

# Uddeholm

# Corrax<sup>®</sup>

## Uddeholm Corrax®

Uddeholm Corrax stainless moulds steel has a unique set of properties that makes it the ultimate choice in a large number of demanding applications. Its superior resistance to corrosion combined with a hardness of up to 50 HRC makes it perfectly suited for moulds making:

- medical parts
- parts made of corrosive plastics, i.e. PVC
- parts made of rubber as well as for moulds running in clean room environment

The mould user can count on two major advantages: The outstanding stainless properties of Uddeholm Corrax cut maintenance costs dramatically. Constant cycle time can be kept during very long runs of production. The mould maker benefits greatly by the very simple heat treatment needed to get hardnesses from 32 to 50 HRC.

Uddeholm Corrax is a part of the Uddeholm Stainless Concept.

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This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as a warranty of specific properties of the products described or a warranty for fitness for a particular purpose.

Classified according to EU Directive 1999/45/EC  
For further information see our "Material Safety Data Sheets".

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## GENERAL

Compared with conventional corrosion resistant tool steel, Uddeholm Corrax has the following advantages:

- Flexible hardness, 34–50 HRC, achieved by an ageing treatment in the temperature range 425–600°C (790–1110°F)
- Extremely good dimensional stability during the ageing
- High uniformity of properties also for large dimensions
- Very good weldability, no preheating necessary
- No hard “white” layer after EDM
- Corrosion resistance superior to that of AISI 420 and W.-Nr. 1.2083

Typical analysis %	C	Si	Mn	Cr	Ni	Mo	Al
	0.03	0.3	0.3	12.0	9.2	1.4	1.6
Delivery condition	Solution treated to ~34 HRC						
Colour code	Black/grey						

## APPLICATIONS

- Injection moulds for
  - corrosive plastics
  - rubber
  - medical and food industry
- Extrusion dies
- Plastic processing
  - screws
- Engineering parts



## PROPERTIES

### PHYSICAL DATA

Aged to approx. 46 HRC.

Temperature	20°C (68°F)	200°C (390°F)	400°C (750°F)
Density kg/m <sup>3</sup> lbs/in <sup>3</sup>	7 700 0.28	– –	– –
Modulus of elasticity N/mm <sup>2</sup> psi	200 000 29 x 10 <sup>6</sup>	190 000 28 x 10 <sup>6</sup>	170 000 25 x 10 <sup>6</sup>
Coefficient of thermal expansion per°C from 20°C per°F from 68°F	– –	11.7 x 10 <sup>-6</sup> 6.5 x 10 <sup>-6</sup>	12.3 x 10 <sup>-6</sup> 6.8 x 10 <sup>-6</sup>
Thermal conductivity W/m °C Btu in/ft <sup>2</sup> h °F	– –	18 125	21 146

### MECHANICAL DATA

Tensile strength at room temperature.

	Solution treated ~34 HRC	Aged to ~40 HRC	Aged to ~46 HRC	Aged to ~50 HRC
Yield strength R <sub>p0.2</sub> N/mm <sup>2</sup> psi	700 100 000	1 000 150 000	1 400 200 000	1 600 230 000
Tensile strength R <sub>m</sub> N/mm <sup>2</sup> psi	1 100 160 000	1 200 170 000	1 500 220 000	1 700 250 000
Elongation A <sub>5</sub> %	15	15	11	10

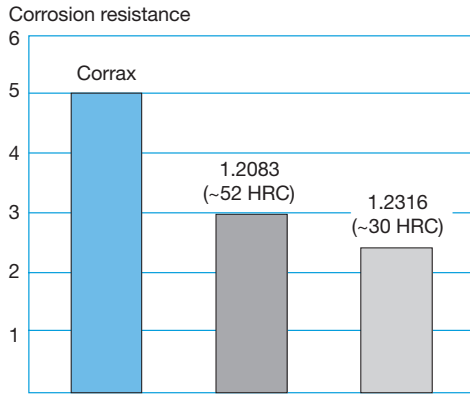
Compressive strength at room temperature.

	Solution treated ~34 HRC	Aged to ~40 HRC	Aged to ~46 HRC	Aged to ~50 HRC
R <sub>c0.2</sub> N/mm <sup>2</sup> psi	900 130 000	1 300 190 000	1 600 230 000	1800 260 000

*Production of PVC tubes or fittings places very high demands on the corrosion resistance of the mould. Uddeholm Corrax is a suitable mould steel for this application.*

## CORROSION RESISTANCE

Uddeholm Corrax has a very good corrosion resistance, better than the corrosion resistant standard grades used for plastic moulding. The corrosion resistance is the same in all heat treated conditions (except after nitriding).



