

KARA ferritic stainless steel offer grade **K03**



Chemical composition

Elements	C	Si	Mn	Cr	Ni
%	0.02	0.50	0.60	11.0	0.40

Typical values

European designation⁽¹⁾

X2CrNi12 1.4003⁽¹⁾

American designation⁽²⁾

UNS 41003

⁽¹⁾ According to NF EN 10088-2

⁽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.
- › PED (Pressure Equipment Directive) in accordance with EN 10028-7.

General characteristics

The principal characteristics of our grade **K03** are:

- › Elevated mechanical properties
- › Excellent weld properties especially at high toughness
- › Good performance in both natural atmosphere and in moderately aggressive media
- › Ease of workmanship – both weldability and forming
- › Very good resistance to impact – this includes welds and at very low temperatures.
- › Good fire resistance (MO)
- › Good fatigue strength
- › Good corrosion-abrasion behaviour – with a corrosion resistance markedly superior to that of construction steels.

- › The CM level enables the use of lighter-weight structures than with construction steels.
- › A competitive offer in HR up to 1.88mm gauge
- › Excellent flatness in the 2B condition in thin gauges

Applications

- › Transport equipment: railway carriages, wagons, containers, coaches and lorries
- › Industrial equipment: hoppers, conveyors, storage tanks
- › Construction: Structural elements, profiles (ceilings, floors, walls), light and secondary non-load-bearing structures, foundations,
- › In short, all of the classic construction-steel applications but with the advantage of a better performance in moderately-corrosive environments.

Product range

Forms: sheets, blanks, coils, strip, discs and tubes.

Thicknesses: 0.80 to 8mm (for below and above this range – contact us)

Width: up to 1524mm in HR or Cold roll – (according to thickness- contact us)

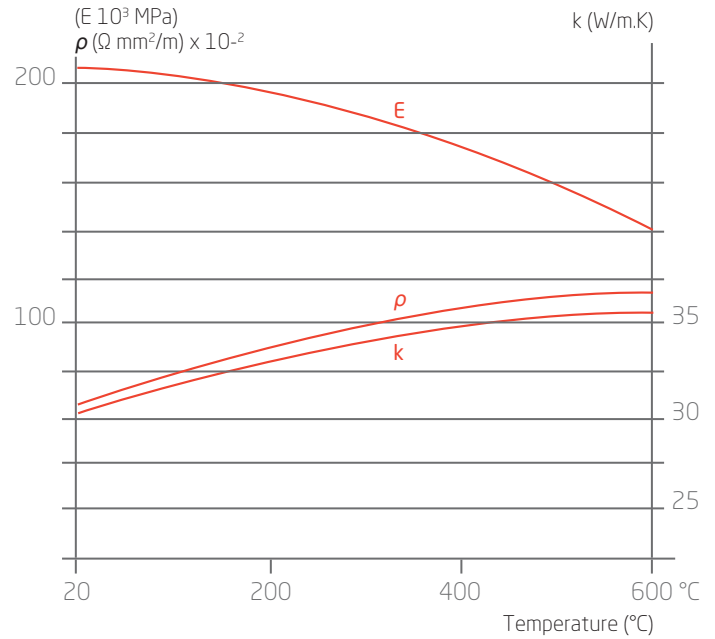
Finishes: Cold-rolled, hot-rolled, according to thickness.

Physical properties

On cold-rolled sheet. In the annealed condition.

Density	d	kg/dm ³	20 °C	7.7
Melting temperature		°C		1460
Specific heat	c	J/kg.K	20 °C	430
Thermal conductivity	k	W/m.K	20 °C	30
Mean coefficient of Thermal expansion	α	10 ⁻⁶ /K	20-100 °C 20-200 °C 20-400 °C	10.4 10.8 11.6
Electric resistivity	ρ	Ω mm ² /m	20 °C	0.60
Magnetic permeability	μ	à 0.8 kA/m DC ou AC	20 °C	850
Modulus of elasticity	E	MPa.10 ³	20 °C	220

Poisson's ratio: 0.28



Mechanical properties

Annealed condition

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

Specimen

Lo = 80 mm (thickness < 3 mm)
Lo = 5,65 \sqrt{So} (thickness \geq 3 mm)

