



# UDDEHOLM RAMAX LH

## TAKING STANDARDS TO A NEW LEVEL

Setting standards is important in the tooling industry. Uddeholm Ramax LH is no exception. It is a first class tool steel for mould bases, with excellent machinability and uniform hardness in all dimensions. This will give you the benefit of reduced tooling cost. In addition, this stainless steel grade prevents corrosion that can clog water cooling channels leading to increased cycle times.

## SHORTER MACHINING TIME

Time is always crucial when it comes to maintaining high productivity. By using Uddeholm Ramax LH you will benefit from optimized alloying content, which leads to greatly improved machinability. This results in a decrease in production time, and therefore reduces your total lead time for completing the mould. This makes it easier for you to meet your customers' demands.

## PART OF UDDEHOLM STAINLESS CONCEPT

With the addition of Uddeholm Ramax LH you can now use Uddeholm grades exclusively in your moulding production. Use Uddeholm Ramax LH for the mould base and use other steel from the Uddeholm Stainless Concept for your inserts to experience the benefits of a completely stainless mould.

Uddeholm Ramax LH is a part of the Uddeholm Stainless Concept.

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".

Edition 2, 10.2008

The latest revised edition of this brochure is the English version, which is always published on our web site [www.uddeholm.com](http://www.uddeholm.com)



SS-EN ISO 9001  
SS-EN ISO 14001

## General

Uddeholm Ramax LH is a new chromium alloyed stainless holder steel, which is supplied in the hardened and tempered condition.

Uddeholm Ramax LH is characterized by:

- outstanding machinability
- good corrosion resistance
- good hardenability
- uniform hardness in all dimensions
- good indentation resistance

Uddeholm Ramax LH is delivered in the hardened and tempered condition to 270–310 HB.

Typical analysis %	C	Si	Mn	Cr	Mo	Ni	V	S	+N
	0.12	1.0	1.45	14.0	0.20	0.36	0.10	0.13	
Delivery condition	Hardened and tempered to ~ 290 HB								
Colour code	Yellow/brown								

## Applications

- Holders/bolsters for plastic moulds
- Plastic and rubber moulds with low requirements on polishability
- Die and calibers for plastic extrusion
- Constructional parts

## Properties

### Physical data

Hardened and tempered to 302 HB. Data at room and elevated temperatures.

Temperature	20°C (68°F)	200°C (390°F)
Density kg/m <sup>3</sup> lbs/in <sup>3</sup>	7 700 0.280	– –
Modulus of elasticity MPa psi	210 000 30.5 × 10 <sup>6</sup>	200 000 29.0 × 10 <sup>6</sup>
Coefficient of thermal expansion per °C from 20°C per °F from 68°F	– –	11.0 × 10 <sup>-6</sup> 6.1 × 10 <sup>-6</sup>
Thermal conductivity* W/m °C Btu in/ft <sup>2</sup> h °F	– –	24 166
Specific heat capacity J/kg °C Btu/lb°F	460 0.110	–

\* Thermal conductivity is very difficult to measure. The scatter can be as high as ±15%.

## Tensile strength

Approximate values. Samples were taken from a bar with dimension 306 x 54 mm in length direction. Hardness 302 HB.

Testing temperature	20°C (68°F)	200°C (390°F)
Tensile strength, Rm N/mm <sup>2</sup> p.s.i	1 015 1.47 × 10 <sup>5</sup>	905 1.31 × 10 <sup>5</sup>
Yield strength, Rp0,2 N/mm <sup>2</sup> p.s.i	860 1.25 × 10 <sup>5</sup>	775 1.12 × 10 <sup>5</sup>
Reduction of area Z, %	45	43
Elongation A5, %	13	13

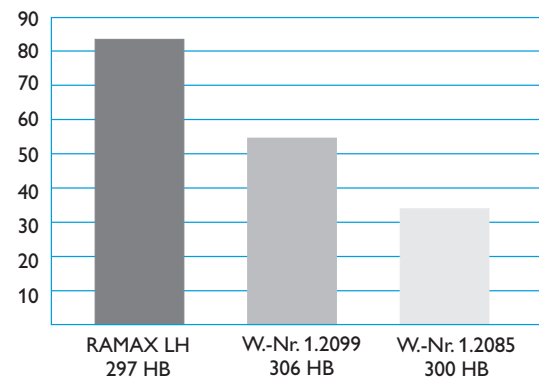
Note: The high sulphur content gives lower mechanical properties in the transverse compared with the longitudinal direction.

## Machinability

The machinability of Uddeholm Ramax LH is outstanding according to the tests shown below.

