Stainless Europe

ArcelorMittal

KARA ferritic stainless steel offer: grade K36X

Chemical composition

Elements	C	N	Si	Mn	Cr	Mo	Nb
%	0.015	0.015	0.40	0.25	17.5	1.25	0.40

Typical values

European designation	
X6CrMoNb17-1	1. 4526 (1)

American designation
Type 436 (2)

(1) In accordance with NF EN 10088-2

(2) In accordance with ASTM A 240

IMDS n°
5034475

Our 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.

General characteristics

Our K36X grade is characterised by:

- Good resistance to pitting corrosion,
- Good performance in industrial atmosphere,
- Good performance in salt spray environment,
- Good formability, free from “roping”,
- Excellent polishability,
- Elevated mechanical properties at high temperature,
- Resistance to high temperature oxidation up to 950°C,
- Good corrosion resistance in exhaust gas atmospheres.

Applications

- Various parts of exhaust systems (manifold, catalytic converter shell, connecting pipe, silencer)
- Automotive exhaust tailpipe.

Product range

Forms: sheets, blanks, coils, strip, discs.
Thicknesses: from 0.40 to 2.0 mm.
Width: according to thickness; consult us.
Condition: cold-rolled.

K36X

18% chromium niobium-stabilised ferritic stainless steel with molybdenum addition

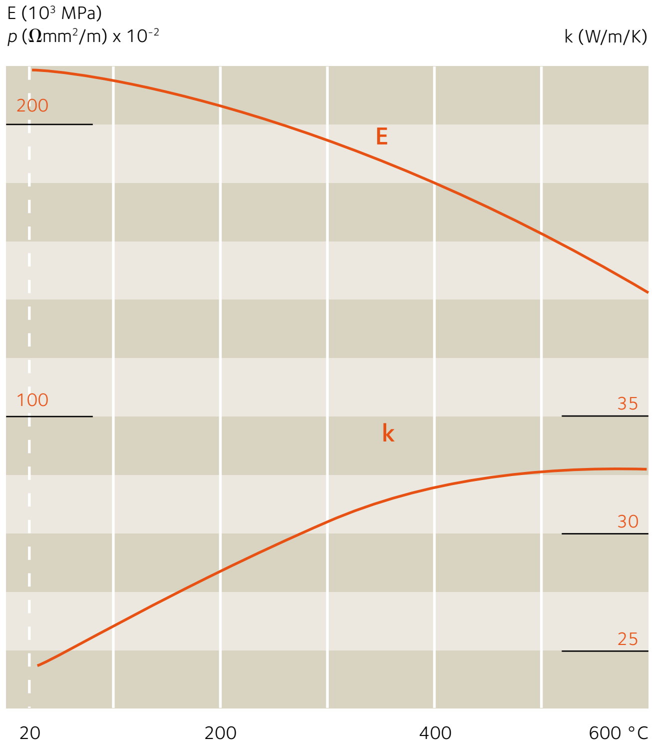
KARA
key for value

Physical properties

On cold-rolled sheet.

In the annealed condition.

Density	d	kg/dm^3	20 °C	7.7
Melting point		°C	Liquidus	1480
Specific heat	c	J/kg.K	20 °C	440
Thermal conductivity	k	W/m.K	20 °C	30
Mean coefficient of linear expansion	a	10^{-6}/K	20-200 °C 20-400 °C 20-600 °C 20-800 °C	11.7 12.1 12.7 14.2
Electrical resistivity	p	h.mm^2/m	20 °C	0.70
Magnetic permeability	µ	à 0.8 kA/m DC ou AC	20 °C	550
Modulus of elasticity	E	MPa.10^3	20 °C	220



Mechanical properties

In the annealed condition

In accordance with EN 10002, test specimen perpendicular to the rolling direction

Test specimen

Lo = 80 mm (ép. < 3 mm)

