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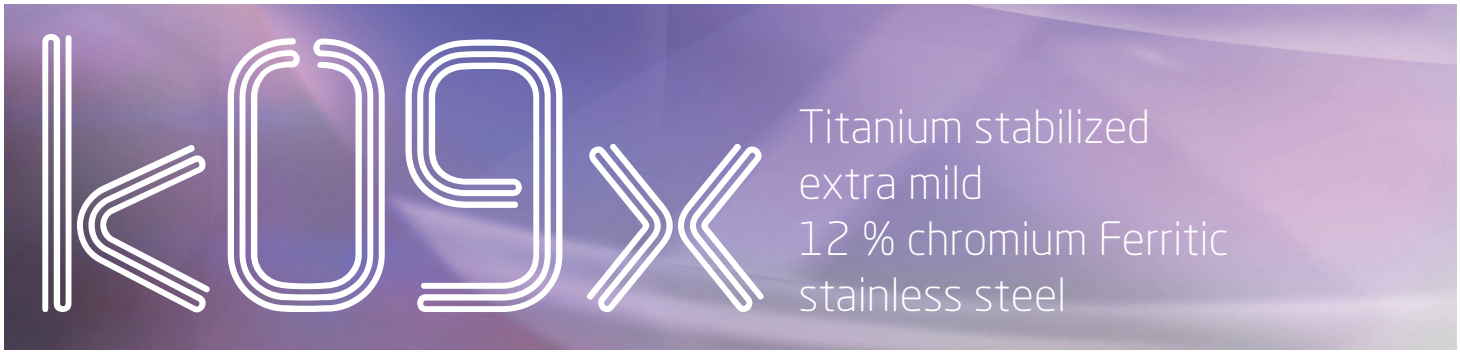
KARA ferritic stainless steel offer grade K09X



Chemical composition

Elements	C	Si	Mn	Cr	Ti
K09X (%)	0.01	0.45	0.30	11.30	0.19

Typical values

European designation	American designation
X2CrTi12	AISI 409 (2)
1.4512 (1)	IMDS n° 336833190

(1) In accordance with EN 10088-2

(2) In accordance with ASTM A 240

"X" for exhaust means the warranty of:

- Just in time deliveries
- Reliable quality
- Continuous improvement as required by the automotive market

This 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 to Annex II dated 27 June 2002.

Applications

- Various parts of automotive exhaust systems: manifolds, front pipes, catalytic shells, mufflers.
- Welded structures exposed to relatively unaggressive corrosion conditions or subjected to temperatures not exceeding 800°C.

General characteristics

The principal features of K09X are:

- Good weldability
- Good formability similar to that of low alloy steels
- Good oxidation resistance up to 800°C
- Good corrosion resistance in natural atmospheres and in contact with moderately aggressive media.

Product range

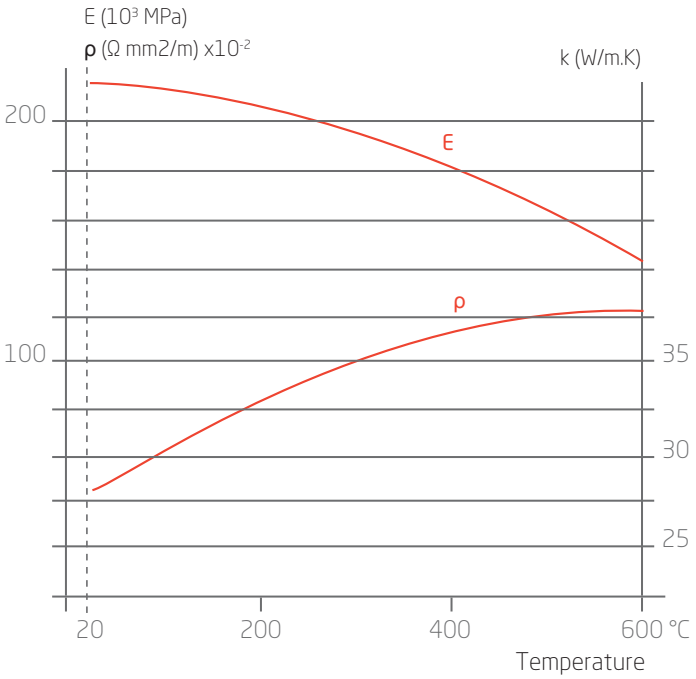
Forms: sheets, blanks, coils, strips, circles.
Thicknesses: 0.4 to 8 mm.
Width: according to thickness, consult us.
Finishes: cold rolled or hot rolled, according on the thickness.

