

**Uddeholm**

**Idun<sup>®</sup>**

## Uddeholm Idun®

Reliable and efficient steel is essential for good results. The same goes for achieving high productivity and high availability. When choosing the right steel many parameters must be considered. By using superior steel your productivity and your product performance can be greatly improved. When using a pre-hardened and stainless steel you will spend less time to finish your product.

Uddeholm Idun allows you to skip the long and costly process of hardening, surface treatment and the transportation in between that is often required with standard materials. A safe and reliable fast forward button to your finished product. It shortens the tool making lead time and improves the tool holder durability. It is e.g. perfect for custom made tool holders.

The driving force behind our research and development is always to enhance your competitiveness and strengthen your business. Uddeholm Idun is the solution that keeps you one step ahead.

### UDDEHOLM TOOL HOLDER CONCEPT

The concept has been developed specifically for the extreme working conditions of drilling, milling and turning applications. In close collaboration with leading tool holder manufacturers we bring a new generation of unique, specialized steel grades to life. Uddeholm Idun is a part of the Uddeholm Tool Holder Concept together with Uddeholm Bure and Uddeholm Balder.

The properties of Uddeholm Idun also makes it a suiting steel grade for components where the combination of being pre-hardened and stainless is required.

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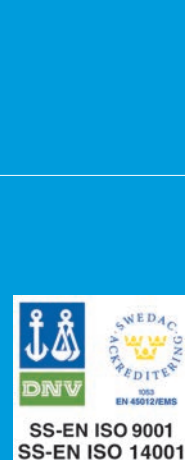
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This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as a warranty of specific properties of the products described or a warranty for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

Uddeholm Idun is a remelted stainless tool steel supplied prehardened to 42–46 HRC.

Uddeholm Idun is produced using the electroslag remelting (ESR) process—an additional step in the steelmaking process that ensures very clean steel with low sulphur content (0.003% max.) and non-metallic inclusions.

Uddeholm Idun is characterized by:

- good machinability
- good wear resistance
- excellent ductility and toughness
- uniform hardness, even in large dimensions
- excellent corrosion resistance

These properties combined give you a steel with outstanding production performance.

The practical benefits of good corrosion resistance can be summarized as follows:

- time-saver
- no coating needed
- no nickel handling
- shiny lasting finish
- stainless properties throughout the material

The benefit of the pre-hardened condition can be summarized as follows:

- no hardening risks
- no hardening costs
- time saving, e.g. no waiting for heat treatment
- possible to machine the final product in one step

In addition, the combination of high hardness with a high toughness results in a component with good resistance to indentations and minimizes the risk of unexpected failures.

Typical analysis %	C	Si	Mn	Cr	Mo	Ni	V	N
	0.21	0.9	0.45	13.5	0.2	0.6	0.25	+
Delivery condition	Prehardened to 42–46 HRC							
Colour code	Brown/Dark green							

## APPLICATIONS

Uddeholm Idun is intended for applications with severe demands on high-temperature strength, while also requiring good machinability.

Examples of applications are:

- indexable insert drills and milling cutters
- milling chucks and tool tapers
- engineering components with severe demands on high temperature strength and stainless properties

## PROPERTIES

### PHYSICAL DATA

Hardened and tempered to 42–46 HRC.

Data at room and elevated temperatures.

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 0.278	–	–
Modulus of elasticity MPa psi	215 000 31.2 x 10 <sup>6</sup>	210 000 30.4 x 10 <sup>6</sup>	195 000 28.3 x 10 <sup>6</sup>
Coefficient of thermal expansion /°C from 20°C /°F from 68°F	–	10.6 x 10 <sup>-6</sup> 5.9 x 10 <sup>-6</sup>	11.4 x 10 <sup>-6</sup> 6.3 x 10 <sup>-6</sup>
Thermal conductivity W/m °C Btu in/(ft <sup>2</sup> h °F)	–	20 139	21 145
Specific heat J/kg °C Btu/lb, °F	460 0.110	–	–



## MECHANICAL DATA

### TENSILE STRENGTH

All specimens have been taken from a bar Ø 35 mm (1.4"), hardness 42–46 HRC.

