Ni-CROMAX®

Nickel-chrome-plated bar

OVAKO

In standard form, **Ni-Cromax®** is based on the same steel grade as Cromax 280X, a low-carbon, micro-alloyed steel combining high strength with excellent machinability and weldability. For $\phi \leq 90$ mm, yield and tensile strength are 20% higher than is normal for chrome- or nickel-chrome-plated products based on low-carbon weldable steel of 20MnV6-type. This improvement is achieved without detriment to machinability or weldability.

Average chemical analysis Ni-Cromax® based on 280X steel

C %	Si %	Mn %	S %	V %	C.E % (*)
0.18	0.35	1.55	0.025	0.11	0.55 max.

*C.E. = % C + % Mn / 6 + (% Cu + % Ni) / 15 + (% Cr + % Mo + % V) / 5

Corresponding standards

The table shows the closest corresponding standard for the 280X steel base in Ni-Cromax.

Ni-Cromax	EN	DIN	BS	AFNOR	ASTM
280X	20MnV6	20MnV6	55M	E420	A572

Mechanical properties

Size (ϕ), mm	Yield stress, R_{eH}, N/mm^2, min.	Ultimate tensile stress, R_m, N/mm^2	Elongation, A_5, %, min.	Hardness, HB	Toughness, KV, Joule, min.
$\leq$ 20	520	650 - 800	12	200 - 240	No guarantee
20 - 90	520	650 - 800	19	200 - 240	27 at -20 °C
> 90 - 125	440	550 - 700	19	180 - 230	27 at -20 °C
> 125 - 150	350	550 - 700	19	180 - 230	27 at -20 °C

Nickel and chrome layer

In standard execution, the thickness of the nickel layer is minimum 30 µm, while the chrome layer is at least 20 µm thick (Ni-Cromax 30). An execution combining min. 10 µm of nickel and min. 20 µm of chrome can also be supplied (Ni-Cromax 10).

Surface roughness

The surface roughness (Ra) is always less than 0.2 µm and normally in the range 0.05-0.15 µm. Rt (ISO) is always less than 2.0 µm and normally in the range 0.5-1.5 µm.

Surface hardness

The chrome layer hardness is 850 $HV_{0.1}$ min. The hardness of the nickel layer is about 300 $HV_{0.1}$.

Straightness

For $\phi < 30$ mm, the maximum deviation is 0.1 mm/0.5 m.
For larger sizes, the maximum deviation is 0.1 mm/m.

Roundness

The out of roundness is maximised at 50% of the diameter tolerance interval.

Diameter tolerance

ISO f7 is standard. Other tolerances can be supplied on request (narrowest range is ISO level 7).

Tolerance ranges

Size, mm	ISO f7, µm upper	lower
18	- 16	- 34
> 18 - 30	- 20	- 41
> 30 - 50	- 25	- 50
> 50 - 80	- 30	- 60
> 80 - 120	- 36	- 71
> 120 - 150	- 43	- 83

Standard sizes

Dia., mm	kg/m	Dia., mm	kg/m	Dia., inch	kg/m
18	2.00	60	22.19	3/4	2.23
		63	24.47	7/8	3.05
20	2.47	65	26.05		
22	2.98			1	3.97
25	3.85	70	30.21	1 1/4	6.22
28	4.83	75	34.68	1 1/2	8.94
				1 3/4	12.19
30	5.55	80	39.46		
32	6.31	90	49.94	2	15.91
35	7.55	100	61.65	2 1/2	24.87
36	7.99				
		110	74.60	3	35.81
40	9.86	120	88.78	3 1/2	48.72
45	12.48	125	96.33	4	63.65
50	15.41	130	104.19	4 1/2	80.54
55	18.65	140	120.83	5	99.44
56	19.33	150	138.72	5 1/2	120.32

Other sizes can be supplied upon request but not outside the above range.

Delivery lengths

Standard production lengths are 6.1+0.1/-0 m.

The "non-plated length" of each bar, i.e. the length at the bar-end over which the layer properties and tolerances can not be guaranteed, is at most 0.2 m at the one end and 0.05 m at the other.

Fixed, cut lengths can be supplied if required, but at a higher price than production lengths.

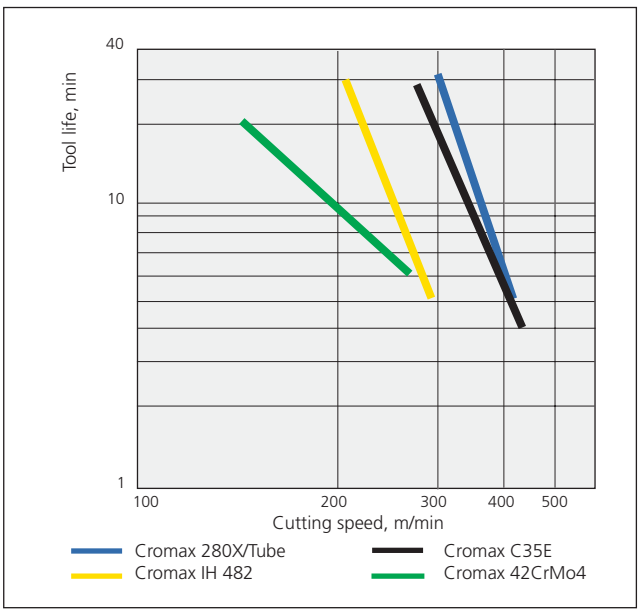
Weldability

Ni-Cromax based on grade 280X has excellent weldability. However, for Ø>90 mm, preheating to 150-200°C is recommended. Suitable consumables are OK 48.00/38.84 for MMA welding and OK 12.64 for MAG welding (shielding gas 80% Ar, 20% CO_2).