Uddeholm Corrax will withstand attacks from most corrosive plastics and diluted acids.

A mould made of Uddeholm Corrax will also have good resistance to humid working and storage conditions. Uddeholm Corrax also shows better resistance to stress corrosion cracking than standard hardenable corrosion resistant steel grades.

## HEAT TREATMENT

Uddeholm Corrax is delivered in solution treated condition and can be used in the as-delivered condition. When, however, the steel is to be heat treated to a higher hardness, the following instructions may be helpful.

### STRESS RELIEVING

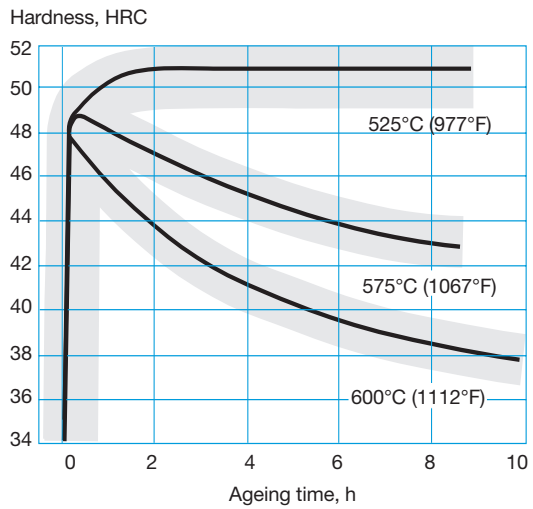
Stress relieving can not be performed as for other steel grades since an increase in temperature results in a higher hardness because of ageing effect.

### AGEING

Uddeholm Corrax can be used in as-delivered condition.

Higher hardness is obtained by ageing. Suitable ageing parameters can be obtained from the

figure below. Ageing time means the time at the ageing temperature after the tool is fully heated through.



When the ageing time is reached, cool the tool in air to room temperature. Ageing at high temperature gives a better toughness compared with ageing to the same hardness at a lower temperature.

### AGEING RECOMMENDATION

Ageing temperature/time	Hardness
525°C/4 h (977°F/4 h)*	49–52 HRC
575°C/4 h (1067°F/4 h)	44–47 HRC
600°C/4 h (1112°F/4 h)	40–43 HRC

\* Ageing 49–52 HRC is only recommended when toughness is not important

If Uddeholm Corrax is used at temperatures higher than 200°C (390°F) the solution treated condition (delivery condition) is not recommended because ageing can occur during use.

### SOLUTION TREATMENT

It is possible to solution treat Uddeholm Corrax, if aged, in order to get back to the delivery condition.

Solution treatment should be done at 850°C (1560°F), holding time 30 minutes. Cool in air.

## DIMENSIONAL CHANGE

Ageing results in a small and uniform decrease in volume. The following shrinkage can be expected during ageing.

Ageing	Dimensional change %		
	Longitudinal direction	Transversal direction	Short transversal direction
525°C/4 h (977°F/4 h) ~50 HRC	-0.07	-0.07	-0.07
575°C/4 h (1067°F/4 h) ~46 HRC	-0.09	-0.09	-0.09
600°C/4h (1112°F/4h) ~40 HRC	-0.14	-0.14	-0.14

## CUTTING DATA RECOMMENDATIONS

The cutting data below are to be considered as guiding values which must be adapted to existing local conditions. More information can be found in the Uddeholm publication “Cutting data recommendations”.

*The recommendations, in the following tables, are valid for Uddeholm Corrax in solution treated condition approx. 34 HRC.*

## TURNING

Cutting data parameters	Turning with carbide		Turning with high speed steel
	Rough turning	Fine turning	Fine turning
Cutting speed ( $v_c$ ) m/min f.p.m.	110–160 360–525	160–210 525–690	13–18 43–59
Feed (f) mm/rev i.p.r.	0.2–0.4 0.008–0.016	0.05–0.2 0.002–0.008	0.05–0.2 0.002–0.008
Depth of cut ( $a_p$ ) mm inch	2–4 0.08–0.16	0.5–2 0.02–0.08	0.5–3 0.02–0.12
Carbide designation ISO	P20–P40 Coated carbide	P10 Coated carbide or cermet	–