Testing temperature	20°C (68°F)	200°C (390°F)
Tensile strength, Rm MPa psi	1 490 215 200	1 340 193 800
Yield strength, Rp0.2 MPa psi	1 250 181 000	1 100 159 200
Reduction of area, Z %	51	50
Elongation, A5 %	12	11

## HEAT TREATMENT

Uddeholm Idun is intended for use in the as-delivered condition, i.e. hardened and tempered to 42–46 HRC.

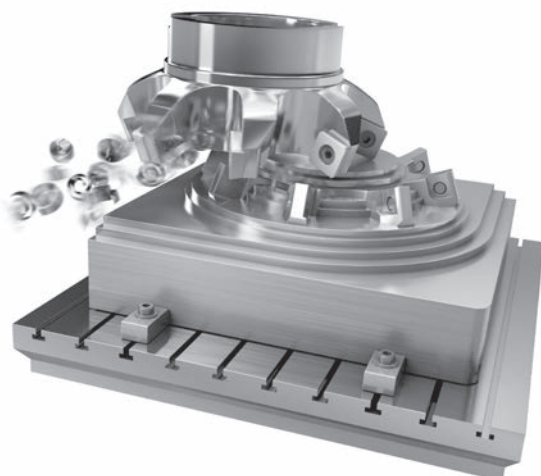
When the steel is to be heat treated to a higher hardness, instructions below are to be followed.

### SOFT ANNEALING

Protect the steel and heat through to 780°C (1430°F). Cool at 10°C (50°F) per hour to 600°C (1110°F), then cool freely in air.

### STRESS RELIEVING

After rough machining, the component should be heated through to max. 500°C (930°F), holding time 2 hours, then cool freely in air.



## HARDENING

*Note:* It is recommended to do soft annealing before hardening.

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

*Austenitizing temperature:* 980–1000°C (1800–1830°F) but usually 980°C (1800°F).

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

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

## QUENCHING MEDIA

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

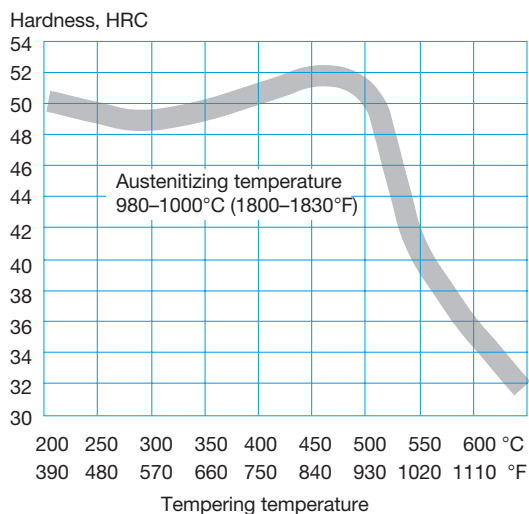
In order to obtain the optimum properties, the cooling rate should be as fast as possible within acceptable distortion limits. Temper the component as soon as its temperature reaches 50–70°C (120–160°F).

## TEMPERING

Choose the tempering temperature according to the hardness required by reference to the tempering graph. Temper minimum twice with intermediate cooling to room temperature. Lowest tempering temperature 250°C (480°F). Holding time at temperature minimum 2 hours.

### TEMPERING GRAPH

The tempering curve is approximate.



Above tempering curve is obtained after heat treatment of samples with a size of 15 x 15 x 40 mm, cooling in forced air. Lower hardness can be expected after heat treatment of tools, components and dies due to factors like the actual size of the part and heat treatment parameters.

## MACHINING RECOMMENDATIONS

The cutting data below is to be considered as a guideline and may require adjustments based on equipment, selection of cutting tools, etc. More information can be found in the technical report "Cutting data recommendation".

The recommendations in the following tables are valid for Uddeholm Idun, hardness approx. 45 HRC.

