

## Cromax® hard-chrome-plated bar

### Cromax® 280X

#### General information

Cromax 280X is a hard-chrome bar based upon a low-carbon, micro-alloyed steel which combines high strength with good weldability and machinability. For the majority of dimensions, yield and tensile strength are 15-25% higher than for standard hard-chrome bars based upon weldable low-carbon steel. Furthermore, this improvement has no negative consequences for impact toughness, machinability or weldability.

When compared with standard products based upon grade 19MnVS6 or its equivalents, the superior properties profile of Cromax 280X offers the hydraulic cylinder designer a number of potential benefits, not the least of which being the possibility to downsize piston rods without loss of load-bearing capacity, thereby reducing not only weight but also cost.

#### Typical chemical analysis of steel 280X

C%	Mn%	P%	S%	V%	CEV % (*)
0.18	1.55	0.020 max	0.025	0.10	0.55 max

\*  $CEV = \%C + \%Mn/6 + (\%Cu + \%Ni)/15 + (\%Cr + \%Mo + \%V)/5$

#### Corresponding international standards

The closest equivalent steel grades in some selected international standards for the base steel in Cromax 280X are tabulated below. Note that in some instances, the correspondence is only approximate.

Ovako	EN 10267	DIN (*)	SS (*)	AFNOR (*)	BS (*)	ASTM A572	JIS G 3106
280X	19MnVS6 1.1301	20MnV6	2144	18MV5	55C	Grade 65	SM570

\* These standards are discontinued.

#### Mechanical properties (§)

Diameter, mm	Yield stress, $R_{eH}$ (*), MPa	Ultimate tensile stress, $R_m$ , MPa	Elongation (#), $A_{5.65}$ , %	Hardness, HB	Impact toughness (#), ISO-V, Joule
≤ 20	520 min.	650–850	12 min.	200–240	–
> 20–90	520 min.	650–850	19 min.	195–250	27 min. @ -20°C
> 90–125	440 min.	650–850	19 min.	195–240	27 min. @ -20°C
> 125	400 min.	600–750	19 min.	180–230	27 min. @ -20°C

§ In finished chrome-plated condition.

\*  $R_{p0.2}$  in the event that there is no discontinuous yield point.

# In longitudinal direction.

#### Chrome layer

For diameters from 20 mm and upwards, the chrome-layer thickness is 20 µm or more. For smaller sizes, the minimum thickness is 15 µm.

#### Surface roughness

The surface roughness (Ra) is always less than 0.2 µm and normally between 0.05–0.10 µm. Rt (ISO) is always less than 2.0 µm and normally in the range 0.5–1.0 µm.

#### Hardness of chrome layer

The chrome layer has a minimum hardness of 850 HV0.1.

### Straightness

For diameters below 30 mm, the maximum height of arc over a length of 0.5 m is 0.1 mm. For larger dimensions, the maximum height of arc is the same but with reference to a measurement length of 1 m.

### Diameter tolerance

Tolerance f7 as defined in ISO 286-2 is standard. Other tolerances can be supplied upon request but the narrowest range is ISO level 7.

### Out of roundness

Out of roundness or ovality is at most 50% of the diameter tolerance interval. For example, the diameter of a bar with nominal dimension 40 mm and tolerance f7 lies between 39.950 and 39.975 mm. The tolerance range is therefore 0.025 mm and the maximum out of roundness is 50% of this or 0.0125 mm.

### Dimensions available

Diameter, mm	kg/m	Diameter, mm	kg/m	Diameter, mm	kg/m
10	0.62	40	9.86	80	39.46
12	0.89	42	10.88	85	44.54
14	1.21	45	12.48		
18	2.00			90	49.94
		50	15.41	95	55.64
20	2.47	55	18.65		
22	2.98	56	19.33	100	61.65
25	3.85			110	74.60
28	4.83	60	22.19	115	81.53
		63	24.47	120	88.78
30	5.55	65	26.05	125	96.33
32	6.31				
35	7.55	70	30.21	130	104.19
36	7.99	75	34.68	140	120.83
38	8.90			150	138.72

Other metric sizes can be supplied upon request but not outside the above range. A limited number of imperial dimensions are also manufactured on a regular basis.

