KARA Ferritic Stainless Steel

K03 11% Chromium

KARA key for value

Chemical Composition

Elements (%)	C	Si	Mn	Cr	Ni
K03	0.02	0.50	0.60	11.0	0.40

Typical values

European designation	American designation
X2CrNi12/1.4003 (1)	UNS 41003 (2)

(1) According to NF EN 10088-2

(2) According to ASTM A 240

This grade complies with:

- Aperam Stainless Europe - Safety Information Sheet for Stainless Steel
- European Directive 2000/53/EC on end-of-life vehicles and later modifications
- PED (Pressure Equipment Directive) in accordance with EN 10028-7

Key Features

- Elevated mechanical properties
- Excellent weld properties, especially at high toughness
- Good performance in both natural and moderately aggressive environments
- Ease of workmanship, – both in terms of weldability and forming
- Very good resistance to impact including both welds and very low temperatures
- Good fire resistance (M0) and 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 with construction steels
- A competitive offer in hot rolled, up to 1.88 mm 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
- Well-suited for all traditional construction-steel applications, our K03 grade offers the added advantage of better performance in moderately corrosive environments

Product Range

	Coils	Sheets / Blanks	Flat Bars
Thickness (mm)	0.80 up to 8	0.80 up to 8	2 up to 20
Width (mm)	up to 1,524	up to 1,250	10 up to 300
Finish	1D / 2B / 2D	1D / 2B / 2D	1D / Polished

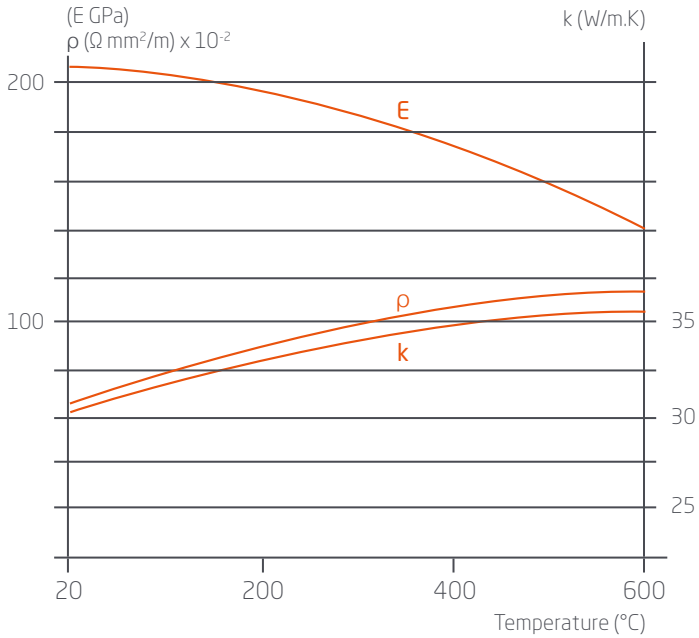
Please contact us regarding all other dimensions and forms

Physical Properties

Cold rolled and annealed sheet

Density	d	kg/dm³	20°C	7.7
Melting temperature		°C	Liquidus	1,460
Specific heat	c	J/kg.K	20°C	430
Thermal conductivity	k	W/m.K	20°C	30
Mean thermal expansion coefficient	α	10^{-6}/K	20-100°C 20-200°C 20-400°C	10.4 10.8 11.6
Electric resistivity	ρ	Ω mm²/m	20°C	0.60
Magnetic resistivity	μ	at 0.8 kA/m DC or AC	20°C	850
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)