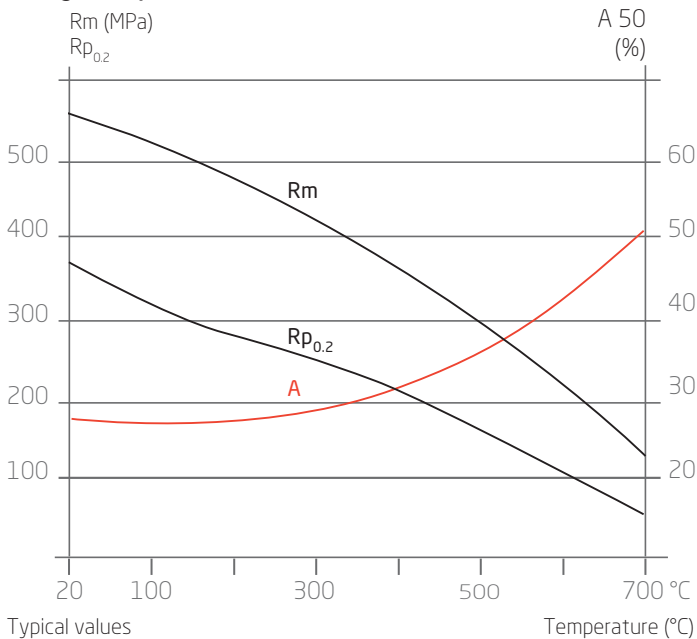
Condition	Rm ⁽¹⁾ (MPa)	Rp _{0.2} ⁽²⁾ (MPa)	A ⁽³⁾ (%)	HV5
Hot-rolled*	510	340	26	155
Cold-rolled*	490	350	28	150

1 MPa = 1 N/mm²

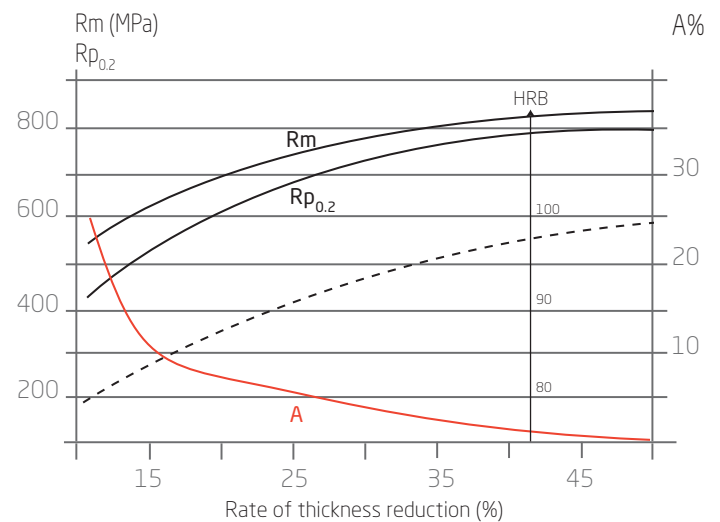
* Typical values

⁽¹⁾ Ultimate tensile strength (UTS). ⁽²⁾ Yield Strength. ⁽³⁾ Elongation (A).

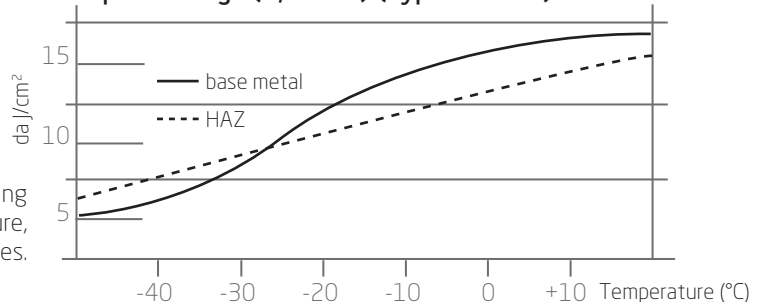
At high temperatures



Effect of cold work (Typical values)



Impact strength (1/2 KCV) (Typical values)



Our K03 has been especially designed for welded constructions requiring high reliability. The HAZ, which has an essentially martensitic structure, with low carbon and a fine grain, offers excellent heat resistance values.

Fatigue resistance

Our **K03** offers a very good fatigue performance characterised by:

- A life-cycle of base metal up to and including 0.50 of 10⁷ cycles

- A resistance in welded assemblies of at least equivalent to similar assemblies produced in conventional steel E 355. **K03** grade would seem particularly suited for welded constructions which are subject to mechanical demands in service.