Most of the above articles are normally available from stock.

### Bar lengths

Stock standard length for bar diameters 25 mm and upwards is 6.1 m with a length tolerance  $-0/+100$  mm. Lengths shorter or longer than standard can be manufactured upon request. However, the maximum length capability is 7.6 m.

Bar lengths for diameters smaller than 25 mm are as follows:

- 10– < 20 mm: 3.0–3.6 m,
- 20 mm: 5.0 m,
- 22 mm: 5.5 m,

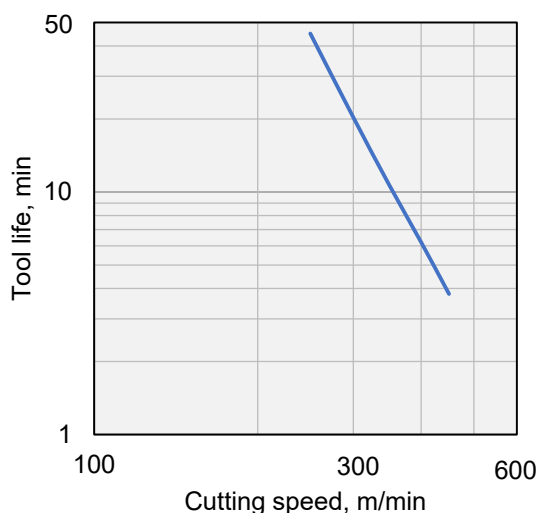
with length tolerance  $-0/+100$  mm in all cases.

The necessity for electrical contact during plating means that tolerances and chrome-layer properties cannot be guaranteed over a length of 100–150 mm at each end of the bar. When working with full-length bars, this so-called “un-chromed portion” must be discarded or alternatively incorporated into a machined section in the finished product.

Appreciable cutting capacity is available for supply of cut-to-length pieces with length tolerance  $-0/+2$  mm irrespective of diameter.

## Machining

A Taylor diagram for turning of the base steel in Cromax 280X is shown below.



### Test details:

Tool: coated carbide Sandvik SNMG 120408 PM-4015

Feed: 0.4 mm/rev.

Cut depth: 2 mm

Cutting fluid: Peralube 0125 5%

Wear criterion: 0.4 mm flank wear

$V_{15}$ -value = 323 m/min

The following table gives specific machining recommendations for turning and threading of Cromax 280X.

Operation	Rough turning	Fine turning	Threading
Tool (coated)	ISO P15–P30	ISO P10–P15 or cermet	ISO P20–P30
Depth of cut, mm	2–5	0.2–2	6–8 passes for pitch 2 mm
Feed, mm/rev.	0.3–0.6	0.05–0.3	–
Speed, m/min	280–350	350–400	200–250
Cutting fluid?	Yes	Carbide: yes Cermet: no	Yes

## Welding

Cromax 280X has good weldability and can be welded using any of the conventional methods. The carbon equivalent of the base steel is 0.55% max and preheating to 100–150°C (depending on heat input) is recommended only for dimensions 80 mm or above. MAG-welding (SMAW) is to be preferred with an appropriate active shielding gas such as M21 (approx. 80% argon, 20% carbon dioxide).

Some suitable consumables for various fusion-welding processes are tabulated below:

Welding process	EN ISO (*)	ESAB	Elga	Böhler Welding
MMA	2560-A; E42 4 B 42 H5	OK 48.00	P 48S	SG3
MAG	14341-A; G 46 2 M21 4Si1	OK Autorod 12.64 OK Aristorod 12.62	Elgamatic 103	Phoenix K 90 S
MCAW	17632-A; T 42 2 M M21 1 H10	OK Tubrod 14.12	Elgacore 71TM	HL 46 T-MC

\* EN ISO classifications given apply to ESAB products. Some of the products listed from other consumable suppliers are not exactly equivalent but will also give welds with satisfactory mechanical properties

For applications where such is deemed necessary, Cromax 280X can be friction welded with good results.