KARA
key for value

Physical properties

Cold rolled sheet. Annealed condition

Density	d	kg/dm³	7 °C	7.7
Melting temperature		°C	Liquidus	1460
Specific heat	c	J/kg.K	20 °C	460
Thermal conductivity	k	W/m.K	20 °C 500 °C	26 28.7
Mean coefficient of Thermal expansion	α	$10^{-6}/K^{-1}$	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	0.60
Magnetic permeability	μ	at 0,8 kA/m DC or top AC	20 °C	850
Young's modulus	E	10^3.MPa	Rolling direction at 20 °C	215



Mechanical properties

Annealed condition
In accordance with ISO 6892-1, test specimen perpendicular to the rolling direction

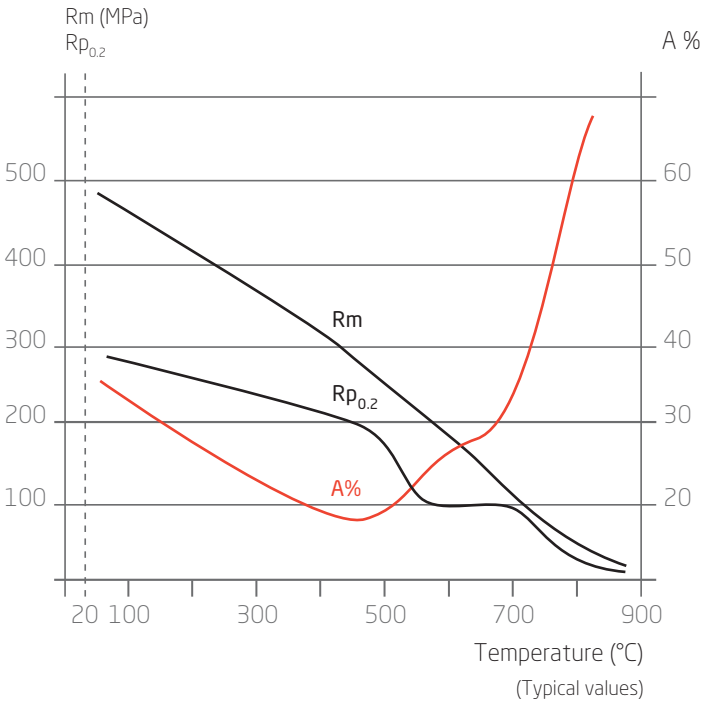
Test specimen
L = 80 mm (thickness < 3 mm)
L = 5.65 √So (thickness ≥ 3 mm)

Presentation	$Rm^{(1)}$ (MPa)	$Rp_{0.2}{}^{(2)}$ (MPa)	$A^{(3)}$ (%)	HV
Cold-rolled*	420	250	32	125

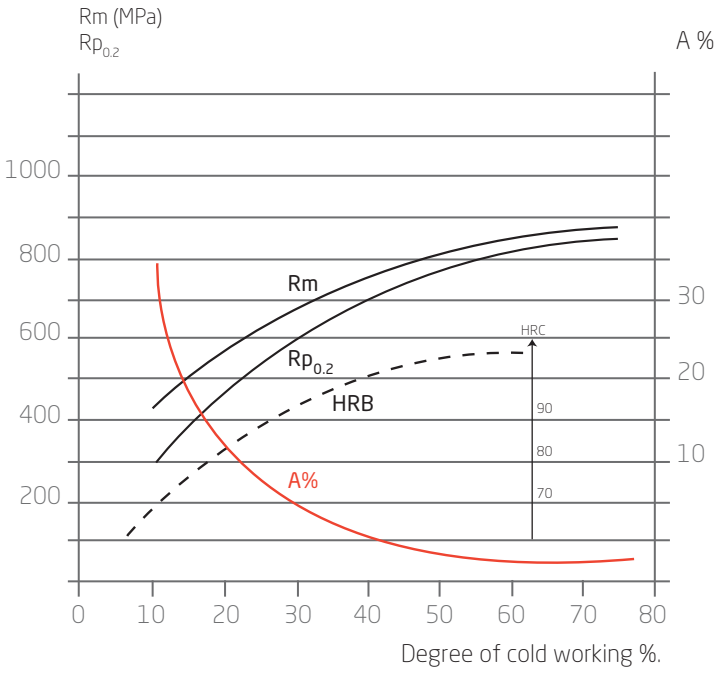
1 Mpa = 1 N/mm². *Typical values

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

At high temperatures



Work hardened by cold rolling



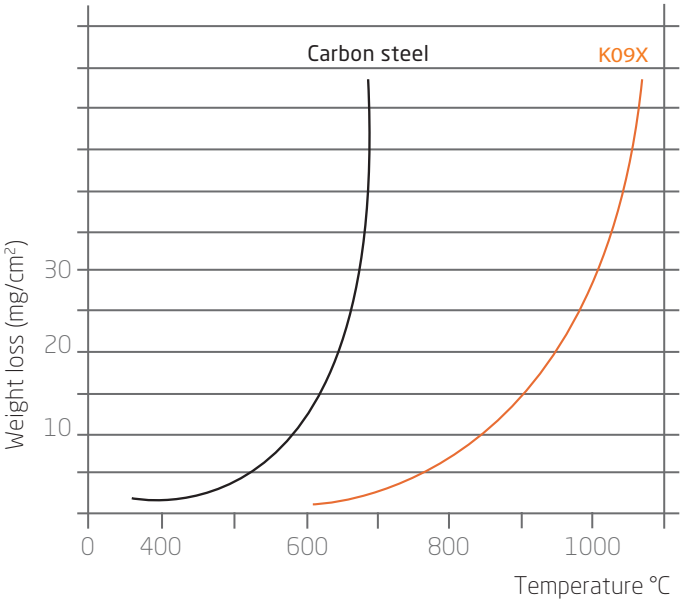
Corrosion resistance

Like all ferritic stainless steels:

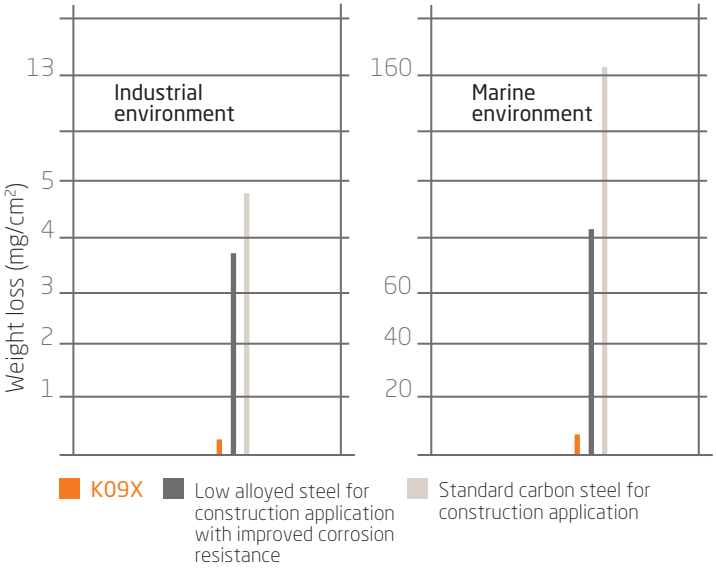
- Our grade **K09X** is insensitive to stress corrosion cracking.
- Our grade **K09X** resists corrosion by acid condensates in gasoline or diesel engine exhaust systems in the car manufacturer's simulation tests.

The corrosion resistance of welds and heat affected zones is similar to that of the base metal.
The corrosion rate of our **K09X**, when displayed in atmosphere, is lower than 1µm per year, i.e. 100 times less than low-alloyed metals. However, the superficial deterioration of the material, resulting in the creation of a brown layer, requires a paint application if the aesthetic criterion is a consideration

High temperature oxidation
Test duration: 100 hours



Exposition trial: 2 years duration



Forming

K09X can be readily cold formed by standard processes (folding, bending, drawing, etc.).

Strain ratio = 1.2 (typical value).

Erichsen test (stretching)

Grades	European designation	AISI	Erichsen deflection* (mm)
K09X	1.4512	409	11.6

* Typical values - 1.5 mm thick sheet

Bending of butt seam tube
The bending ratios permissible with K09X are given in the table below and are based on laboratory results for a bending angle of 90°, where D is the diameter and R is the radius.

Bending (results in laboratory)	Ra = R/D mini*
Tube Ø 40 x 1.5	1.1
Tube Ø 50 x 1.5	1.1

* Typical values - Ra = bending ratio, D = tube diameter, R = bending radius.

Welding

Our **K09X** grade can be resistance welded by spot or seam techniques. Good results are obtained without post treatment provided that the weld is sufficiently forged.

Welding process	Without filler metal	With filler metal			Shielding gas*
	Typical thicknesses	Thickness	Filler metal		*Hydrogen and nitrogen
			Rod	Wire	
Resistance: spot, seam	≤ 2 mm				
TIG	< 1.5 mm	> 0.5 mm	W / G 19 9 L [1] or 18L Nb [1] ER 308 L [2] or 430 LNb 1.4316 or 1.4511[5]		Argon Argon + Helium
PLASMA		> 0.5 mm		G 19 9LSi [1] or 18 L Nb [1] ER 308 LSi [2] or 430 LNb 1.4316 or 1.4511 [5]	Argon Argon + Helium
MIG		> 0.8 mm		G 19 9 LSi [1] or 18 L Nb [1] ER 308 LSi [2] or 430 LNb 1.4316 or 1.4511 [5]	Argon + 2% CO_2 Argon + 2% O_2 Argon + 2% CO_2 + Helium
S.A.W		≤ 2 mm		ER 308 L	
Electrode		Repair	E 199 L [3] E 308 L [4]		
Laser	< 5 mm				Helium Argon in certain conditions

[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 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 %.
In order to restrict grain growth in the HAZ, the use of high welding powers 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. Pulsed MIG/MAG welding has a lower power input than conventional MIG welding and enables better control of both bead geometry and grain size.
K09X has a excellent medium and high frequency induction weldability.
Post-weld heat treatment is generally not necessary.
The welds must be mechanically or chemically descaled, then passivated and decontaminated.
Oxyacetylene torch welding is to be proscribed.

Heat treatment and finishing

Annealing

At 850°C followed by air cooling. It is important never to exceed 925°C.
Parts must be thoroughly degreased prior to any heat treatment operation.

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