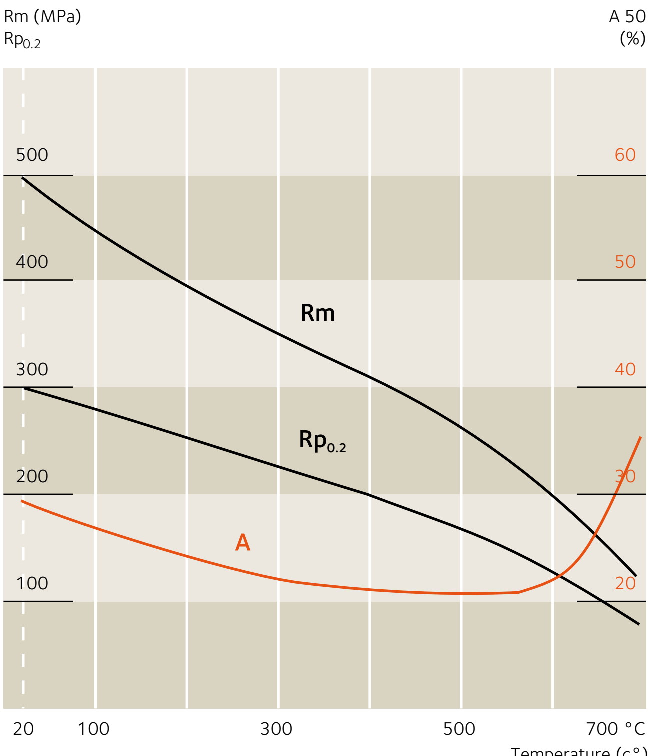
Lo = 5.65 √ So (ép. ≥ 3 mm)

Condition	Rm [1] (MPa)	$Rp_{0.2}$ [2] (MPa)	A [3] (%)	HRB
Cold-rolled*	510	350	30	78

1 MPa = 1 N/mm^2. * Typical values.

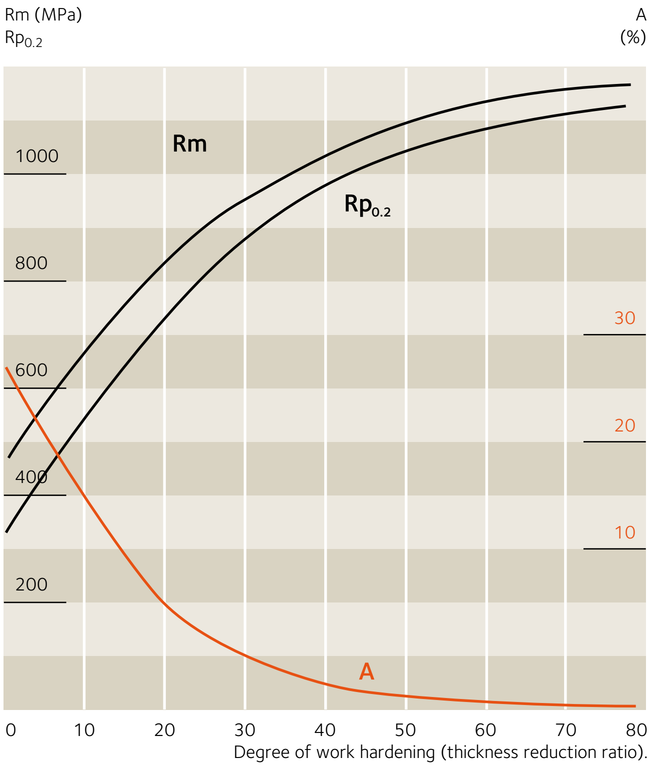
[1] Ultimate Tensile Strength (UTS). [2] Yield Strength (YS). [3] Elongation (A).

At high temperatures*



*Typical values.

Work-hardened by cold rolling



Corrosion resistance

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

Our K36X grade is resistant to corrosion by acid condensates in exhaust systems.

K36X offers good performance in a salt spray environment, as well as in the various cosmetic corrosion tests encountered in the automotive industry.