Grades	R=-1		R=0.1	
	$\Delta\sigma/2$ (MPa)	r	$\Delta\sigma/2$ (MPa)	r
K03 base metal	280	0.53	260	0.50
K03 weld assembly	165	-	140	-
E355 steel weld assembly	160	-	135	-

Endurance ratio: $r = (\Delta\sigma/2)/R_m$

Endurance ratio: $\Delta\sigma/2 = (\sigma_{max} - \sigma_{min})/2$

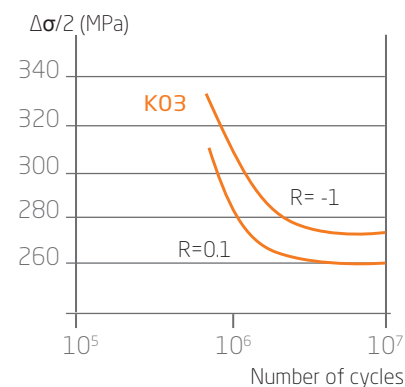
Load ratio: $R = \sigma_{min}$

Typical values.

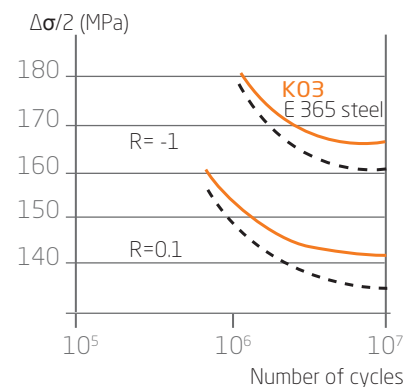
Bend tests (25 Hz)

Values given as indicative for a thickness of 4 mm

Base metal



MIG end-to-end weld



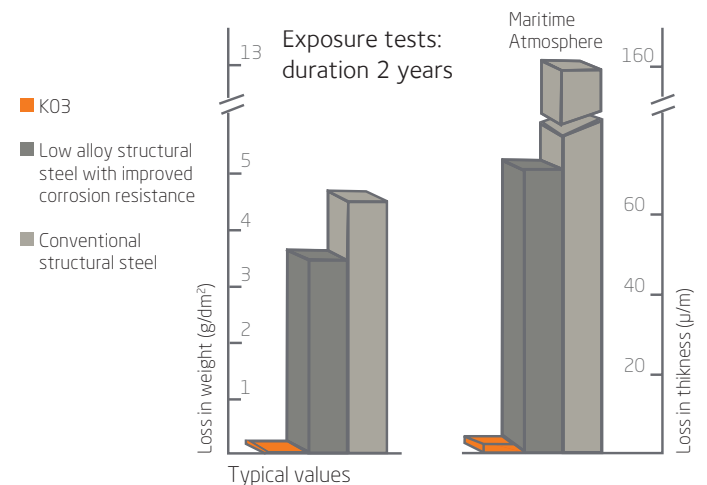
Resistance to corrosion

With rare exceptions, our **K03** grade has a corrosion level, when exposed to the atmosphere, of less than 1 μm per year – around 100 times less than that of classic construction steels.

This excellent performance allows **K03** grade to be used without a paint finish in numerous applications, whilst still preserving functional integrity. However, a brown surface colouring can appear through slight changes in the metal, necessitating the application of paint in aesthetically demanding situations.

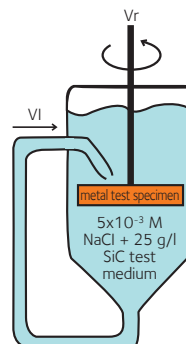
In its painted state, the exposure time needed, in tests in a saline solution (AFNOR NFX 41002), before damage occurs, is increased almost 5 times when compared with a classic construction steel.

The use of **K03**, either painted or non-painted, as a replacement for classic construction steels increases longevity whilst at the same time reducing maintenance costs. This results in an excellent compromise of cost and performance.



Resistance to abrasion-corrosion

The combination of corrosion resistance and good mechanical properties gives our **K03** grade a very good performance in mixed corrosion-abrasion environments, encountered in numerous industries (including stocking and handling of solids or powders in humid environments and industries involving liquids with particles in suspension). Tests in laboratory conditions show the clear superiority of **K03** grade.



