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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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The latest revised edition of this brochure is the English version, which is always published on our web site www.uddeholm.com



SS-EN ISO 9001
SS-EN ISO 14001

General

Uddeholm Holdax is a vacuum-degassed chromium-molybdenum-alloyed steel which is supplied in the hardened and tempered condition.

Uddeholm Holdax is characterized by:

- excellent machinability
- good resistance to indentation
- uniform hardness in all dimensions

Typical analysis %	C	Si	Mn	S	Cr	Mo
	0,40	0,4	1,5	0,07	1,9	0,2
Standard specification	AISI 4130–35 improved, W.-Nr. 1.2312					
Delivery condition	Hardened and tempered to 290–330 HB					
Colour code	Yellow/blue					

Applications

- Holders/bolsters for plastic moulds and die casting dies
- Plastics and rubber moulds with low requirements on polishability
- Support plates
- Constructional parts

Properties

Physical data

Hardened and tempered to 310 HB.

Temperature	20°C (68°F)	200°C (390°F)
Density, kg/m ³ lbs/in ³	7800 0,282	7750 0,280
Coefficient of thermal expansion per °C from 20°C per °F from 68°F	–	12,7 × 10 ⁻⁶ 6,1 × 10 ⁻⁶
Thermal conductivity W/m °C Btu in/ft ² h °F	–	33 225
Modulus of elasticity N/mm ² p.s.i.	200 000 29,0 × 10 ⁶	195 000 28,3 × 10 ⁶
Specific heat capacity J/kg °C Btu/lb °F	460 0,110	–

Mechanical properties

The tensile and compressive strength depends on the delivery hardness.

TENSILE STRENGTH

Tensile strength, R _m	800–1 100 N/mm ² 116 000–159 000 p.s.i.
Yield strength, R _{p0.2}	750–950 N/mm ² 109 000–138 000 p.s.i.

At 200°C (390°F) the tensile strength and the yield strength are approx. 100 N/mm² lower than at room temperature.

COMPRESSIVE STRENGTH

Yield strength, R _{c0.2}	850–1 000 N/mm ² 123 000–145 000 p.s.i.
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The high sulphur content gives worse mechanical properties in the transverse direction compared with the longitudinal direction.

Heat treatment

Uddeholm Holdax is intended for use in the as-delivered condition. When the steel is to be heat treated to higher hardness, instructions below are to be followed.

Soft annealing

Protect the steel and heat through to 720°C (1330°F), holding time 2 hours. Cool in furnace at 10°C (50°F) per hour to 600°C (1110°F), then freely in air.

Stress tempering

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

Hardening

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

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

Austenitizing temperature: 850°C (1560°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

- Forced air/atmosphere (only for small tools)
- Oil
- Martempering bath 450–550°C (840–1020°F) max. 4 minutes, then cool in forced air

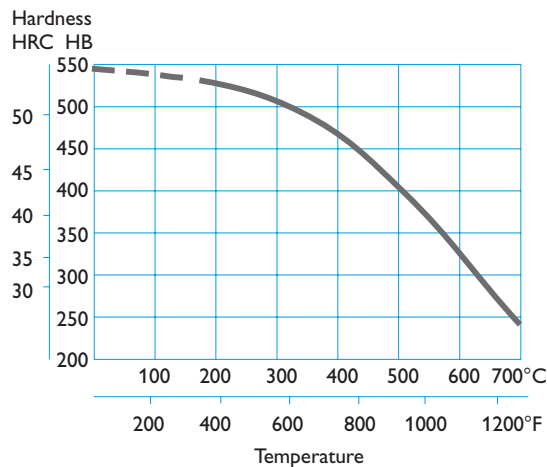
In order to obtain the optimum properties, the cooling rate should be as fast as is concomitant with acceptable distortion. Temper the tool as soon as its temperature reaches 50–70°C (120–160°F).

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 180°C (360°F). Holding time at temperature minimum 2 hours.

The diagram below is valid for small samples (15 x 15 x 40 mm) quenched in air.

Austenitizing temperature 850°C (1560°F), 30 minutes. Holding time 2 + 2 h.



