KARA Ferritic Stainless Steel

K36 18% Chromium with Molybdenum, Niobium stabilized

KARA key for value

Chemical Composition

Elements (%)	C	Si	Mn	Cr	Mo	Nb
K36	0.02	0.40	0.25	17.50	1.25	0.50

Typical values

European designation	American designation
X6CrMoNb17-1/1.4526 (1)	Type 436 (2)

(1) According to NF EN 10088-2

(2) According to ASTM A 240

Our grade complies with:

- Stainless Europe Material Safety Data Sheet no. 1: stainless steels (European Directive 2001/58/EC)
- European Commission Directive 2000/53/EC for end-of-life vehicles, and Annex II, dated 27 June 2002
- French standard NFA 36 711 "Stainless steel intended for use in contact with foodstuffs, products and beverages for human and animal consumption (excluding packaging)"
- NSF/ANSI 51–2009 edition international standard for "Food Equipment Materials" and FDA (United States Food and Drug Administration) requirements regarding materials used in contact with foodstuffs
- French decree No. 92-631, dated 8 July 1992, and European Regulation (EC) No. 1935/2004, dated 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". Steel flat products for pressurised applications (AD 2000 W2 TÜV W494)

Key Features

- Excellent resistance to corrosion (in exhaust environments), pitting corrosion and oxidation (up to 950°C)
- Good performance in industrial and salt spray environments
- Good formability, free from "roping"and polishability
- Enhanced mechanical properties at high temperatures

Applications

- Wheel trims, nut caps, interior and exterior automotive decorative mouldings
- External components of refrigerated trailers
- Domestic electrical appliances
- Kitchen utensils
- Decorative profiles for furniture
- External facades and interior fittings for buildings

Product Range

	Coils	Sheets / Blanks
Thickness (mm)	0.40 up to 4	0.40 up to 4
Width (mm)	up to 1,524	up to 1,250
Finish	2R	2R

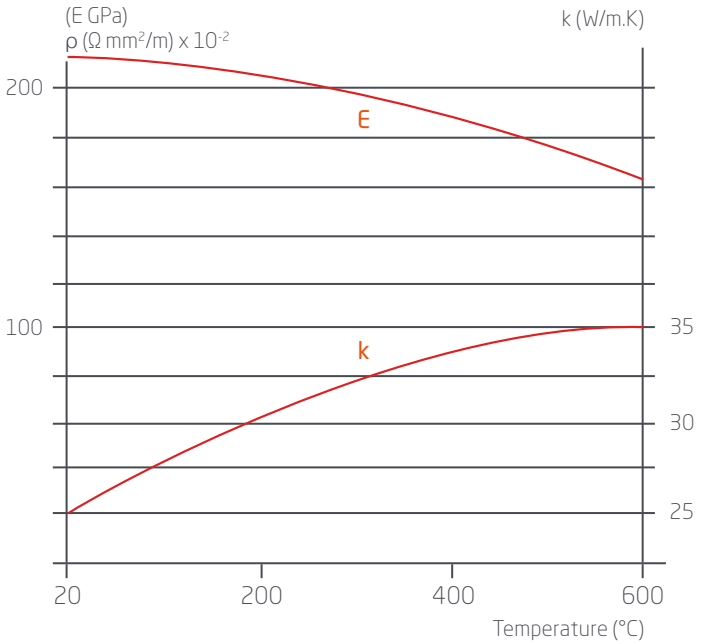
Please contact us regarding all other dimensions, forms and finishes.