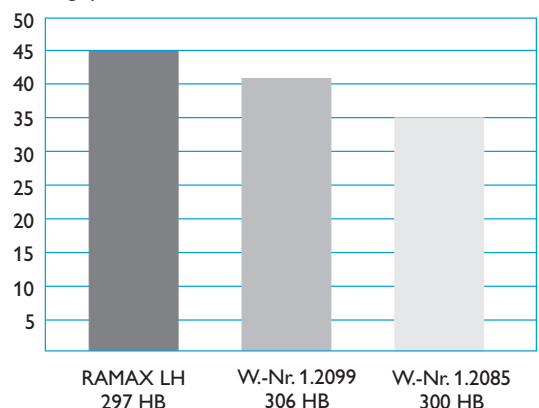
### CAVITY MILLING WITH COATED CARBIDE INSERTS

Milling time, min.



### DRILLING WITH UNCOATED HSS DRILLS

Cutting speed, m/min.



## Corrosion resistance

Holders made from Uddeholm Ramax LH will have good resistance to rusting caused by humid working and storage conditions and when moulding corrosive plastics under normal production conditions.

Uddeholm Ramax LH has a similar corrosion resistance compared with grades of the same type.

## Heat treatment

Uddeholm Ramax LH is intended for use in the as-delivered condition i.e. hardened and tempered to 270–310 HB.

When the steel is to be heat treated to higher hardness, instructions below are to be followed. Note however, that an increased hardness results in a reduced toughness and machinability.

### Soft annealing

Protect the steel and heat through to 740°C (1365°F). Cool at 15°C (30°F) per hour to 550°C (1020°F), then freely in air.

### Stress relieving

After rough machining the tool should be heated through to max. 550°C (1020°F), holding time 2 hours, then cool freely in air.

### Hardening

*Note:* The steel should be soft annealed before hardening.

*Preheating temperature:* 500–600°C (930–1110°F).

*Austenitizing temperature:* 980–1020°C (1795–1870°F).

The steel should be heated through to the austenitizing temperature and held at temperature for 30 minutes.

*Protect the tool against decarburization and oxidation during the hardening process.*

## Quenching media

- Vacuum with sufficient positive pressure
- High speed gas/circulating atmosphere

In order to obtain the optimum properties, the cooling rate should be as fast as possible within acceptable distortion limits. Temper the tool as soon as its temperature reaches 50–70°C (120–160°F).

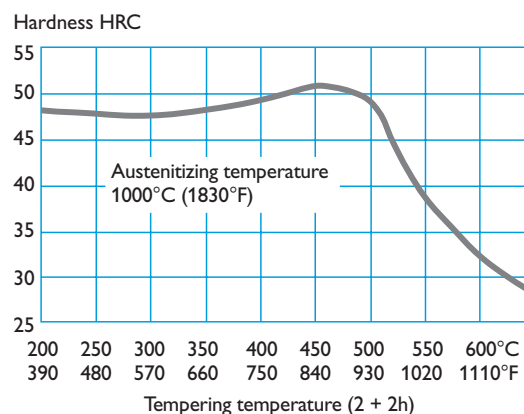
## Tempering

Choose the tempering temperature according to the hardness required by reference to the tempering graph.

Temper twice with intermediate cooling to room temperature. Lowest tempering temperature 250°C (480°F). Holding time at temperature minimum 2 hours.

### TEMPERING GRAPH

Austenitizing temperature: 1000°C (1830°F), 30 minutes. Holding time: 2 x 2 h.



# Machining recommendations

The cutting data below are to be considered as guiding values which must be adapted to existing local conditions.

The recommendations, in following tables, are valid for Uddeholm Ramax LH in hardened and tempered condition to 270–310 HB.

## Turning

Cutting data parameters	Turning with carbide		Turning with HSS Fine turning
	Rough turning	Fine turning	
Cutting speed ( $v_c$ ) m/min. f.p.m.	130–170 430–560	170–210 560–690	18–23 59–75
Feed ( $f$ ) mm/rev. i.p.r.	0.2–0.4 0.008–0.016	–0.3 –0.012	–0.3 –0.012
Depth of cut ( $a_p$ ) mm inch	2–4 0.08–0.16	–2 –0.08	–3 –0.08
Carbide designation ISO	P20–P30 Coated carbide	P10 Coated carbide	–

## Drilling

### HIGH SPEED STEEL TWIST DRILL

Drill diameter		Cutting speed ( $v_c$ )		Feed ( $f$ )	
mm	inch	m/min	f.p.m.	mm/rev	i.p.r.
–5	–3/16	15–17*	49–56*	0.05–0.10	0.002–0.004
5–10	3/16–3/8	15–17*	49–56*	0.10–0.20	0.004–0.008
10–15	3/8 –5/8	15–17*	49–56*	0.20–0.25	0.008–0.010
15–20	5/8 –3/4	15–17*	49–56*	0.25–0.30	0.010–0.012

\* For coated HSS drills  $v_c = 25–27$  m/min. (80–90 f.p.m.)

### CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip <sup>1)</sup>
Cutting speed ( $v_c$ ) m/min. f.p.m.	180–200 590–655	100–120 330–395	70–100 230–330
Feed ( $f$ ) mm/rev. i.p.r.	0.05–0.25 <sup>2)</sup> 0.002–0.01 <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

## 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.	130–170 430–560	170–210 560–690
Feed ( $f_z$ ) mm/tooth in/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 Coated carbide	P10–P20 Coated carbide or cermet

### END MILLING

Cutting data Parameters	Type of milling		
	Solid carbide	Carbide indexable insert	Haigh speed steel
Cutting speed ( $v_c$ ) m/min. f.p.m.	199–130 330–340	120–150 395–490	30–35 <sup>1)</sup> 100–115 <sup>1)</sup>
Feed ( $f_z$ ) mm/tooth in/tooth	0.03–0.20 <sup>2)</sup> 0.001–0.008 <sup>2)</sup>	0.08–0.20 <sup>2)</sup> 0.003–0.008 <sup>2)</sup>	0.05–0.35 <sup>2)</sup> 0.002–0.014 <sup>2)</sup>
Carbide designation ISO	–	P20–P30	–

<sup>1)</sup> For coated HSS end mill  $v_c = 50–55$  m/min. (165–180 f.p.m.)

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

## Grinding

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

### WHEEL RECOMMENDATION

Type of grinding	Annealed condition
Face grinding straight wheel	A 46 HV
Face grinding segments	A 24 GV
Cylindrical grinding	A 60 KV
Internal grinding	A 60 JV
Profile grinding	A 100 KV

## Polishing

As other sulphurized steels the polishability is affected by the higher amount of sulphide inclusions and for that reason Uddeholm Ramax LH should only be used in tools with low to moderate demands on polishability.

## Further information

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

## Welding

Good results when welding tool steel can be achieved if proper precautions are taken during welding (elevated working temperature, joint preparation, choice of consumables and welding procedure).

Welding method	TIG (GTAW)		MMA (SMAW)
Working temperature <sup>1)</sup>	200–250°C (390–480°F)		200–250°C (390–480°F)
Welding consumables	STAVAX TIG-WELD	Austenitic stainless steel Type ER312	Austenitic stainless steel Type ER312
Hardness after welding	54–56 HRC	28–30 HRC	28–30 HRC
Hardness after tempering 1 x 2h at 600°C (1220°F)	41–43 HRC	–	–

