

# CROMAX<sup>®</sup> IH 482

Induction-hardened,  
hard-chrome bar



**OVAKO**

Induction-hardened **Cromax® IH 482** is based on a medium carbon, micro-alloyed steel, which is characterised by high strength in the as-rolled condition, i.e. without heat treatment. The 482 base steel is a cost-effective alternative to traditional low-alloy, quenched and tempered grades with, in the context of piston-rod applications, equivalent properties.

The analysis of the base steel in Cromax IH 482 is well adapted to induction hardening and a high and uniform hardness is achieved throughout the case irrespective of diameter. In consequence, the resistance to even high-energy external impact is excellent.

### Average chemical analysis Cromax® IH 482

C %	Si %	Mn %	S %	V %	C.E. %(*)
0.39	0.40	1.20	0.02	0.13	max 0.72

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

### Corresponding standards

The table shows the closest equivalent standard for the steel in Cromax IH 482. In most cases, the correspondence is only approximate.

Cromax	EN	DIN	AFNOR	SAE/ASTM
482	38MnVS6	38MnSiVS5	30MV6	1045V

### Mechanical properties

Yield stress, $R_{p0.2}$ , N/mm <sup>2</sup> , min.	Ultimate tensile stress, $R_m$ , N/mm <sup>2</sup>	Elongation, $A_5$ , %, min.	Hardness, HB	Toughness, KV
580	850 - 1000	14	250 - 300	No guarantee given, but normally 15-30 J at 20°C

### Chrome layer

The thickness of the chrome layer is minimum 20 µm.

### 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, induction hardening

The chrome layer hardness is 850 HV<sub>0.1</sub> min. The surface hardness in the induction-hardened zone immediately beneath the chrome layer is 55 HRC min.

The depth of hardening, which is defined as the distance from the steel/chrome interface at which the hardness has dropped to 400 HV<sub>5</sub>, is dependent on diameter as tabulated below:

Size, φ mm	Hardening depth, mm
≤ 28	1.0 - 1.5
> 28 - 40	1.3 - 1.7
> 40	1.7 - 2.3

Other hardening depths can be supplied by special arrangement.

### Straightness

The maximum deviation is 0.2 mm/1.0 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 upon request (narrowest range is ISO level 7).

### Tolerance ranges

Size, mm	ISO f7, µm	
	upper	lower
> 18 - 30	- 20	- 41
> 30 - 50	- 25	- 50
> 50 - 80	- 30	- 60
> 80 - 120	- 36	- 71
> 120 - 180	- 43	- 83

### Standard sizes

Dia., mm	kg/m	Dia., mm	kg/m	Dia., inch	kg/m
25	3.85	60	22.19	1	3.97
28	4.83	63	24.47	1 1/4	6.22
30	5.55	65	26.05	1 1/2	8.94
32	6.31	70	30.21	1 3/4	12.19
35	7.55	75	34.68	2	15.91
36	7.99	80	39.46	2 1/4	20.13
38	8.90	85	44.54	2 1/2	24.87
40	9.86	90	49.94	2 3/4	30.09
42	10.88	100	61.65	3	35.81
45	12.48	110	74.60	3 1/4	42.03
50	15.41	120	88.78	3 1/2	48.72
55	18.65	125	96.33	4	63.65
56	19.33			4 1/2	80.55

Other sizes can be supplied upon request but only within the range 12-140 mm inclusive.

### Delivery lengths

Production lengths are between 4.0-7.6 m. Standard is 6.1+0.1/-0 m. Bars with length 7.6+0.1/-0 m can only be supplied for diameters between 40-80 mm.

The "unchromed length" of each bar, i.e. the distance at each end over which the chrome-layer properties and tolerances can not be guaranteed, is at most 0.15 m per end, i.e. 0.3 m in total per bar.

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

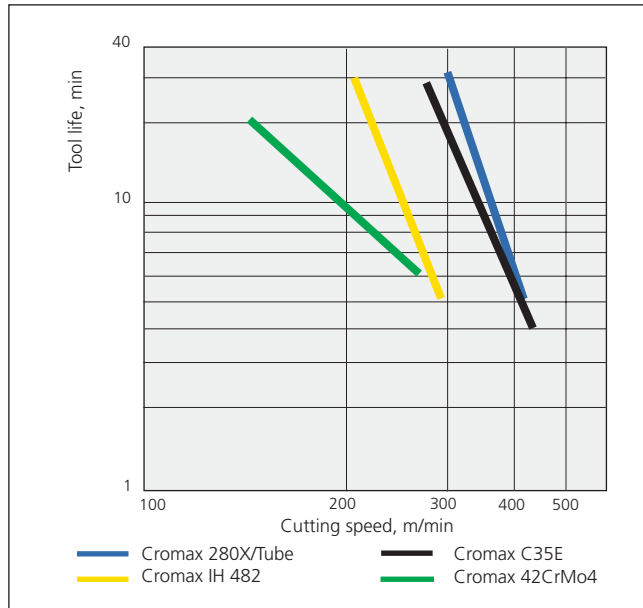
### Weldability

Cromax IH 482 can be MMA or MAG welded at elevated temperature. Preheating to 200-300°C is recommended; however, the upper limit should not be exceeded because of risk for deterioration of the chrome layer.