Flame and induction hardening

Uddeholm Holdax can be flame or induction hardened to a hardness of approximate 50 HRC. Cooling in air is preferable. However, small tools sometimes require forced air cooling. Temper immediately after hardening.

Further information is given in the Uddeholm brochure "Flame hardening of Impax Supreme".

Nitriding and nitrocarburizing

Nitriding gives a hard surface layer which is very resistant to wear and erosion. A nitrided surface also increases the corrosion resistance.

For best result the following steps should be followed:

1. Rough machining
2. Stress tempering at 550°C (1020°F)
3. Fine machining
4. Nitriding

Following surface hardness and nitriding depths will be achieved after nitriding/nitrocarburizing.

	Temperature		Time h	Surface hardness HV	Depth of case approx.	
	°C	°F			mm	in.
Gas-nitriding	510	950	10	750	0.20	0.008
	510	950	30	750	0.30	0.012
	510	950	60	750	0.40	0.016
Ion-nitriding	480	895	10	750	0.20	0.008
	480	895	30	750	0.25	0.010
	480	895	60	750	0.35	0.014
Nitrocarburizing –gas –salt bath	580	1060	2.5	600	0.25	0.010
	580	1060	1	650	0.15	0.006

Machining recommendation

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

Turning

Cutting data parameters	Turning with carbide		Turning with high speed steel Fine turning
	Rough turning	Fine turning	
Cutting speed (v_c) m/min. f.p.m.	140–190 460–620	190–240 620–790	20–25 65–80
Feed (f) mm/r i.p.r.	0,2–0,4 0,008–0,016	0,05–0,2 0,002–0,008	0,05–0,3 0,002–0,012
Dept 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–P20 Coated carbide or cermet	–

Drilling

HIGH SPEED STEEL TWIST DRILLS

Drill diameter		Cutting speed (v_c)		Feed (f)	
mm	inch	m/min	f.p.m.	mm/r	i.p.r.
– 5	–3/16	18–20*	60–65*	0,08–0,20	0,003–0,008
5–10	3/16–3/8	18–20*	60–65*	0,20–0,30	0,008–0,012
10–15	3/8–5/8	18–20*	60–65*	0,30–0,35	0,012–0,014
15–20	5/8–3/4	18–20*	60–65*	0,35–0,40	0,014–0,016

* For coated HSS drills $v_c = 32–34$ m/min (105–112 f.p.m.)

CARBIDE DRILLS

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Brazed carbide ¹⁾
Cutting speed (v_c) m/min. f.p.m.	120–150 390–490	200–220 655–720	70–90 230–295
Feed (f) mm/r i.p.r.	0,05–0,15 ²⁾ 0,002–0,0106 ³⁾	0,08–0,20 ³⁾ 0,003–0,008 ³⁾	0,15–0,25 ⁴⁾ 0,006–0,010 ⁴⁾

¹⁾ Drill with replaceable or brazed carbide tip

²⁾ Feed rate for drill diameter 20–40 mm (0.8"–1.6")

³⁾ Feed rate for drill diameter 5–20 mm (0.2"–0.8")

⁴⁾ Feed rate for drill diameter 10–20 mm (0.4"–0.8")

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.	80–150 260–490	150–190 490–620
Feed (f_z) mm/tooth in/tooth	0,2–0,4 0,008–0,016	0,1–0,2 0,004–0,008
Dept of cut (a_p) mm inch	2–4 0,08–0,16	–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.	70–110 230–360	80–120 260–390	20–25 ¹⁾ 65–80 ¹⁾
Feed (f_z) mm/tooth in/tooth	0,03–0,20 ²⁾ 0,001–0,008	0,08–0,20 ²⁾ 0,003–0,008	0,05–0,35 ²⁾ 0,002–0,014
Carbide designation ISO	–	P20–P30	–

¹⁾ For coated HSS end mill $v_c = 40–45$ m/min. (130–148 f.p.m.)

²⁾ Depending on radial depth of cut and cutting 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	Prehardend 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 LV

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).

