# CROMAX® 42CrMo4

## Quenched-and-tempered, hard-chrome bar


OVAKO

Quenched-and-tempered **Cromax® 42CrMo4** is manufactured from the standard low-alloy chromium-molybdenum steel. The product finds application where there is a requirement for elevated strength in combination with a defined and high level of toughness.

**Average chemical analysis Cromax® 42CrMo4**

| C % | Si % | Mn % | S % | Cr % | Mo % |
|---|---|---|---|---|---|
| 0.42 | 0.25 | 0.80 | 0.02 | 1.05 | 0.20 |

## Corresponding standards

The table shows the closest equivalent standard for the steel in Cromax 42CrMo4.

| Cromax | EN | DIN | BS | AFNOR | SAE/ASTM |
|---|---|---|---|---|---|
| 42CrMo4 | 42CrMo4+QT | 42CrMo4V | 708M40 | 42CD4 | 4140 |

## Mechanical properties

Quenched and tempered in accordance with EN 10083-1 + A1. Other heat-treatment conditions can be supplied by special arrangement.

| Size (ϕ), mm | Yield stress, $R_{p0,2}$, N/mm², min. | Ultimate tensile stress, $R_m$, N/mm² | Elongation, $A_5$, %, min. | Hardness, HB | Toughness, KV, Joule, min. |
|---|---|---|---|---|---|
| < 40 | 750 | 1000 - 1200 | 11 | 295 - 355 | 35 at 20 °C |
| 40 - 95 | 650 | 900 - 1100 | 12 | 265 - 325 | 35 at 20 °C |
| > 95 | 550 | 800 - 950 | 13 | 235 - 295 | 35 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 $HV_{0.1}$.

Cromax 42CrMo4 can be supplied in an induction-hardened execution. In such a case, the hardness immediately beneath the chrome layer is 55 HRC min., and the depth of hardening is between 1.0 and 3.0 mm depending on dimension.

However, for applications requiring a surface-hardened execution, Cromax IH 482, induction-hardened hard-chrome bar is recommended.

## 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 |

## 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 | | | 3 1/2 | 48.72 |
| 55 | 18.65 | | | 4 | 63.65 |
| 56 | 19.33 | | | | |

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

## 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.

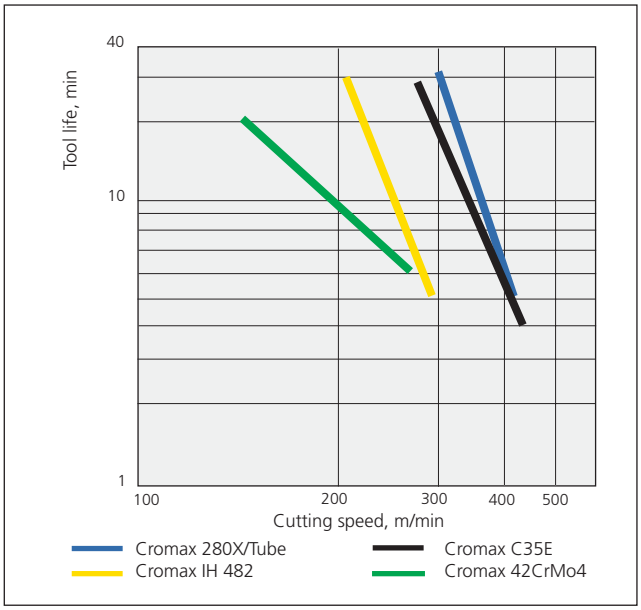
## Weldability

Cromax 42CrMo4 has only limited weldability. Preheating to 200-300°C is strongly recommended; the upper limit should not be exceeded because of risk for deterioration of the chrome layer.

Cromax 42CrMo4 can be friction welded. However, precautions are necessary so as to limit the formation of undesirable micro-structures in the welded zone.

## 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 42CrMo4 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 | 130 – 180 | 180 – 230 | 110 – 140 |

## 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 40h in AASS test. The same rating will be achieved in NSS test after about 100h.

## Packaging

Cromax 42CrMo4 can be supplied with three different packaging options:

- Paper tubes with the characteristic blue and yellow spiral stripes.
- Green 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 roll-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,
- induction-hardened bar, Cromax IH 482, 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.*

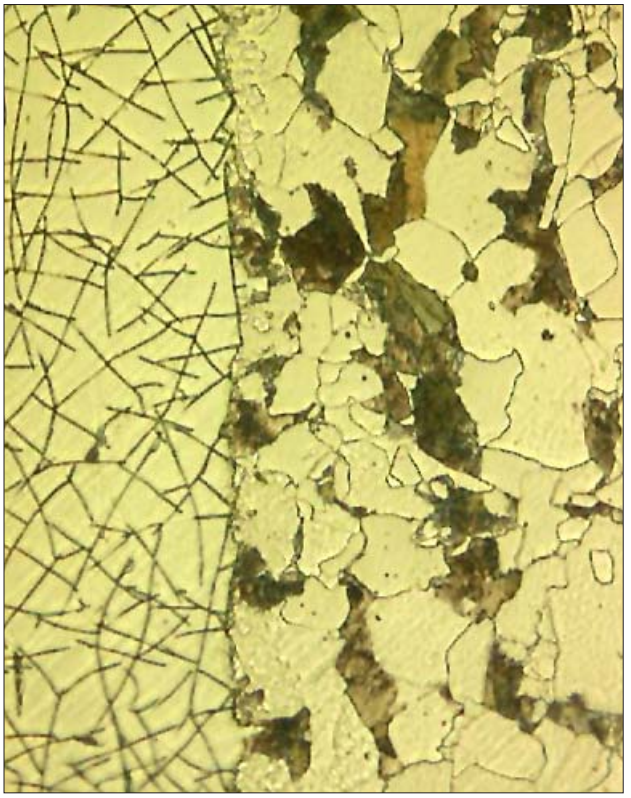
*Ni-Cromax execution is described in more detail in a separate data sheet.*

**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.



APRIL 2006

Inset cover illustrations by courtesy of Atlas Copco AB.

**Ovako Cromax AB**
Box 5013
SE-194 05 UPPLANDS VÄSBY
Sweden
Tel. +46 8 622 13 00
Fax. +46 8 622 13 28

**Ovako Hallstahammar AB**
Box 505
SE-734 27 HALLSTAHAMMAR
Sweden
Tel. +46 220 23 000
Fax. +46 220 10 207

**Ovako Mora AB**
Box 421
SE-792 27 MORA
Sweden
Tel. +46 250 28 400
Fax. +46 250 28 420

**Ovako Twente B.V.**
Box 867
NL-7600 AW ALMELO
The Netherlands
Tel. +31 546 588 666
Fax. +31 546 588 602

**Ovako Redon SAS**
Avenue des Nouies, B.P.10308
F-35603 REDON CEDEX
France
Tel. +33 299 714 168
Fax. +33 299 721 520

**Ovako Molinella S.p.A.**
Via F.Turati, 11
I-40062 MOLINELLA (BO)
Italy
Tel. +39 051 690 03 32
Fax. +39 051 880 482

OVAKO

www.ovako.com