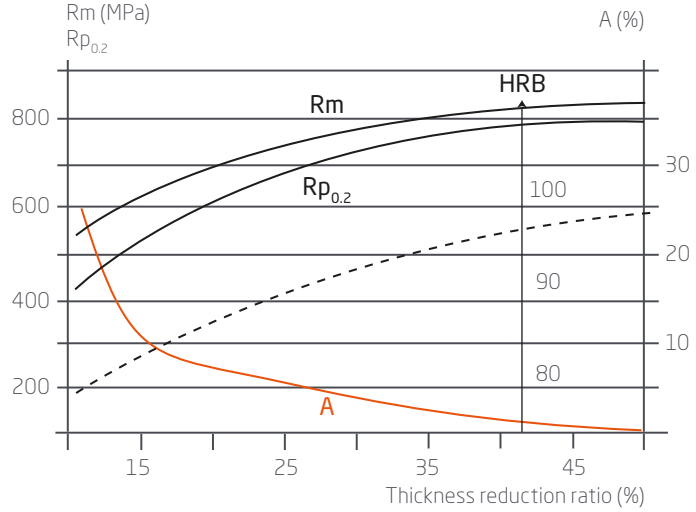
In the annealed condition

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

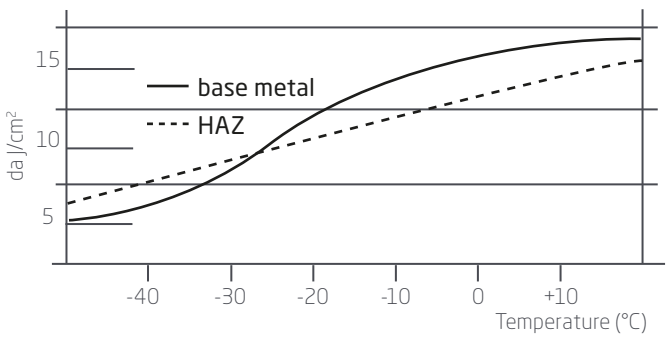
Grade	Condition	Rm(1) (MPa)	Rp0.2(2) (MPa)	A(3) %	HV5
K03	Hot-rolled	510	340	26	155
	Cold- rolled	490	350	28	150

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

Effect of cold rolling (Typical values)

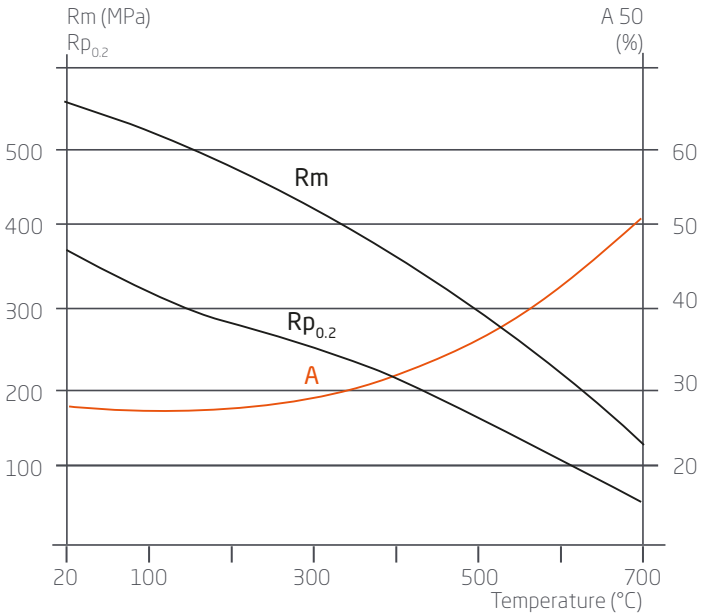


Impact strengh (½ KCV) (Typical values)



At high temperatures (Typical values)

Our K03 grade was specifically 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 grade offers very good fatigue performance characterised by a:

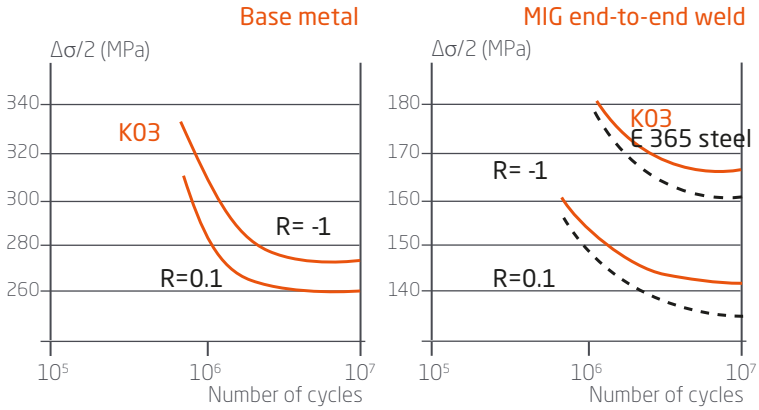
- Life-cycle of base metal up to and including 0.50 of 107 cycles
- Resistance in welded assemblies that is at least equivalent to that of similar assemblies produced using conventional steel E 355. K03 grade is particularly well-suited for welded constructions that are subject to mechanical demands while in service

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

Endurance ratio: r= (Δ/σ2)/Rm - Endurance ratio: Δσ/2= (σmax - σmin)/2 - Load ratio : R=σmin
Typical values.

Bend tests (25 Hz)

Values given as indicative for a thickness of 4 mm.



