

# CROMAX<sup>®</sup> TUBE

Hard-chrome-plated tube



**OVAKO**

The starting material for **Cromax® TUBE** is either hot-finished or cold-drawn tube in a microalloyed, low-carbon weldable steel of 20MnV6-type. Cromax Tube exhibits a good combination of strength and toughness along with excellent machinability and weldability.

### Average chemical analysis Cromax® TUBE

C %	Si %	Mn %	S %	V %	C.E. %(*)
0.19	0.35	1.50	0.02	0.11	0.55 max.

\*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 TUBE.

Cromax TUBE	EN	DIN	BS	AFNOR	ASTM
	20MnV6	20MnV6	55M	E420	A572

### Mechanical properties

Yield stress, R <sub>eH</sub> , N/mm <sup>2</sup> , min.	Ultimate tensile stress, R <sub>m</sub> , N/mm <sup>2</sup>	Elongation, A <sub>5</sub> , %, min.	Hardness, HB	Toughness, KV, Joule, min.
450	550 - 800	20	160 - 240	27 at - 20°C

### Chrome layer

The chrome layer thickness is 20 µm min.

### 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<sub>0.1</sub> min.

### Straightness

The maximum deviation is 0.3 mm/1.0 m.

### OD roundness

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

### OD tolerance

ISO f8 is standard. Other tolerances can be supplied upon request (narrowest range is ISO level 7).

### Tolerance ranges for OD

Size, mm	upper	ISO f8, µm	lower
> 18 - 30	- 20		- 53
> 30 - 50	- 25		- 64
> 50 - 80	- 30		- 76
> 80 - 120	- 36		- 90
> 120 - 180	- 43		- 106

### ID tolerance

This is determined by the tolerances for OD and wall thickness.

### Wall tolerances

No guarantee can be given with respect to eccentricity or wall thickness tolerance. Typical levels are ±5% for wall thickness and ±10% (of average wall thickness) for eccentricity.

### Delivery lengths

Cromax TUBE is normally supplied with length 6.1+0.1/-0 m. Lengths of up to 7.6 +0.1/-0 m can be supplied by special agreement.

The "unchromed length" of each tube, 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 tube.

Fixed, cut lengths can be supplied if required, but with a price premium over production lengths.

### Typical dimensions

The table below shows dimensions, which are produced relatively frequently and which are often available from stock. Other dimensions can be supplied but delivery time will always be longer and a commitment to purchase a specified minimum quantity will normally be required.

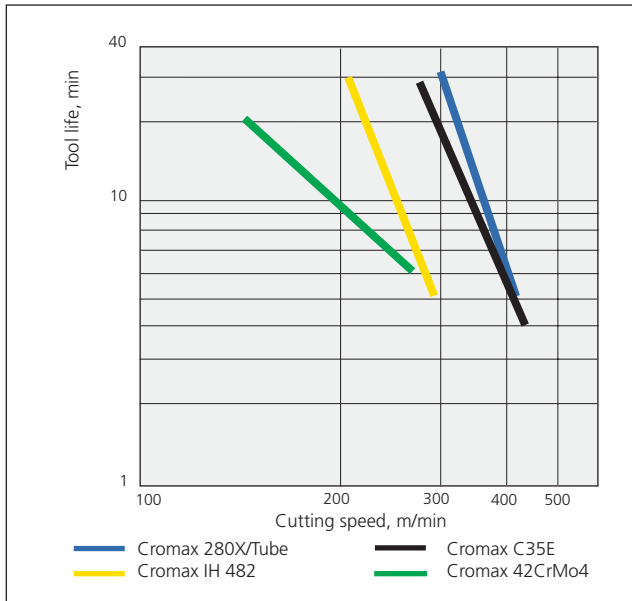
OD x ID mm	kg/m	OD x ID mm	kg/m
30 x 16	3.97	60 x 40	12.33
30 x 20	3.08	63 x 32	18.16
32 x 16	4.73	70 x 42	19.33
35 x 20	5.09	70 x 49	15.41
40 x 20	7.40	75 x 50	19.27
40 x 24	6.31	80 x 56	20.12
40 x 28	5.03	90 x 60	27.74
45 x 25	8.63	100 x 70	31.44
45 x 29	7.30	110 x 71	43.52
50 x 28	10.58	125 x 87	49.66
50 x 34	8.29	140 x 101	57.94
55 x 35	11.10		
60 x 32	15.88	<b>OD x ID, inch</b>	<b>kg/m</b>
		3 x 2	19.89
		3 1/2 x 2 1/2	23.86

### Weldability

The steel in Cromax TUBE has excellent weldability and does not normally require preheating. Suitable consumables are OK 48.00/38.84 for MMA welding and OK 12.64 for MAG welding (shielding gas 80% Ar, 20% CO<sub>2</sub>).

## 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 TUBE 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

## 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 TUBE can be supplied with three different packaging options:

- Paper tubes with the characteristic blue and yellow spiral stripes.
- Blue plastic sleeve, which can be left on as protection during piston-rod manufacture.
- Plastic spacer rings.


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

Irrespective of mode of packaging, every tube 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
- quenched and tempered bar, Cromax 42CrMo4.




### 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.*



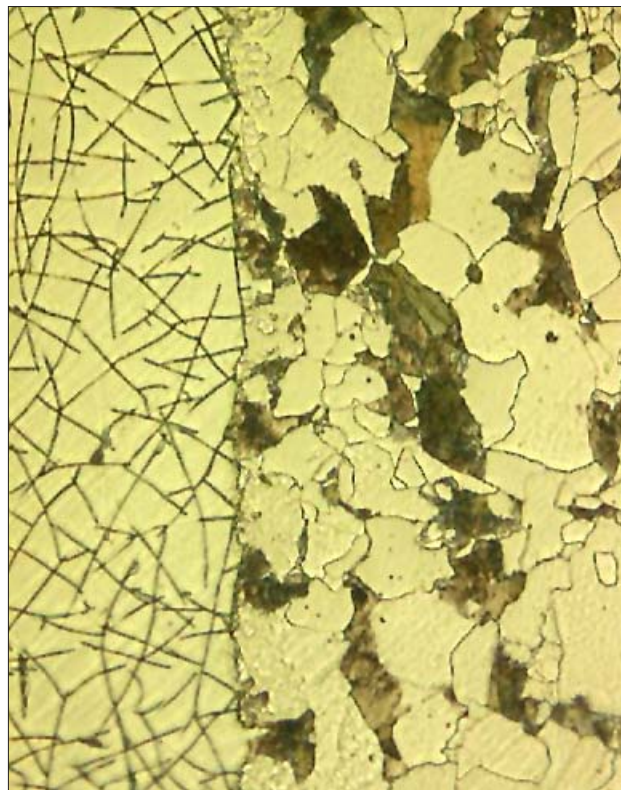
We reserve the right to make changes to dimensions, tolerances and other data given in this sheet.

**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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