## MILLING

### FACE- AND SQUARE SHOULDER MILLING

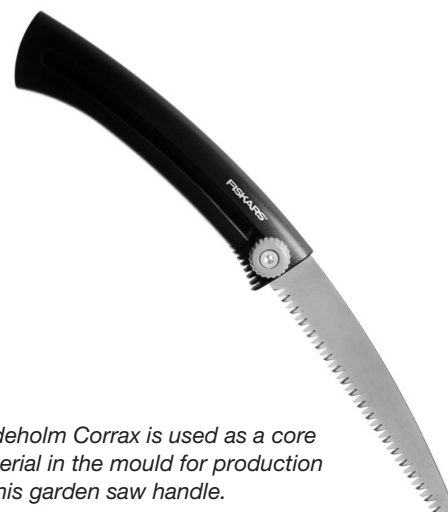
Cutting data parameters	Milling with carbide	
	Rough milling	Fine milling
Cutting speed ( $v_c$ ) m/min f.p.m.	70–90 230–295	90–110 295–360
Feed ( $f_z$ ) mm/tooth inch/tooth	0.2–0.4 0.008–0.016	0.1–0.2 0.004–0.008
Depth of cut ( $a_p$ ) mm inch	2–5 0.08–0.20	–2 –0.08
Carbide designation ISO	P20–P40 Coated carbide	P10–P20 Coated carbide or cermet

### END MILLING

Cutting data parameters	Type of milling		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed ( $v_c$ ) m/min f.p.m.	60–100 200–328	70–110 230–360	20–25 <sup>1)</sup> 66–82 <sup>1)</sup>
Feed ( $f_z$ ) mm/tooth inch/tooth	0.006–0.20 <sup>2)</sup> 0.0002–0.008 <sup>2)</sup>	0.06–0.20 <sup>2)</sup> 0.002–0.008 <sup>2)</sup>	0.01–0.35 <sup>2)</sup> 0.0004–0.014 <sup>2)</sup>
Carbide designation ISO	–	P20–P30	–

<sup>1)</sup> For coated HSS end mill  $v_c = 35–45$  m/min. (115–148 f.p.m.)

<sup>2)</sup> Depending on radial depth of cut and cutter diameter



*Uddeholm Corrax is used as a core material in the mould for production of this garden saw handle.*

## DRILLING

### HIGH SPEED STEEL TWIST DRILL

Drill diameter		Cutting speed (v <sub>c</sub> )		Feed (f)	
mm	inch	m/min	f.p.m.	mm/rev	i.p.r.
– 5	–3/16	13–15*	43–49*	0.05–0.10	0.002–0.004
5–10	3/16–3/8	13–15*	43–49*	0.10–0.20	0.004–0.008
10–15	3/8–5/8	13–15*	43–49*	0.20–0.25	0.008–0.010
15–20	5/8–3/4	13–15*	43–49*	0.25–0.30	0.010–0.012

\* The same cutting speed when using coated HSS drill  
v<sub>c</sub> = 13–15 m/min. (43–49 f.p.m.)

### CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip <sup>1)</sup>
Cutting speed (v <sub>c</sub> ) m/min f.p.m.	180–200 590–656	100–130 328–427	50–70 164–230
Feed (f) mm/rev i.p.r.	0.05–0.15 <sup>2)</sup> 0.002–0.006 <sup>2)</sup>	0.10–0.25 <sup>2)</sup> 0.004–0.01 <sup>2)</sup>	0.15–0.25 <sup>2)</sup> 0.006–0.01 <sup>2)</sup>

<sup>1)</sup> Drill with replaceable or brazed carbide tip

<sup>2)</sup> Depending on drill diameter

## GRINDING

A general grinding wheel recommendation is given below. More information can be found in the Uddeholm publication “Grinding of Tool Steel”.

Type of grinding	Delivery condition and aged condition
Face grinding straight wheel	A 46 GV
Face grinding segments	A 36 FV
Cylindrical grinding	A 60 JV
Internal grinding	A 60 IV
Profile grinding	A 120 JV

When good surface finish is required a SiC-wheel could be an alternative.

## PHOTO-ETCHING

Uddeholm Corrax has a very good corrosion resistance and a special process is thus required for chemical photo-etching. Fine patterns with shallow depths <0.04 mm (0.002") are readily achievable.

## EDM

Uddeholm Corrax can be EDM'd in the same way as ordinary tool steels. The “white layer” will, however, not be as hard and is therefore more easily removed.

## WELDING

Preheating is not necessary. When welding on Uddeholm Corrax in delivery condition, intermittent welding is recommended.

In order to obtain an even hardness, it is necessary to carry out a heat treatment after welding. The temperature and time are determined by the required hardness and the filler material. Corrax TIG-Weld is recommended to be used as filler material.

