000/53/EC relating to end-of-life vehicles and Annex II dated 27 June 2002.
- French standard NFA 36 711 "Non packaging steel - Stainless steel intended for use in contact with foodstuffs, products and beverages for human and animal consumption".
- NSF/ANSI 51–2009 edition international standard for "Food Equipment Materials" and the requirements of the FDA(United States Food and Drug Administration) regarding materials used in contact with foodstuffs.
- French decree No. 92-631 dated 8 July 1992 and European Regulation (EC) No. 1935/2004 of 27 October 2004 on materials and articles intended to come into contact with food (and abrogative Directives 80/590/EEC and 89/109/EEC).
- French Ministerial Order dated 13 January 1976 relating to materials and articles made of stainless steel in contact with foodstuffs.
- Standard EN 10028-7 "Flat products made of steels for pressure purposes, Stainless steels".

General characteristics

The principal characteristics of our K41 grade are:

- Good weldability.
- Ease of forming
- Its suitability for surface finishing (polishing, brushing, scotch brite).
- Good resistance to pitting corrosion.
- Elevated hot mechanical properties without risk of σ phase formation at intermediate temperatures.
- Resistance to high temperature oxidation up to 950°C.
- Good corrosion resistance in boiler and burner gas atmospheres.
- Greater thermal conductivity than austenitics and a lower coefficient of expansion.

Applications

- Catering kitchen cladding, Trolleys, Work surfaces.
- Extractor hoods, hobs, oven casings and linings.
- Sinks.
- Cooking utensils.
- Lift doors and cabins.
- Construction: profiles, fascias, panels, decorative tubes.
- Domestic boiler burners.
- Condensing boilers.
- Fume pipes (chimneys).
- Exchangers for cold ceiling.
- Welded structures under mild corrosion conditions or when components are exposed to temperatures of up to 950°C.

Product range

Forms: sheets, blanks, coils, strip, discs.
Thicknesses: 0.4 to 2.0 mm (from 2 to 6.5 mm consult us).
Width: according to thickness; consult us.
Finishes: cold-rolled, hot-rolled according to thickness.

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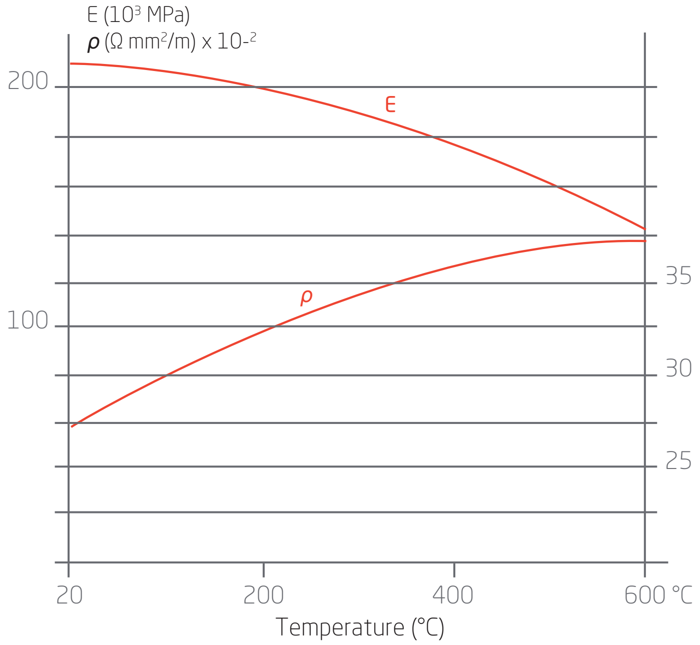
Physical properties

On cold-rolled sheet. In the annealed condition.*

Density	d	kg/dm³	20 °C	7.7
Melting temperature		°C		1505
Specific heat	c	J/kg.K	20 °C	460
Thermal conductivity	k	W/m.K	20 °C 500 °C	25 26.3
Mean coefficient of thermal expansion	α	10^{-6}/K	20-200 °C 20-400 °C 20-600 °C 20-800 °C	11.0 11.5 12.1 12.8
Electric resistivity	ρ	Ω mm²/m	20 °C	0.6
Magnetic permeability	μ	at 0.8 kA/m DC or AC	20 °C	850
Young's modulus	E	MPa.10^3	20 °C	220