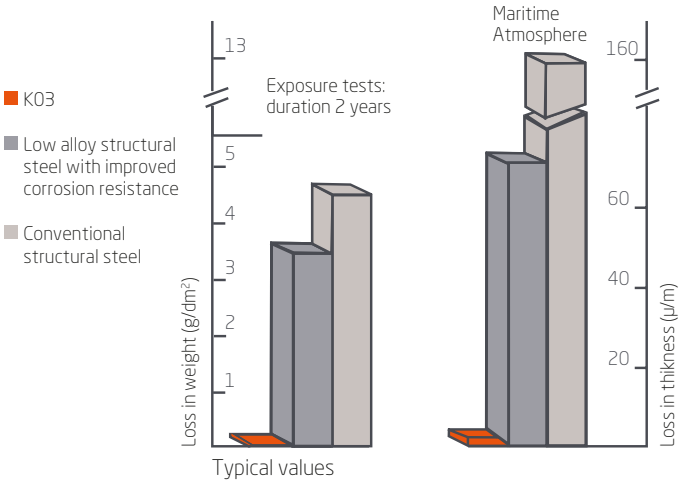
Corrosion Resistance

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

This excellent performance means the K03 grade can be used in many applications without the need for a paint finish, 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 compared to classic construction steel.

The use of K03, either painted or unpainted, as a replacement for classic construction steels increases longevity whilst also reducing maintenance costs. This results in an excellent balance of cost and performance.



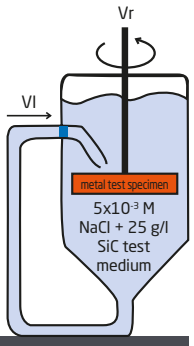
Resistance to Abrasion-Corrosion

The combination of corrosion resistance and good mechanical properties means our K03 grade offers very good performance in the mixed corrosion-abrasion environments often 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 our K03 grade.

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

Typical values



Forming

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

Bending

K03's ductility allows for bends of up to 180°.

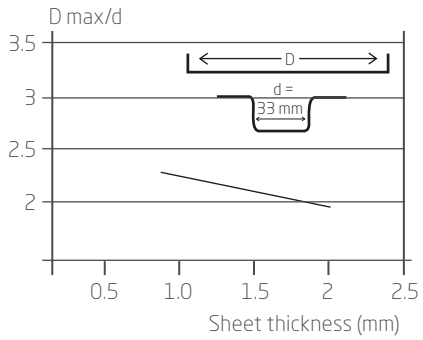
Drawing

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

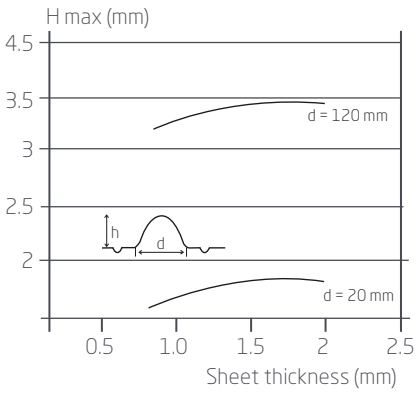
Thickness (mm)	Minimum bend radius (mm) Transverse direction	
	90°	180°
< 4.5	0.5 e	1 e
4.5 - 6.5	1 e	1.5 e

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

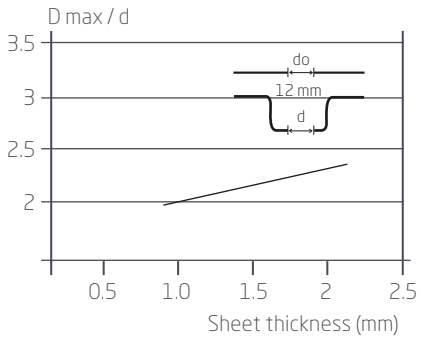
Swift test (drawing)



Erichsen test (expansion)



KWI test (expansion of a hole)



Welding

Our K03 grade can be 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	G 19 9 L [1] or G18 8 Mn [1] ER 308L [2] or ER307 n° 1.4316 or 1.4370 [5]		Ar Ar + He
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]	Ar Ar + He
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]	Ar + 2% CO_2 Ar + 2% O_2 Ar + 2% CO_2 + He
Electrode		Repairs	E19 9 L or E18 8 Mn [3] E 308 L or E 307 [4]		
Laser	< 5 mm				He

[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 CO_2 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% HNO_3 + 1% HF)
- Use descaling pastes for weld zones

Passivation

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