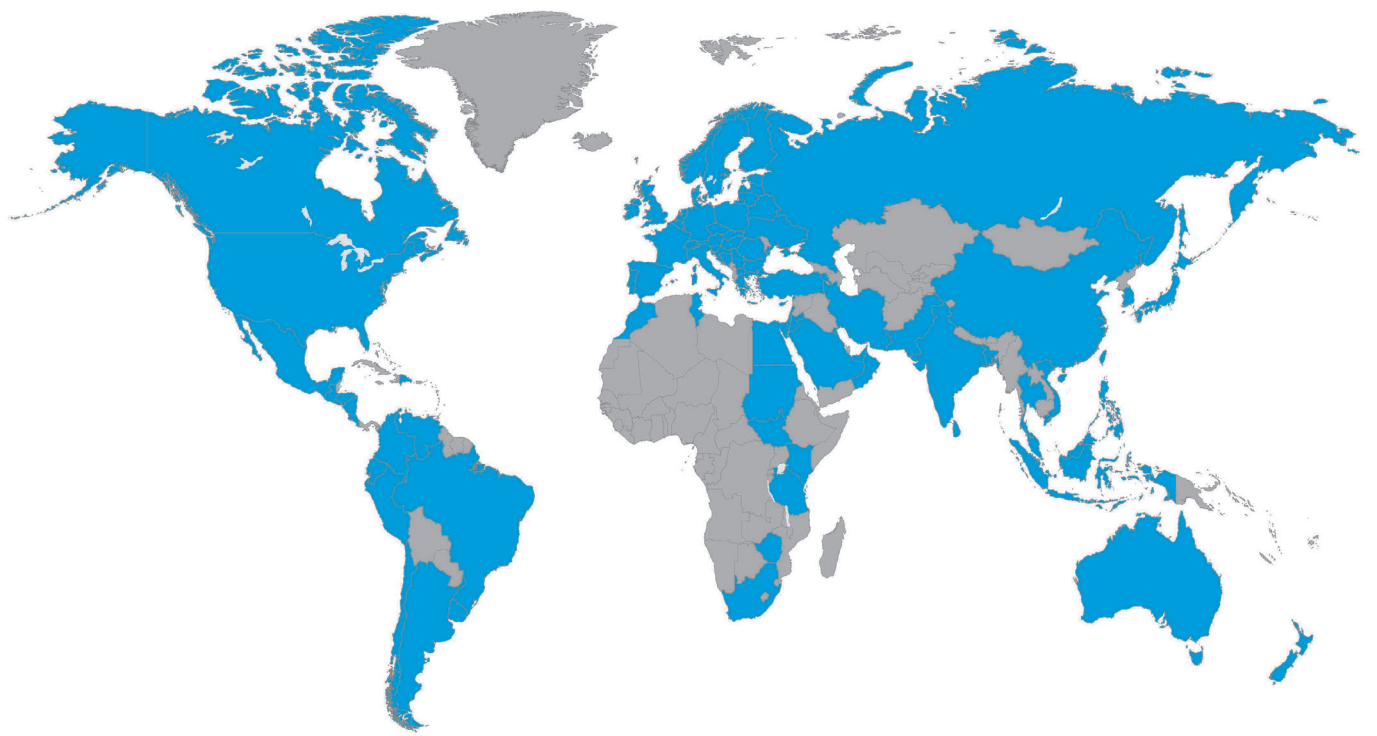
For further information, please contact your local Uddeholm office.

## PROPERTY COMPARISON CHART

Uddeholm steel grade	Hardness HRC	Wear resistance	Corrosion resistance
Corrax	34		
Corrax	50		
Mirrax ESR	50		
Stavax ESR	52		
Elmax	58		
Ramax HH	37		
Impax Supreme	32		

## FURTHER INFORMATION

Please, contact your local Uddeholm office for further information on the selection, heat treatment, application and availability of Uddeholm tool steels.



## **NETWORK OF EXCELLENCE**

Uddeholm is present on every continent. This ensures you high-quality Swedish tool steel and local support wherever you are. We secure our position as the world's leading supplier of tooling materials.

Uddeholm is the world's leading supplier of tooling materials. This is a position we have reached by improving our customers' everyday business. Long tradition combined with research and product development equips Uddeholm to solve any tooling problem that may arise. It is a challenging process, but the goal is clear – to be your number one partner and tool steel provider.

Our presence on every continent guarantees you the same high quality wherever you are. We secure our position as the world's leading supplier of tooling materials. We act worldwide. For us it is all a matter of trust – in long-term partnerships as well as in developing new products.

For more information, please visit [www.uddeholm.com](http://www.uddeholm.com)