Physical Properties

Cold rolled and annealed sheet

Density	d	kg/dm³	20°C	7.7
Melting temperature		°C	Liquidus	1,480
Specific heat	c	J/kg.K	20°C	440
Thermal conductivity	k	W/m.K	20°C	30
Mean thermal expansion coefficient	α	10^{-6}/K	20-200°C 20-400°C 20-600°C 20-800°C	11.7 12.1 12.7 14.2
Electric resistivity	ρ	Ω mm²/m	20°C	0.70
Magnetic resistivity	μ	at 0.8 kA/m DC or AC	20°C	550
Young's modulus	E	GPa	20°C	220

Poisson's coefficient: 0.28



Mechanical Properties

Test piece

Length = 80 mm (thickness < 3 mm)
Length = 5.65 √ S_o (thickness ≥ 3 mm)

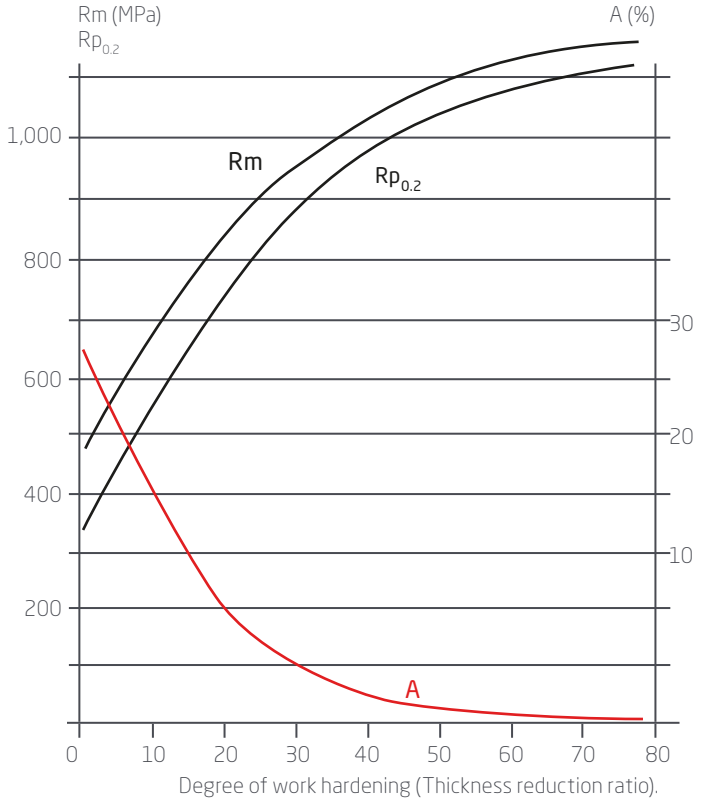
In the annealed condition

In accordance with ISO 6892-1, part 1
Test piece perpendicular to rolling direction

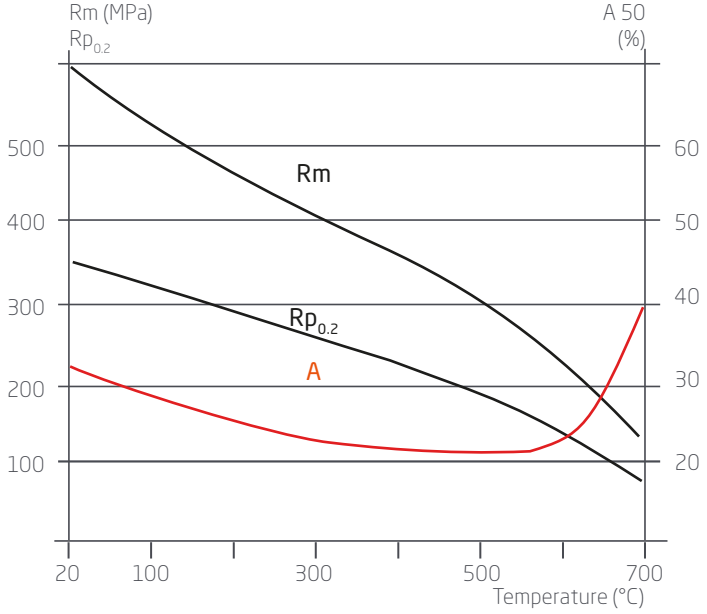
Grade	Condition	Rm(1) (MPa)	Rp0.2(2) (MPa)	A(3) %	HV5
K36	Cold- rolled	500	350	29	80

1 MPa = 1 N/mm² - Typical values
(1) Ultimate Tensile Strength (UTS) - (2) Yield Strength (YS) - (3) Elongation (A)

Work-hardened by cold rolling (Typical values)



At high temperatures (Typical values)



Corrosion Resistance

The addition of molybdenum provides this grade with good resistance to pitting corrosion and extends its field of application.