* Typical values



Mechanical properties

In the annealed condition

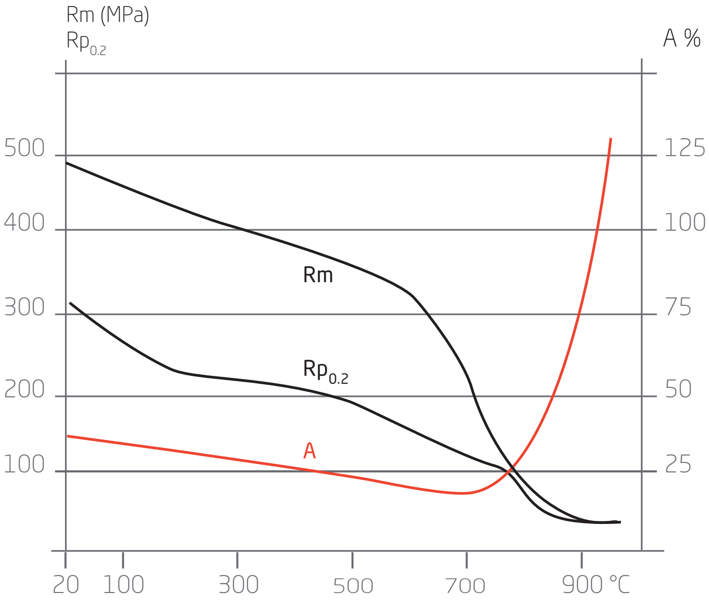
In accordance with ISO 6892-1, part 1, test specimen perpendicular to the rolling direction.

Test specimen
L = 80 mm (thickness < 3 mm)
L = 5.65 √ So (thickness ≥ 3 mm)

Condition	Rm(1) (MPa)	$Rp_{0.2}$ (2) (MPa)	A(3) (%)	HRB
Cold-rolled*	480	310	30	78

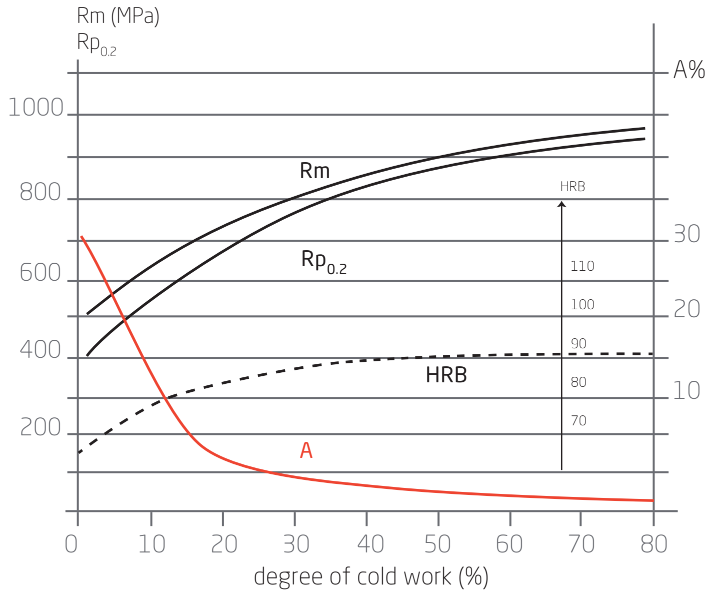
* Typical values 1 MPa = 1 N/mm²
(1) Ultimate tensile strength (UTS) (2) Yield strength (YS) (3) Elongation