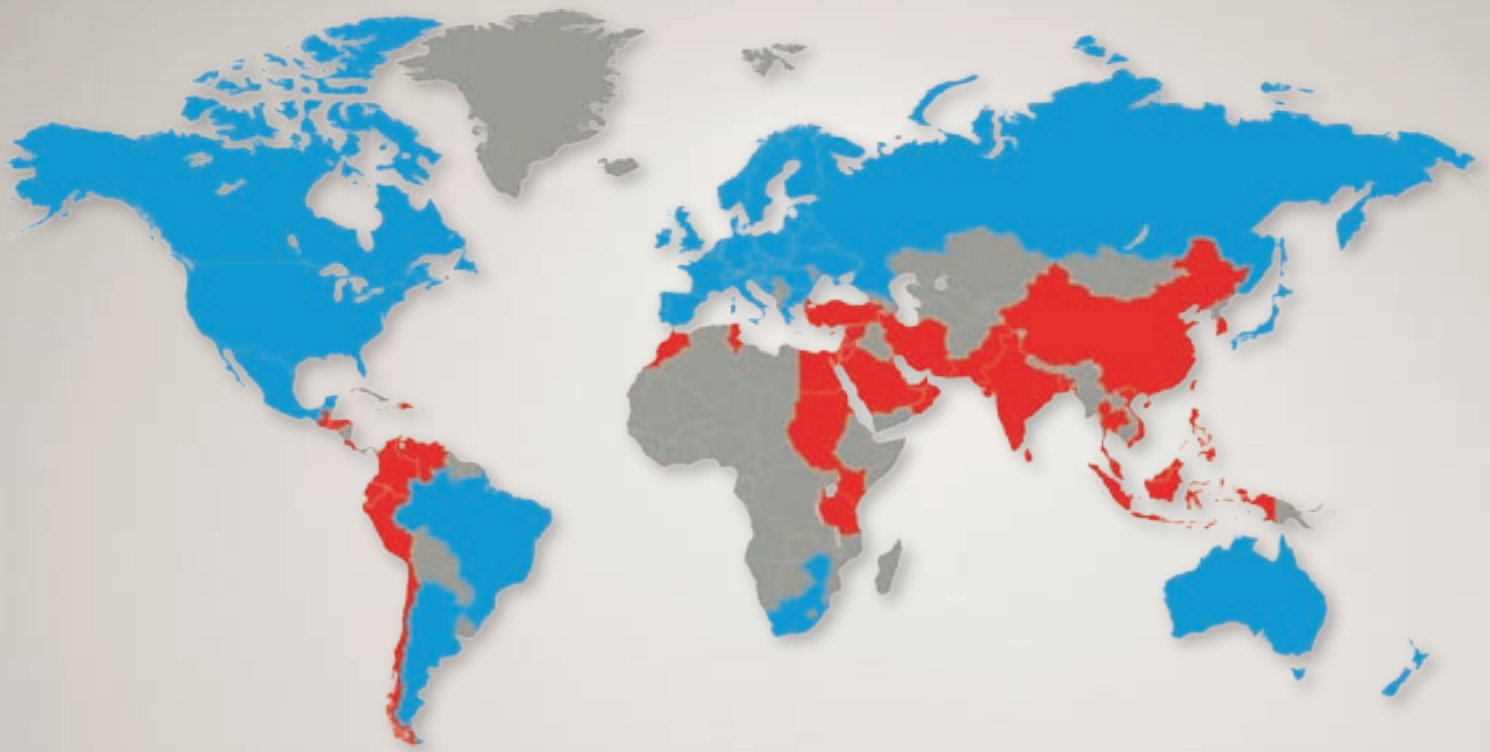
<sup>1)</sup> Minor welding operations can be done without preheating.

Uddeholm Ramax LH has a high sulphur content, which means an increased risk for hot cracking during welding. To minimize the risk, keep the dilution as low as possible.

Further information is given in the Uddeholm brochure “Welding of Tool Steel”.



Uddeholm Ramax LH is a first class tool steel for mould bases.



## Network of excellence

UDDEHOLM is present on every continent. This ensures you high-quality Swedish tool steel and local support wherever you are. ASSAB is our wholly-owned subsidiary and exclusive sales channel, representing Uddeholm in various parts of the world. Together 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. ASSAB is our wholly-owned subsidiary and exclusive sales channel, representing Uddeholm in various parts of the world. Together we secure our position as the world's leading supplier of tooling materials. We act worldwide, so there is always an Uddeholm or ASSAB representative close at hand to give local advice and support. For us it is all a matter of trust – in long-term partnerships as well as in developing new products. Trust is something you earn, every day.

For more information, please visit [www.uddeholm.com](http://www.uddeholm.com), [www.assab.com](http://www.assab.com) or your local website.

UD  
WOR  
RUST IS SOM  
TRUST IS I  
AUTOMOTIVE  
KINDING SU  
TOUGHNESS ST  
MATERIALS H  
EDDING WATER  
BYSTANDIN  
RESULTS. M  
CUSTOMER B  
BILITY TRUST IS  
AUTOMOTIVE  
LEADING SU  
INNOVATION  
STRENGTH INNOVATION  
WORLDWIDE PRE  
SOMETHING YO  
PROBLEM  
THE WORL  
NOMY THE  
DUCTILITY TO  
COMMITMENT PART  
KNOWLEDGE UN  
KNOWLEDGE  
RELIABILITY  
OF EXCEL  
AUTOMOTIVE A  
ECONOMY THE  
TOTAL ECONOMY  
DUCTILITY TOUGHNE  
HARDNESS WORLDW  
TRUST IS SOMETH  
UNDERSTANDING MACHIN  
RESULTS SOLVING PROB  
ECONOMY THE WORL  
STRENGTH IN  
TOUGHNESS STRENGTH I  
MATERIALS PARTN  
UNDERSTANDING MACHIN  
BILITY RELIABILITY RESU  
LASTING TOOLS TOTAL  
YOU EARN, EVERY DAY. LO  
OF THINKING HIGH PE  
OFTOOLING MATERIALS C  
INNOVATION KNOWLEDGE  
STRENGTH INNOVATION KNOW  
REFERENCE LONG DURABILITY  
TRUST IS SOMETHING YOU EARN,  
PROBLEMS AUTOMOTIVE