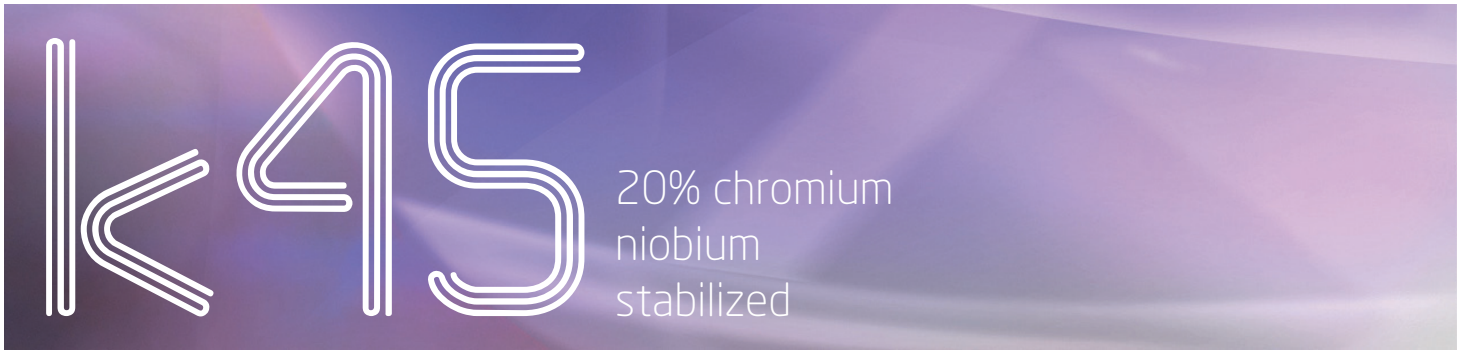
aperam
made for life

KARA ferritic stainless steel offer
grade K45



Chemical composition

Elements	C	Si	Mn	Cr	Nb	Cu
%	0.015	0.25	0.25	20.20	0.45	0.45

Typical values

European designation		American designation
X2CrNbCu21	1. 4621[1]	(UNS 44500) [2]

[1] According prEN 10088-2

[2] According to ASTM A 240

This grade complies with:

- Stainless Europe Material 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.
- Standard NFA 36 711 "Stainless steel intended for use in contact with foodstuffs, products and beverages for human and animal consumption" (non packaging steel).
- The requirements of NSF/ANSI 51-2009e 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 the 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 Order dated 13 January 1976 relating to materials and articles made of stainless steel in contact with foodstuffs.

General characteristics

The principal features of our grade K45 are:

- Resistance to pitting corrosion equivalent to grade 1.4301, Type 304
- Suitable for exposure in moderately aggressive industrial and urban environments,
- Good resistance to salt spray test,
- Excellent polishability,
- Good mechanical properties at high temperatures.

Applications

- Automotive: internal and external decorative trims, model name plates, sill and door protectors, roof rails, hub caps and lock-nuts, various fasteners and accessories.
- External parts of refrigerated trailers.
- Household appliances and domestic equipment.
- Cookware.
- Commercial food equipment, various parts and equipment for catering.
- Elevators, doors and cabins.
- Construction: traditional roofing, roofing profiles, self-supporting trays, façade, cassette panels, composite panels, street furniture, decoration, accessories.

Product range

Forms: sheets, blanks, coils, strips, circles.
Thicknesses: 0.4 to 2.0 mm.
Width: according to thickness, consult us.
Finish: cold rolled according to thickness.

KARA
key for value

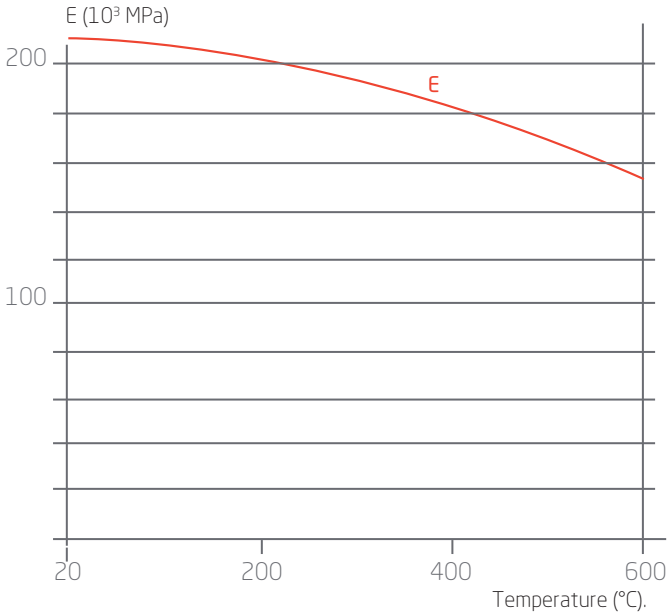
Physical properties

(Cold rolled sheet - annealed*)