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

Resistance to condensate corrosion

Grade designations	Accelerated "DIP-DRY" simulation tests Cyclic tests in synthetic condensate furnace at 300°C, pH4						
	Maximum depth of corrosion in µm						
	Free sheet surface		Crevice corrosion		Under-deposit corrosion		
	500 hrs	1000 hrs	30 days	90 days	30 days	30 days+ Fe Cl_3 6%	5 days+ pH1.6 +Fe Cl_3 6%
K09X	6	18	180	500	18	108	500
K34X(1)	-	-	6	30	-	-	-
K39M(2)	6	12	36	350	12.5	96	270
K41X	-	-	18	42	-	-	-
K36X	**2**	**4**	**6**	**20**	**0**	**101**	**200**

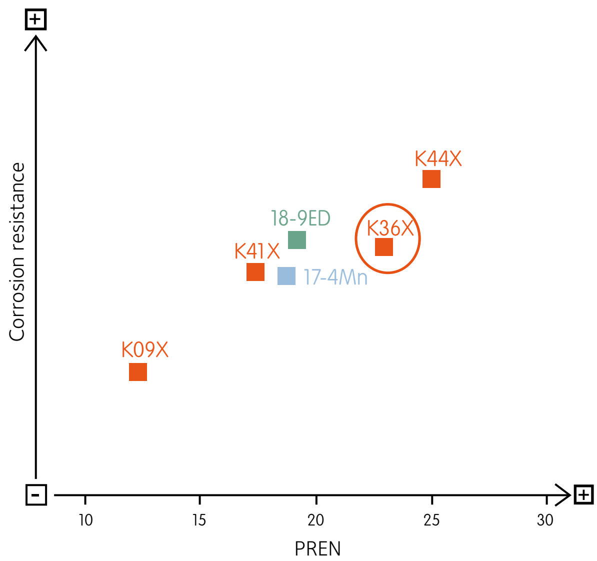
(1) EN 1.4113, Type 434
(2) EN 1.4510, Type 430 Ti

Resistance to localised corrosion

Grade designations	Standards		
	ASTM		EN
	Designations		
	Type	UNS	
K09X	409	S40910	1.4512
K41X	441 (1)	S43932	1.4509
K36X	**436**	**S43600**	**1.4526**
K44X	444	S44400	1.4521
17-4Mn	201.1	S20100 (3)	1.4618 (2)
18-9 ED	304	S30400	1.4301

(1) Common designation.
(2) Pending revision of standard.
(3) With copper addition and "rich side" properties of 201.1, ASTM A240.

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



Forming

K36X 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 K36X are given in the table below, based on laboratory tests for a bending angle of 90°, where D is the tube diameter and R is the bending radius.

Bending of butt seam tube

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

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

Welding

Our **K36X** 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	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 12 3L (1) ER 316L (2) 1.4430 (3)		Argon Argon + Helium
PLASMA	< 1.5 mm	> 0.5 mm		G 19 12 3L (1) ER 316L (2) 1.4430 (3)	Argon Argon + Helium
MIG		> 0.8 mm		G 19 12 3L (1) ER 316L (2) 1.4430 (3)	Argon + 2 % CO_2 Argon + 2 % O_2 Argon + 2 % CO_2 + Helium
Electrode		Repair	G 19 12 3L (4) ER 316L (5) 1.4430 (3)		
Laser	< 5 mm				Helium Under certain conditions: Argon

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 CO2 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.

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

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 enables restoration of the microstructure.

Pickling

Nitric-hydrofluoric acid mixture (10% HNO3 + 2% HF).
Descaling pastes for weld zones.

Passivation

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

Head office
ArcelorMittal Paris
Stainless Europe
1-5 rue Luigi Cherubini
FR-93212 La Plaine Saint-Denis Cedex
www.arcelormittal.com/stainlesseurope
www.arcelormittal.com/stainlesseurope/kara
stainless.europe@arcelormittal.com

Information
Tel. : (33) 1 71 92 06 52
Fax : (33) 1 71 92 07 97