At high temperatures*



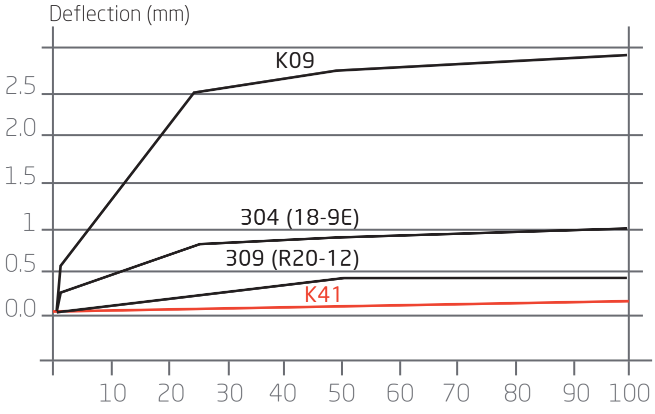
* Typical values

Effect of cold rolling*



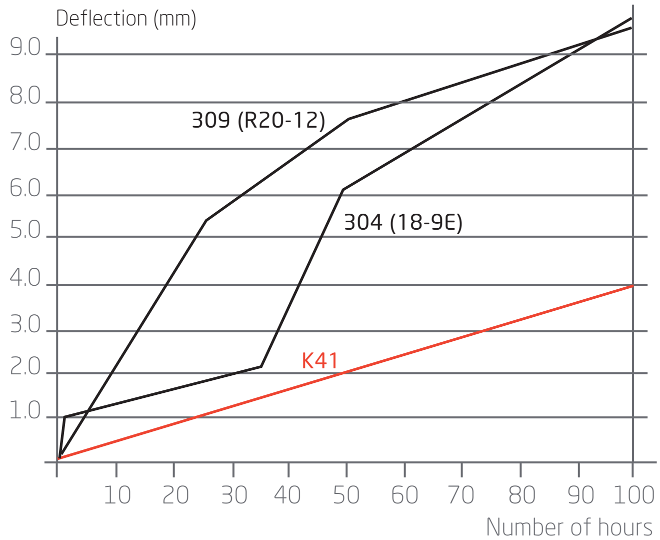
Creep properties

Sag test at 850°C* (thickness 2 mm)



according to analysis and process Stainless Europe

Sag test at 950°C* (thickness 2 mm)



Resistance to corrosion

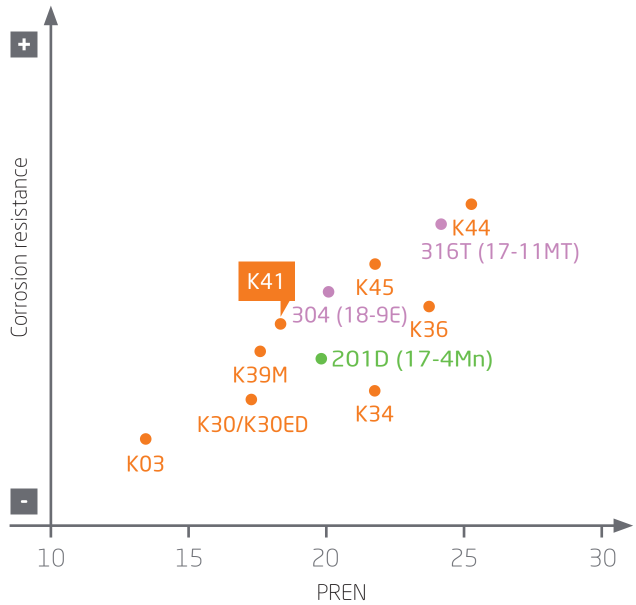
Our K41 grade has resistance to pitting corrosion close to that of 1.4301. The performance differential measured between K41 and K30 is equivalent to that measured between 1.4404/1.4571 and 1.4301. Like all ferritic grades, K41 is not susceptible to stress corrosion. Resistance to weld and heat-affected zone corrosion is similar to that of the parent metal. In particular, dual stabilisation with titanium and niobium affords K41 excellent resistance to grain boundary corrosion.

Resistance to localised corrosion

	Norms		
Grades	**ASTM**	**UNS**	**EN**
K03		S41003	1.4003
K30/K30ED	430	S43000	1.4016
K39M	430Ti	S43036	1.4510
K41	441[1]	S43932/S43940	1.4509
K34	434		1.4113
K45	445[1]	S44500	1.4621[2]
K36	436	S43600	1.4526
K44	444	S44400	1.4521
201D (17-4Mn)	201.1	S20100[3]	1.4618 [2]
304 (18-9E)	304	S30400	1.4301
316T (17-11MT)	316Ti	S31635	1.4571

[1] Common designation. [2] Pending.
[3] With copper addition and "rich side" mechanical properties of 201.1 per ASTM A240.