Cromax IH 482 can normally be friction welded without problems. Special procedures may, however, be necessary for larger diameters.

## Machinability

The machinability of Cromax products in turning is compared in the diagram below. Coated carbide tool Sandvik SNMG 120408-PM-4015. Feed 0.4 mm/r. Cutting depth 2 mm. Wear criterion 0.4 mm. Cutting fluid: Peralube 0125 5%.



Specific machining recommendations for turning and threading of Cromax IH 482 (base steel) 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	180 – 230	230 – 280	120 – 150

### Turning of induction-hardened layer

Best results are obtained with mixed ceramic inserts. However, it is possible to use a coated cemented carbide insert with high wear resistance. Recommended data are tabulated below.

Tool	Speed, m/min	Feed, mm/r	Depth of cut, mm
Mixed ceramic, dry machining	120 - 140	0.08	2 - 3
Cemented carbide with cutting fluid	40 - 45	0.2	2 - 3

For further information, please ask for Cromax Technical Report on machinability testing of induction-hardened piston-rod material.

### Corrosion resistance

The chromium layer generated in hard-chrome plating contains micro-cracks and its corrosion resistance is thereby limited. Ovako's Cromax products are characterised by a controlled micro-crack distribution with high crack density, which in combination with specially adapted finishing procedures, provides for superior corrosion resistance.

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.

Cromax in standard execution is guaranteed to attain rating 9 or better after 40 h in AASS test. The same rating will be achieved in NSS test after about 100 h.

### Packaging

Cromax IH 482 can be supplied with three different packaging options:

- Paper tubes with characteristic blue and yellow spiral stripes.
- Yellow 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.

Irrespective of mode of packaging, every Cromax bar is marked with product and batch information so as to facilitate full traceability.

### Other Cromax products

Ovako's hard-chrome product programme also comprises:

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



**CROMAX® C, Ni-CROMAX®**

*When the application demands a higher corrosion resistance than afforded by standard Cromax, then Cromax C or Ni-Cromax execution is recommended.*

*Cromax C is guaranteed for min. rating 9 after 100h in ISO 9227, AASS. Ni-Cromax is guaranteed not to corrode at all (rating 10) after 350h in AASS or 1 000h in NSS.*

*In order to distinguish from standard execution, Cromax C is supplied in a red plastic sleeve. Ni-Cromax is characterised by white plastic or a white paper tube.*

*Ni-Cromax execution is described in more detail in a separate data sheet.*

We reserve the right to make changes to dimensions, tolerances and other data given in this sheet.

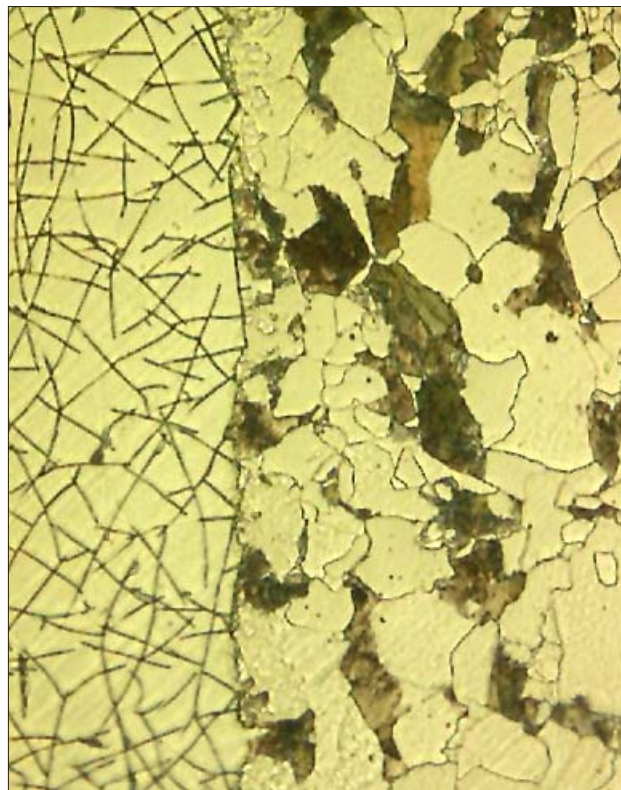
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**Ovako** is a leading European producer of special steel long products for the automotive and engineering industries. Deliveries in 2005 exceeded 1.6 million tons and comprised low-alloy and carbon steels in the form of bars, wire rod, tubes, rings 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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