Our K36 grade has good resistance to urban, and fresh water atmospheres. K36 also offers good performance in a salt spray environment.

Like all ferritic grades, this steel is not susceptible to stress corrosion cracking.

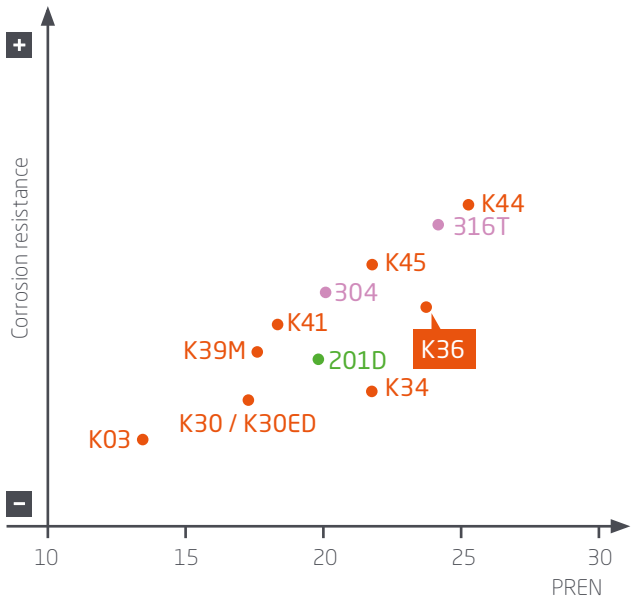
Resistance to localised corrosion

Grades	Norms		
	ASTM	UNS	EN
K03		S41003	1.4003
K30/K30ED	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
201D	201.1	S20100[3]	1.4618[2]
304	304	S30400	1.4301
316T	316Ti	S31635	1.4571

[1] Common designation - [2] Pending update of the standard - [3] With copper addition and 2010.1 "rich side" properties per ASTM A240

Pitting corrosion

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 K36 grade can be cold formed using all common processes (folding, contour forming, bending, deep drawing, slitting).
Thicknesses less than 0.7 mm can be folded sharply through 180°. For greater thicknesses, the minimum bend radius will be: r > 0.5t (thickness).
Deep drawing operations can be facilitated by the production of a large-radius preform.

Bending of welded tubes

The bending ratios permissible with K36 are given in the table to the right, based on laboratory tests for a bending angle of 90°, where D is the tube diameter and R is the bending radius.
Like all ferritic grades, this steel is not susceptible to stress corrosion cracking.

Bending of butt seam tube

Bending (laboratory results)	Ra = R/D mini
Tube Ø 40 mm x 1.5 mm	1.3
Tube Ø 50 mm x 1.5 mm	1.3

Ra = bending ratio - D = tube diameter - R = bend radius
Angle 90°

Welding

Our K36 grade can be resistance welded using both spot and seam techniques. Good results are obtained without post treatment so long as the weld is sufficiently forged.

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 316L (Si)	ER 316L (Si)	Ar Ar + He
PLASMA	< 1.5 mm	> 0.5 mm		ER 316L (Si)	Ar Ar + He
MIG		> 0.8 mm		ER 316L (Si)	Ar + 2 % CO_2 Ar + 2 % O_2 Ar + 2% CO_2 + He
SAW				ER 316L	
Electrode		Repairs	ER 316L		
Laser	< 5 mm				He Under certain conditions: Ar

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 the 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.

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

Heat treatment

Parts must be thoroughly descaled prior to any heat treatment operation.
After cold work, annealing for a few minutes at 825-850°C, followed by rapid cooling, will restore the microstructure.

Pickling

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

Passivation

- 20-25% cold nitric acid bath at 20°C
- Use passivating pastes for weld beads