If necessary, Ni-Cromax can be friction welded without difficulty.

Machinability

The machinability of Cromax products in turning is compared in the diagram below. Coated carbide tool Sandvik SNMG120408-PM-4015. Feed 0.4 mm/r. Cutting depth 2 mm. Wear criterion 0.4 mm. Cutting fluid: Peralube 0125 5%.



Standard Ni-Cromax with 280X base has the same machining characteristics as Cromax 280X. Specific machining recommendations for turning and threading of Ni-Cromax are tabulated below.

Operation/ parameters	Rough turning	Fine turning	Threading
Feed, mm/r	0.3 – 0.6	0.05 – 0.3	–
Cut depth, mm	2 – 5	0.2 – 2.0	–
Tool (coated)	ISO P15 – P30	ISO P10 – P15	ISO P20 – P30
Speed, m/min	280 – 350	350 – 400	200 – 230

Special production procedures guarantee good adhesion between base steel and the nickel and chrome layers. Hence, there is little risk for spalling of the protective layers in association with machining, which is a problem often encountered when steel is coated with nickel.

Corrosion resistance

Prior to hard-chrome plating using the same procedures as Ovako's Cromax products, the bars are electrolytically coated with nickel. The nickel layer is completely free from cracks, pores and other defects. This duplex treatment engenders a product with an unparalleled level of corrosion resistance while at the same time maintaining the excellent friction and wear properties of a hard chrome layer.

Most corrosion-resistance specifications for hard-chrome products are based on salt-spray testing following the ISO 9227 standard or its equivalents (see below), combined with evaluation according to ISO 10289.

ISO 9227	ASTM	DIN 50021	Salt spray type
NSS	B 117	SS	Neutral
AASS	B 287	ESS	Acetic acid
CASS	B 368	CASS	Copper-accelerated acetic acid

While the correlation between these methods is not always clear, our experience is that a given degree of corrosion is reached 2-3 times as fast in the AASS test as in NSS-testing.

Ni-Cromax 30 in standard execution is guaranteed to withstand at least 1 000 hours in NSS test or 350 hours in AASS test without any corrosion (rating 10). Long-term field exposure tests have also proven that Ni-Cromax shows no corrosion after a two-year exposure in salt-laden coastal atmosphere.

Packaging

Ni-Cromax can be supplied with three different packaging options:

- Paper tubes with the characteristic white colour.
- White plastic sleeve, which can be left on as protection during piston-rod manufacture.
- Plastic spacer rings.

For the two latter alternatives, the bars are normally packed in a wooden box for additional protection during transport.

Ni-Cromax bars packed in plastic or paper tubes are individually marked with product and batch information so as to facilitate full traceability.

Ni-Cromax finish is available with other steel bases and executions

Any base steel grade in the Ovako Cromax programme can be supplied with Ni-Cromax execution. By special arrangement, Ni-Cromax finish can be offered in combination with induction hardening or on product in the form of tube.

Other Cromax products

Ovako's hard-chrome product programme also comprises:

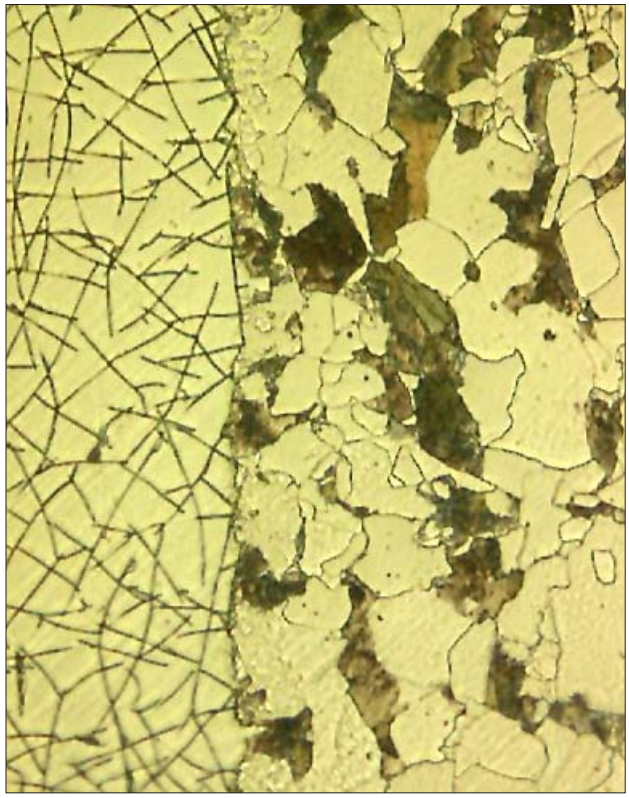
- carbon steel bar, Cromax C35E,
- Cromax 280X, based on a weldable, microalloyed steel,
- induction-hardened bar, Cromax IH 482,
- quenched and tempered bar, Cromax 42CrMo4, and
- Cromax in the form of tube (Cromax Tube).

Ovako is a leading European producer of special steel long products for the automotive and engineering industries. Deliveries in 2005 exceeded 1.6 million tons and comprised low-alloy and carbon steels in the form of bars, wire rod, tubes, rings and pre-components. The company has 16 manufacturing sites and several sales companies in Europe and the USA. Ovako has 4,600 employees.

Ovako Cromax is the major manufacturer in Europe of hard-chrome plated products in the form of bar and tube. The Cromax Group comprises five modern production units, two in Sweden and one in each of Holland, France and Italy.

The majority of the base-material requirements for Cromax manufacture are supplied by Ovako's own steel production units. The high and reproducible quality and superior mechanical characteristics of Cromax products are to a large extent attributable to a complete control over the entire manufacturing chain from steel melting to finished bar.

Ovako Cromax has about 200 employees and a turnover of EUR 60 million.



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