Density	d	kg/dm³	20 °C	7.7
Melting temperature		°C		1500
Specific heat	c	J/kg.K	20 °C	450
Thermal conductivity	k	W/m.K	20 °C	21.3
Mean coefficient of thermal expansion	α	10^{-6}/K	20-200°C 20-400°C 20-600°C 20-800°C	11.5 12 12.6 13.5
Electric resistivity	ρ	Ω mm²/m	20 °C	0.70
Magnetic permeability	μ	at 0.8 kA/m DC or AC	20 °C	550
Modulus of elasticity	E	MPa.10^3	20 °C	210

* Typical values

Young's modulus at hight temperature



Tensile properties

Annealed condition
According to ISO 6892-1, part 1,
specimen perpendicular to the rolling direction

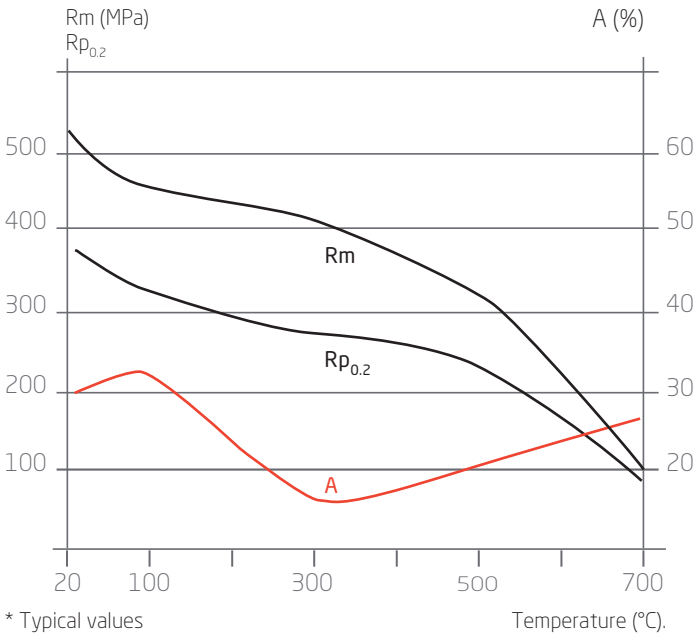
Specimen
Lo = 80 mm (thickness < 3 mm)
Lo = 5.65√So (thickness ≥ 3 mm)

Condition	$Rm^{(1)}$ (MPa)	$Rp_{0.2}{}^{(2)}$ (MPa)	$A^{(3)}$ (%)	HRB
Cold-rolled*	510	360	29	78

1 MPa = 1 N/mm² * Typical values

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

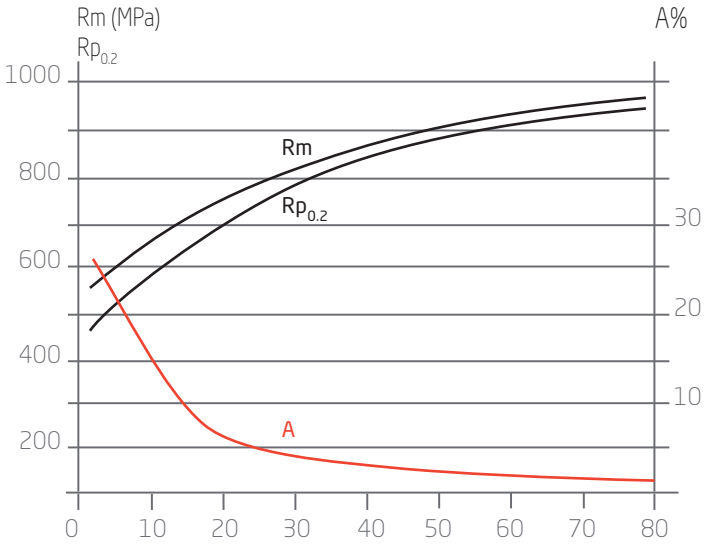
At high temperatures*



* Typical values

Temperature (°C).

Effect of cold rolling



Degree of cold work (%).

Corrosion resistance

The chromium content in excess to 20% in this grade confers good resistance to pitting corrosion equivalent to grade 1.4301, Type 304. Our grade K45 has good resistance to urban and rural atmospheres and to fresh water.