Grades	Weight loss (g)	
	Vr= 150 t/min Vi = 3 m/s	Vr= 1000 t/min Vi = 5 m/s
K03	15	20
E355 steel	95	130

Typical values

Forming

Our **K03** can be cold formed using all common processes (folding, profiling, bending, drawing etc)

Bending

The ductility of **K03** allows bends of up to 180 degrees

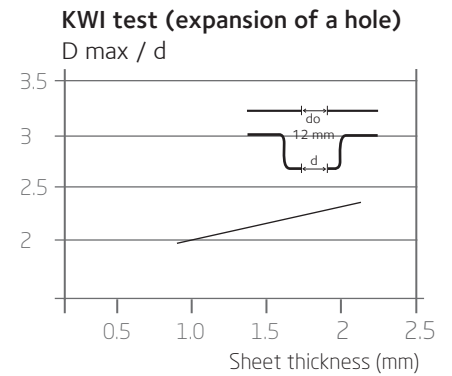
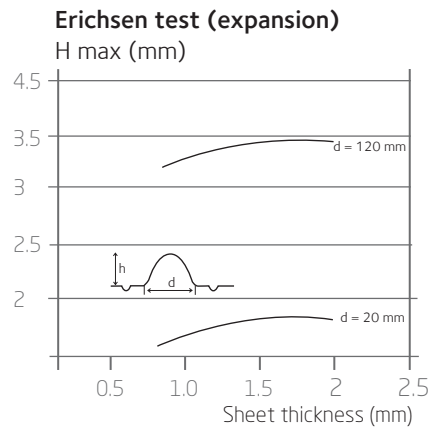
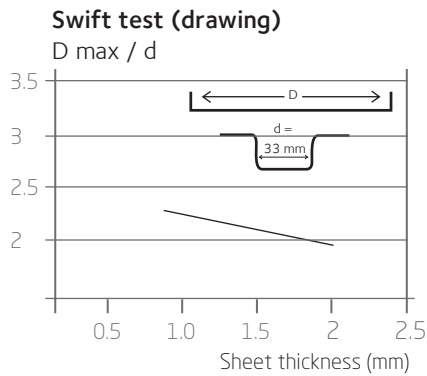
Drawing

K03 offers good drawing characteristics, making it suitable for the production of a range of drawn components.

Thickness (mm)	Minimum bend radius in mm (transverse direction)	
	90°	180°
<4.5	0.5 e	1 e
4.5 - 6.5	1 e	1.5 e

Standard test procedure NFA 03157 and NFA 03158 (June, 1978)

Typical values



Welding

Our **K03** grade can be welded by spot or seam techniques. Good results are obtained without post treatment provided the weld is sufficiently forged.

Welding process	No filler metal	With filler metal		Shielding gas*	
	Typical thicknesses	Thicknesses	Thickness		
			Rod		Wire
Resistance Spot, seam	≤ 2 mm				
TIG	< 1.5 mm	> 0.5 mm	G 19 9 L ⁽¹⁾ or G18 8 Mn ⁽¹⁾ ER 308L ⁽²⁾ or ER307 n° 1.4316 or 1.4370 ⁽⁵⁾		Argon Argon + Helium
PLASMA	< 1.5 mm	> 0.5 mm		G 19 9 L ⁽¹⁾ or G18 8 Mn ⁽¹⁾ ER 308L ⁽²⁾ or ER307 n° 1.4316 or 1.4370 ⁽⁵⁾	Argon Argon + Helium
MIG ⁽²⁾		> 0.8 mm		G 19 9 L ⁽¹⁾ or G18 8 Mn ⁽¹⁾ ER 308L ⁽²⁾ or ER307 n° 1.4316 or 1.4370 ⁽⁵⁾	Argon + 2% CO ₂ Argon + 2% O ₂ Argon + 2% CO ₂ + Helium
Electrode		Repairs	E19 9 L or E18 8 Mn ⁽³⁾ E 308 L or E 307 ⁽⁴⁾		
Laser	< 5 mm				Helium

⁽¹⁾ according to EN ISO 14343, ⁽²⁾ according to AWS A5.9, ⁽³⁾ according to EN 1600, ⁽⁴⁾ according to AWS A5.4, ⁽⁵⁾ according to 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 the use of CO₂ is restricted to 3%.

In order to restrict grain growth on 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 not generally necessary. To restore corrosion resistance qualities to the metal, welds should be mechanically or chemically descaled and then passivated. For some applications, this might not be necessary.

Heat treatment and finishing

Annealing

After cold deformation, a few minutes annealing at 750 °C enables the structure to be restored.

K03 is tempered when it is rapidly cooled from 780 °C.

Polishing - brushing burnishing -satin-finishing - painting

No difficulties encountered.

Pickling

Nitric-hydrofluoric acid mixture (20% HNO₃ + 1% HF).

Descaling pastes for weld zones.

Passivation

20-25% nitric acid bath at 20 °C. Passivating pastes for weld beads.