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

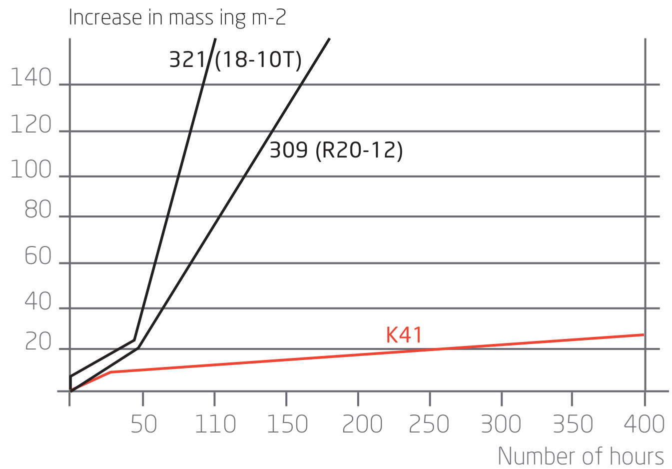


Resistance to oxidation

Cyclic oxidation

At high temperatures, K41 exhibits high resistance to oxidation and in particular cyclic oxidation, enabling its use up to 980°C. This property is particularly useful for heating or gas circulation systems.

Cyclic oxidation kinetics (increase in mass = quantity of oxide formed to the detriment of the parent metal that is consumed and reduced in thickness) of grades 18-10T, 309 (R20-12) and K41 at 950°C for up to 400 hours.



Forming

Our K41 grade can be cold formed using all common processes (folding, deep drawing, hydroforming, bending).

Bending of welded tubes

Folding	Ra = R/D mini*
Tube ø 50 mm x 1.5 mm	1.2

* Tests performed on typical values using 2 mm thickness.
Ra = bending ratio
D = tube diameter
R = bend radius
Angle = 90°

Erichsen (cupping) test

Grades	European designation	ASTM A 240	Erichsen test* (mm)
K41	1.4509	S43932/S43940	11.8

* Tests performed on typical values using 2 mm thickness.

Welding

Our **K41** grade is weldable by these processes: resistance (spot, seam), electrical arc, high frequency, LASER and electron beam. Good results are obtained without post treatment provided that the weld is sufficiently forged. Its dual stabilisation with titanium and niobium enables elimination of any risk of grain boundary corrosion, grain growth and embrittlement at high temperature.

Welding process	Without filler metal	With filler metal			Shielding gas*
	Typical thicknesses	Thicknesses:	Filler metal		* Hydrogen and nitrogen forbidden in all cases
			Rod	Wire	
Resistance: spot, seam	≤ 2 mm				
TIG	< 1.5 mm	> 0.5 mm	G 19 9L (1) or 18L Nb (1) ER 308L (2) or 430LNb 1.4316 or 1.4511 (5)		Argon Argon + Helium
PLASMA		> 0.5 mm		G 19 9LSi (1) or 18L Nb (1) ER 308LSi (2) or 430LNb 1.4316 or 1.4511 (5)	Argon Argon + Helium
MIG		> 0.8 mm		G 19 9LSi (1) or 18L Nb (1) ER 308LSi (2) or 430LNb 1.4316 or 1.4511 (5)	Argon + 2% CO_2 Argon + 2% O_2 Argon + 2% CO + Helium
Electrode		Repair	E 19 9 L (3) E 308 L (4)		
Laser	< 5 mm				Helium Under certain conditions: Argon

(1) In accordance with EN ISO 14343, (2) In accordance with AWS A5.9, (3) In accordance with EN 1600, (4) In accordance with AWS A5.4, (5) In accordance with VDEH.

The addition of hydrogen or nitrogen to the argon must be avoided as this reduces weld ductility. For similar reasons, the use of nitrogen is forbidden and use of CO_2 is restricted to 3%. In order to restrict grain growth in the HAZ, the use of excessive welding power must be avoided. For example, in automatic TIG welding, the power should not exceed 2.5 kJ/cm for a sheet thickness of 1.5 mm. As a further example, pulsed MIG/MAG welding has a lower power input than conventional MIG welding and enables better control of both bead geometry and grain size.
K41 also exhibits excellent high- and medium-frequency induction weldability. Post-weld heat treatment is generally not necessary.
Welds must be mechanically or chemically descaled and then passivated and decontaminated. Oxyacetylene torch welding must be avoided.

Heat treatment and finishing

Annealing

960°C followed by air cooling. Avoid exceeding 1000°C.
Parts must be degreased prior to any heat treatment operation.

Pickling

Nitric-hydrofluoric acid mixture (10% HNO_3 + 2% HF).
Descaling pastes for weld zones.

Passivation

20-25% cold nitric acid bath. Passivating pastes for weld beads.

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