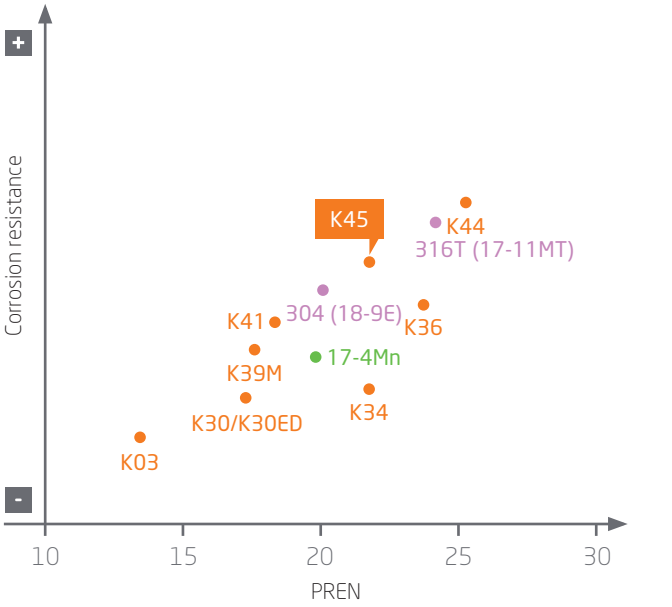
K45 also exhibits good resistance to salt spray corrosion and is not suseptible to stress corrosion cracking.

Localised corrosion resistance

	Norms		
Grades[1]	ASTM	UNS	EN
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]
304 (18-9E)	304	S30400	1.4301
316T (17-11MT)	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).



Forming

Our grade K45 can be cold formed using the common processes (folding, contour forming, bending, deep drawing,slitting, etc.).
Thicknesses less than 0.7 mm can be folded sharply through 180°, while for larger thicknesses, the minimum bending radius r is related to the thickness t by r ≥ 0.5 t. Deep drawing operations are facilitated by the production of a large radius preform.

Welded tube bending

The bending ratios permissible with K45 are given in the table below, based on laboratory results for a bending angle of 90°, where D is the tube diameter and R is the bending radius.

Bending	Ra = R/D mini*
40 mm Ø x 1.5 mm tube	1.3
50 mm Ø x 1.5 mm tube	1.3

* Typical values tests done on 2 mm thick.
Ra = bending ratio
D = tube diameter
R = bending radius
Angle = 90°

Erichsen test (expansion test)

Grades	European designation	ASTM A 240	Erichsen test* (mm)
K45	1.4621	UNS44500	10.8

* Typical values tests done on 2 mm thick.

Welding

Our grade K45 can be resistance welded by spot or seam techniques. Good results are obtained without the need for post treatment provided that the forming of the weld is sufficient. The addition of hydrogen or nitrogen to the argon must be avoided since these gases decrease the ductility of the welds. For the same reason, nitrogen shielding must not be employed, while additions of CO_2 must be limited to 3%.

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	ER 316 L (Si)	ER 316 L (Si)	Argon Argon + Helium
PLASMA	< 1.5 mm	> 0.5 mm		ER 316 L (Si)	Argon Argon + Helium
MIG		> 0.8 mm		ER 316 L (Si)	Argon + 2% CO_2 Argon + 2% O_2 Argon + 2% CO_2 + Helium
S.A.W		> 2 mm		ER 316 L	
Electrode		Repairs	E 316 L		
Laser	< 5 mm				Helium Argon in certain conditions

In order to restrict grain growth in the HAZ, the use of excessive welding power must be avoided. For example, in automatic TIG welding, power should not exceed 2.5 kJ/cm for a sheet thickness of 1.5 mm.

Pulsed MIG/MAG welding has a lower power input than conventional MIG welding and enables better control of both bead geometry and grain size.

Post-weld heat treatment is generally not necessary.
The welds must be mechanically or chemically descaled, then passivated and decontaminated. Oxyacetylene torch welding should be avoided.

Heat treatment and finishing

Annealing

Thorough pickling is necessary prior to any heat treatment operation.

After cold work, annealing for a few minutes at 825-850°C followed by rapid cooling enables the microstructure to be restored.

Pickling

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

Passivation

20-25 % HNO_3 solution at 20 °C. Passivating pastes for weld zones.

Aperam Stainless Europe
1-5 rue Luigi Cherubini
FR-93212 La Plaine Saint Denis Cedex

Information
Tel. : +33 1 71 92 06 52
Fax : +33 1 71 92 07 97
www.aperam.com/stainlesseurope
stainless.europe@aperam.com