NIROSTA® 4002

Material no.	1.4002 to EN 10 088-2		
Code names	D	(DIN/EN)	X 6 CrAl 13
	USA	(ASTM)	405
	Japan		SUS 405
	CIS		–

Chemical composition (in % by weight)

	C	Cr	Al	Mn
min.	–	12.0	0.10	–
max.	0.08	14.0	0.30	1.0

Product forms: Hot-rolled wide strip, cold-rolled wide strip, slit strip, cut sheets, circles, blanks

Mechanical properties (Transverse samples) at room temp. to EN 10 088-2

Dimensions range	$R_{p\,0.2}$ (0.2% yield strength) N/mm²	R_m (tensile strength) N/mm²	A_{80} (elongation) %
Cold-rolled strip s ≤ 8 mm	≥ 250	400 – 600	≥ 17
Hot-rolled strip s ≤ 13.5 mm	≥ 230	400 – 600	≥ 17

Minimum properties at elevated temperatures

Temperature °C	100	150	200	250	300	350	400
$R_{p\,0.2}$ (0.2% yield strength) N/mm²	220	215	210	205	200	195	190

Heat treatment

Annealing temperature °C	Time min	Cooling	Microstructure
750 – 810	~ 5/mm thickness	Water/air	Ferrite

Physical properties

Density kg/dm³	Modulus of elasticity in kN/mm² at 20 °C	100 °C	200 °C	300 °C	400 °C	Thermal expansion in $10^{-6} \cdot K^{-1}$ between 20 °C and 100 °C	200 °C	300 °C	400 °C	500 °C
7.7	220	215	210	205	195	10.5	11.0	11.5	12.0	12.0

Thermal conductivity at 20 °C W/m · K	Specific heat capacity at 20 °C J/kg · K	Electrical resistivity at 20 °C Ω · mm²/m	Magnetisability
30	460	0.60	present

Surface finish: 1 D (II a)

Edge finish: Untrimmed, cut edges, dressed edges on request

Published by: ThyssenKrupp Nirosta GmbH · 47794 Krefeld · www.nirosta.de

Chemical resistance

Our publication “Chemical Resistance of NIROSTA® Steels” contains tables giving some guide to chemical resistance.

Processing

Suitable for light cold forming operations. Preheating to 200 to 400 °C is recommended for heavier forming operations and/or greater sheet thicknesses. Hot forming at 700 to 800 °C may also be necessary.

Heat tints or scale from hot forming or welding reduce corrosion resistance and should be removed by pickling (e.g. with pickling pastes) or grinding/sand-blasting (iron-free).

NIROSTA® 4002 can be polished to a limited extent.

Welding

Weldability:
NIROSTA® 4002 can be welded by all methods suitable for stainless steels. Heat input during welding should be minimized to limit the reduction in toughness in the heat-affected zone due to grain coarsening. Preheat temperatures of 200 to 400 °C are required for sheet thicknesses in excess of 3 mm. Stress-relieving at 650 to 680 °C is recommended after welding, depending on the application.

Filler metals:

Material no.	1.4018
THERMANIT®	14 K

Applications

NIROSTA® 4002 is principally used in process equipment for the oil industry (e.g. crackers) and in water turbines. The addition of aluminum reduces the tendency towards hardening in the heat-affected zone and thereby lowers susceptibility to cracking.

The material possesses its highest resistance to corrosion when precision ground or polished.