## Corrosion resistance

The chromium layer on Ovako's Cromax products is characterised by a controlled micro-crack distribution with high crack density. This combined with adapted finishing processes provides for a superior level of corrosion resistance. Specifications for corrosion resistance of hard-chrome-plated products are usually based upon salt-spray testing following procedures given in ISO 9227 or equivalent standards (see below), combined with evaluation as stipulated in ISO 10289.

ISO 9227	DIN 50021	ASTM	JIS Z 2371	Salt-spray type
NSS	SS	B 117	NSS	Neutral
AASS	ESS	B 287	AASS	Acetic acid
CASS	CASS	B 368	CASS	Copper-accelerated acetic acid

The relevance of accelerated salt-spray testing for appraisal of the corrosion performance of piston rods in the field is a matter for conjecture. However, the above procedures are accepted and useful for quality control of chrome-plated products. The correlation between results obtained with the various salt-spray types is not always clear but our experience is that a given degree of corrosive attack is achieved about twice as fast in an AASS-test in comparison with testing in NSS.

Every batch of Cromax 280X is tested with 48-hours exposure in acetic-acid salt spray. The standard acceptance requirement is rating 9 or better. The corresponding exposure in neutral salt spray is 96 hours but the prolonged test time normally precludes control of each and every batch. Upon request, other corrosion-resistance requirements involving testing in AASS or in NSS can be met.

## Cromax C and NiKrom®

For applications where piston rods are exposed to aggressive environments and/or remain extended for long periods of time, Ovako offers coatings with a corrosion performance which is superior even to the already high level offered by standard Cromax 280X.

Cromax C is a product with a thicker layer of chrome which is plated in two steps. The coating normally comprises two chrome layers with thickness 20 + 20 µm and the acceptance level for corrosion resistance is rating 9 or better after 100 hours exposure in AASS. Apart from these features, Cromax 280X with C-execution has the same characteristics and properties as for standard Cromax 280X with a single layer of chrome.

In NiKrom execution, a standard chrome layer with minimum thickness 20 µm is combined with an underlying layer of nickel with minimum thickness 30 µm (NiKrom 500) or 10 µm (NiKrom 150). The nickel layer, which is comparatively soft and thereby defect-free, provides for outstanding performance when piston rods are exposed to aggressive environments. In AASS-testing, the acceptance criteria for NiKrom 500 and 150 are no attack (rating 10) after exposure for respectively 500 hours or 150 hours. In spite of the extended exposure times, every manufactured batch is tested to confirm its conformance to the stipulated high levels of corrosion resistance. The product NiKrom® is presented in more detail in a separate data sheet.

## Packaging

Suitable packaging is essential to conserve the fine finish of Cromax products and to prevent damage during transport and handling. Standard packing is in tough, durable plastic sleeves but the bars can if required be supplied packed in cardboard tubes. Additional packing protection, in wooden boxes or pallets for example, is dependent on the mode of transport and final destination of the order.

Cromax 280X is packed in blue plastic sleeves which are marked with information permitting complete traceability (product name, dimension, heat number, manufacturing batch number etc) at regular intervals along the length of the bar.

## Contact us

E-mail: [info.cromax@ovako.com](mailto:info.cromax@ovako.com)

Tel: +46 (0)8 622 1300

[www.ovako.com/en/contact/](http://www.ovako.com/en/contact/)

## Disclaimer

*The information in this document is for illustrative purposes only. The data and examples are only general recommendations and not a warranty or a guarantee. The suitability of a product for a specific application can be confirmed only by Ovako once given the actual conditions. The purchaser of an Ovako product has the responsibility to ascertain and control the applicability of the products before using them. Continuous development may necessitate changes in technical data without notice. This document is only valid for Ovako material. Other material, covering the same international specifications, does not necessarily comply with the properties presented in this document.*