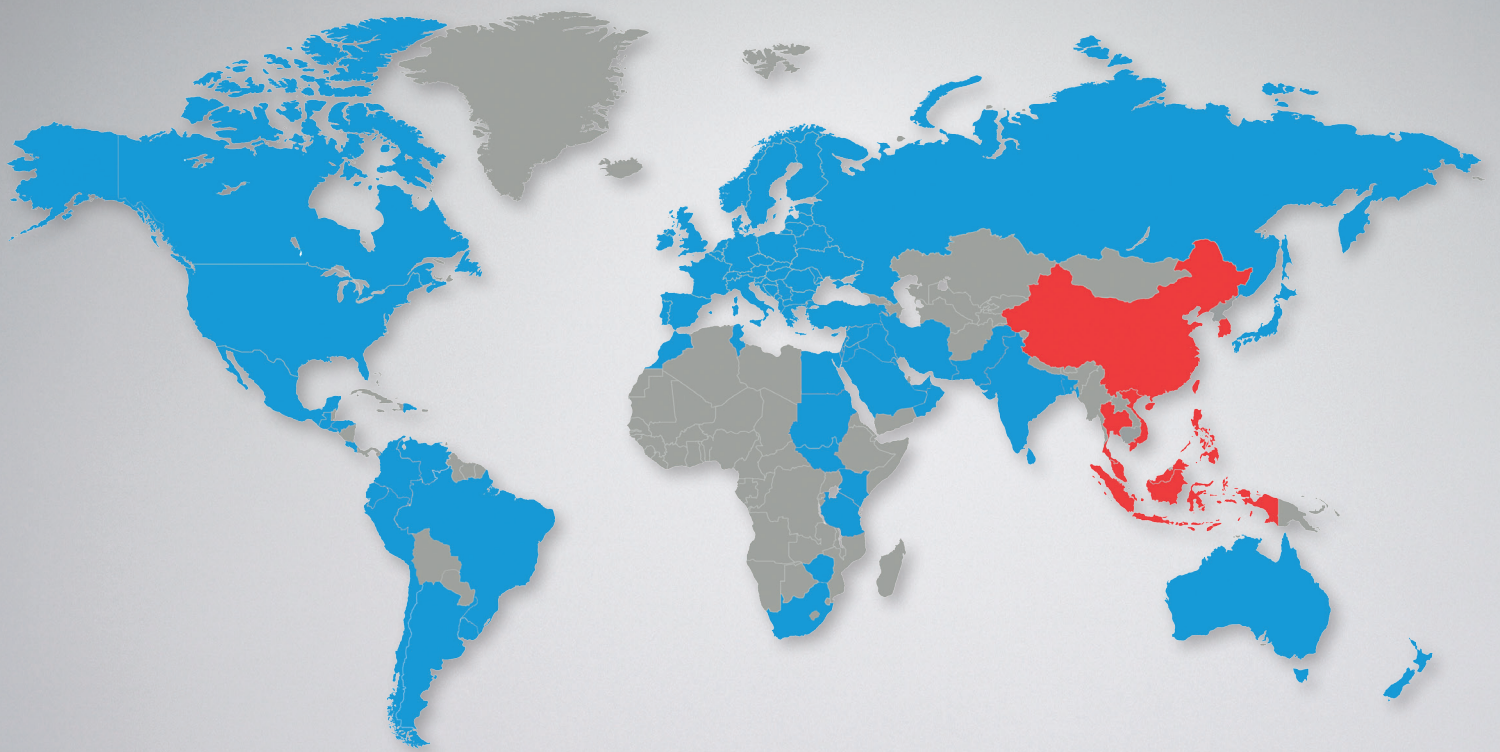
Welding method	TIG	MMA (SMAW)
Working temperature	200–250°C (390–480°F)	200–250°C (390–480°F)
Welding consumables	IMPAX TIG-WELD	IMPAX WELD
Hardness after welding	320–350 HB	320–350 HB

Uddeholm Holdax 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”.

Further information

Please contact your local Uddeholm office for further information on the selection, heat treatment and application of Uddeholm tool steel, including the publication “Steel for Moulds”.



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 exclusive sales channel, representing Uddeholm in the Asia Pacific area. 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 exclusive sales channel, representing Uddeholm in the Asia Pacific area. 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, www.assab.com or your local website.