### TURNING

Cutting data parameter	Turning with carbide	
	Rough turning	Fine turning
Cutting speed ( $v_c$ ) m/min f.p.m.	60–80 200–260	80–100 260–330
Feed (f) mm/rev i.p.r.	0.2–0.4 0.008–0.016	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
Carbide designation ISO US	P20–P30 C6–C5 Coated carbide	P10 C7 Coated carbide

### DRILLING

#### COATED HIGH SPEED STEEL TWIST DRILLS

Drill diameter		Cutting speed ( $v_c$ )		Feed (f)	
mm	inch	m/min	f.p.m.	mm/rev	i.p.r.
–5	–3/16	10–12	33–39	0.05–0.15	0.002–0.006
5–10	3/16–3/8	10–12	33–39	0.15–0.20	0.006–0.008
10–15	3/8–5/8	10–12	33–39	0.20–0.25	0.008–0.010
15–20	5/8–3/4	10–12	33–39	0.25–0.30	0.010–0.014

#### CARBIDE DRILL

Cutting data parameter	Type of drill		
	Indexable insert	Solid carbide	Carbide tip <sup>1)</sup>
Cutting speed, ( $v_c$ ) m/min f.p.m.	90–110 300–360	80–100 260–333	70–80 230–260
Feed, (f) mm/rev i.p.r.	0.05–0.25 <sup>2)</sup> 0.002–0.010 <sup>2)</sup>	0.10–0.25 <sup>3)</sup> 0.004–0.010 <sup>3)</sup>	0.15–0.25 <sup>4)</sup> 0.006–0.010 <sup>4)</sup>

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

<sup>2)</sup> Feed rate for drill diameter 20–40 mm (0.8"–1.6")

<sup>3)</sup> Feed rate for drill diameter 5–20 mm (0.2"–0.8")

<sup>4)</sup> Feed rate for drill diameter 10–20 mm (0.4"–0.8")

### MILLING

#### FACE AND SQUARE SHOULDER MILLING

Cutting data parameter	Milling with carbide	
	Rough milling	Fine milling
Cutting speed ( $v_c$ ) m/min f.p.m.	40–50 130–165	50–70 165–230
Feed ( $f_z$ ) mm/tooth in/tooth	0.15–0.25 0.006–0.01	0.1–0.2 0.004–0.008
Depth of cut ( $a_p$ ) mm inch	2–4 0.08–0.16	–2 –0.08
Carbide designation ISO US	P20–P40 C6–C5 Coated carbide	P10–P20 C7–C6 Coated carbide

### END MILLING

Cutting data parameter	Type of end mill		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed ( $v_c$ ) m/min f.p.m.	60–100 200–330	80–100 260–330	8–10 <sup>1)</sup> 26–33
Feed ( $f_z$ ) mm/tooth in/tooth	0.03–0.15 <sup>2)</sup> 0.001–0.006 <sup>2)</sup>	0.08–0.15 <sup>2)</sup> 0.003–0.006 <sup>2)</sup>	0.05–0.20 <sup>2)</sup> 0.002–0.008 <sup>2)</sup>
Carbide designation ISO US	–	P15–P40 C6–C5	–

<sup>1)</sup> For coated high speed steel end mill  $v_c = 25–30$  m/min (82–98 f.p.m.)

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

### THREAD CUTTING

For making small internal thread we recommend to use thread milling. A suitable cutting speed is 40–50 m/min. (131–164 f.p.m.).

### 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
Face grinding straight wheel	A 46 HV
Face grinding segments	A 36 GV
Cylindrical grinding	A 60 KV
Internal grinding	A 60 JV
Profile grinding	A 120 JV

## WELDING

Good results when welding tool steel can be achieved if proper techniques are used. Precautions such as preheating, heat treatment, post weld heat treatment, joint preparation, selection of consumables, etc. are required.

For best result after polishing and photo-etching use consumables with a matching chemical composition to the mould steel.

Welding method	TIG
Working temperature	200–250°C (390–480°F)
Welding consumables	MIRRAX TIG-WELD
Hardness after welding	54–56 HRC
Heat treatment * after welding	Temper 530°C (990°F), 2 h. Weld metal hardness after tempering 42–46 HRC.

\* Post treatment is recommended to reduce the risk of cracking and to achieve an even hardness profile.

Small repairs can be made at room temperature.

### LASER WELDING

For laser welding Uddeholm Stavax laser weld rods are available. See the information leaflet “Uddeholm Laser Welding Rods”.

Further information is given in the Uddeholm brochure “Welding of Tool Steel” or nearest Uddeholm sales office.

## POLISHING

Uddeholm Idun has a very good polishability in the hardened and tempered condition.

The main principle is to use smaller steps at the fine-grinding/polishing stages and not to start polishing on too rough of a surface. It is also important to stop the polishing operation immediately after the last scratch from the former grit size has been removed.

More detailed information on polishing techniques is given in the brochure “Polishing of tool steel”.

## PHOTO-ETCHING

Uddeholm Idun has a very low inclusion content and a homogeneous microstructure. The high cleanliness level provides for good photo-etching/texturing characteristics.

The special photo-etching process that might be necessary because of Uddeholm Idun's good corrosion resistance is familiar to all the leading photo-etching companies.

Further information is given in the Uddeholm brochure “Photo-etching of tool steel”.

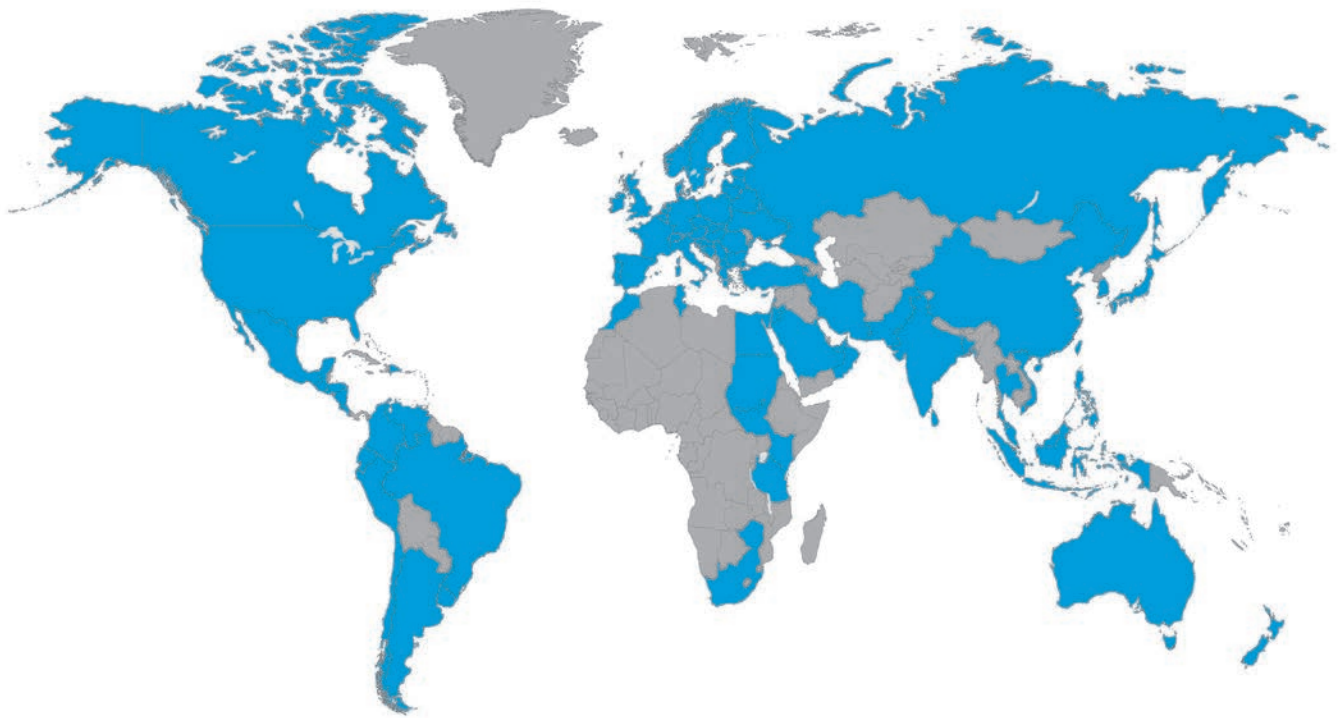
## ELECTRICAL-DISCHARGE MACHINING — EDM

If spark-erosion, EDM, is performed in the as delivered condition, the tool should then be given an additional temper at approx. 500°C (930°F). If the steel has been rehardened, the additional tempering temperature should be 25°C (50°F) lower than the last tempering temperature used. However, the best is to remove the affected layer completely by grinding.

## FURTHER INFORMATION

Please contact your local Uddeholm office for further information on the selection, heat treatment and application 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)