Uddeholm Impax® Supreme

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Uddeholm Impax Supreme is a premium prehardened mould steel with very good polishing and texturing properties. Uddeholm Impax Supreme is available in a very wide dimensional range, where even the largest dimensions show a very uniform hardness profile all through the cross section.

The delivery hardness of ~310 HB, makes the steel suitable for a many different applications like:

- Moulds for plastic injection moulding
- Moulds for blow moulding
- Dies for plastic extrusion
- General constructional parts, like machine components requiring improved fatigue strength and reliability

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

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GENERAL

Uddeholm Impax Supreme is a premium-quality vacuum-degassed Cr-Ni-Mo-alloyed steel which is supplied in the hardened and tempered condition, offering the following benefits:

- No hardening risks
- No hardening costs
- Time saving, e.g. no waiting for heat treatment
- Lower tool cost (e.g. no distortion to rectify)
- Modifications easily carried out
- Can be subsequently nitrided to increase surface wear resistance or locally flame hardened to reduce surface damage

Uddeholm Impax Supreme is manufactured to consistently high quality standards with a very low sulphur content, giving a steel with the following characteristics:

- Good polishing and photo-etching properties
- Good machinability
- High purity and good homogeneity
- Uniform hardness

Note: Uddeholm Impax Supreme is 100% ultrasonic tested.

Heavier sections are supplied premachined which offers the following advantages compared with un-machined material:

- Saving of weight
- Non-decarburized surface
- Exact nominal size (plus tolerance)
- Less machining
- Absence of scale minimizes machine and tool wear

Approx. analysis %	C 0.37	Si 0.3	Mn 1.4	Cr 2.0	Ni 1.0	Mo 0.2
Standard spec.	AISI P20 modified					
Delivery condition	Hardened and tempered to 290–330 HB					
Colour code	Yellow/green					

APPLICATIONS

- Injection moulds for thermoplastics
- Extrusion dies for thermoplastics
- Blow moulds
- Forming tools, press-brake dies (possibly flame hardened or nitrided)
- Aluminium die casting prototype dies
- Structural components, shafts

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	7 800 0.282	7 750 0.280
Coefficient of thermal expansion per °C from 20° per °F from 68°F	 – –	 12.7 x 10^{-6} 7.0 x 10^{-6}
Thermal conductivity W/m °C Btu in/ft^2 h °F	 –	 28 194
Modulus of elasticity N/mm^2 tsi psi	 205 000 13 280 29.7 x 10^6	 200 000 12 960 29.0 x 10^6
Specific heat capacity J/kg °C Btu/lb°F	 460 0.110	 – –

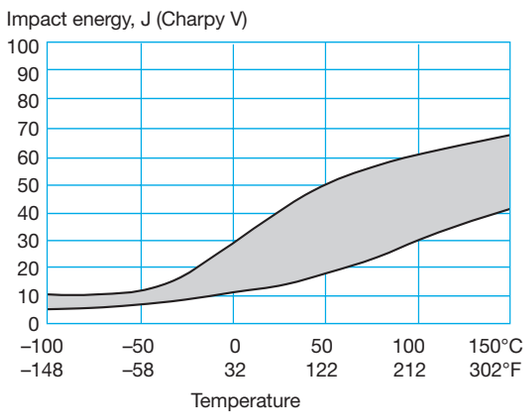
MECHANICAL PROPERTIES

Impact strength, tensile strength and the compressive strength depends on the hardness in the delivered condition.

IMPACT STRENGTH

The energy absorption at impact testing depends on the test material (bar size and delivered hardness), testing temperature and the specimen (type, location, and orientation in the bar).

The graph below shows how the impact energy changes as a function of the test tem-perature and hardness variation within the delivery hardness range.



TENSILE STRENGTH

Approx. values. Samples were taken from a flat bar, 90 x 300 mm (3.5” x 11.8”).

Hardness: 325 HB.

Testing temperature	20°C (68°F)	200°C (390°F)
Ultimate tensile strength Rm N/mm²	1020	930
Yield strength Rp0.2 N/mm²	900	800

COMPRESSIVE STRENGTH

Compressive yield strength Rc0.2 N/mm²	850–1000

HEAT TREATMENT

Uddeholm Impax Supreme is intended for use in the hardened and tempered condition, i.e. the delivery condition.

When, however, the steel is to be heat trea-ted to a higher hardness or case hardened, the following instructions may be helpful.

SOFT ANNEALING

Protect the steel and heat through to 700°C (1300°F). Then cool in the furnace at 10°C (50°F) per hour to 600°C (1110°F), then freely in air.

STRESS RELIEVING

After rough machining the tool should be heated through to 550°C (1020°F), holding time 2 hours. Cool slowly to room temp-erature.

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 temp-erature for 30 minutes.

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

QUENCHING MEDIA

- High speed gas/circulating atmosphere (Only suitable for small dimensions)
- Oil (60–80°C/140–175°F)
- Martempering bath 300°C (570°F) max. 4 minutes, then air

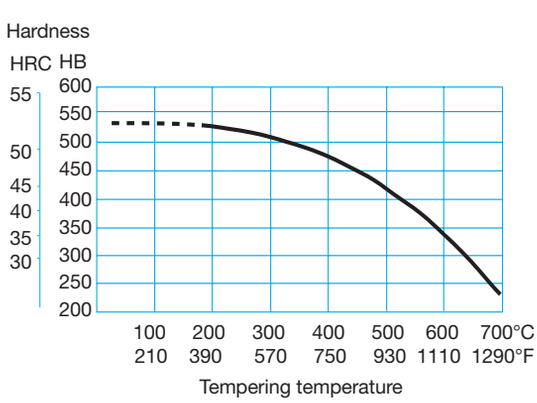
Note: Temper immediately tool reaches 50–70°C (120–160°F).

TEMPERING

Choose the tempering temperature acc-ording to the hardness required by reference to the tempering graph. Temper twice with inter-mediate cooling to room temperature. Lowest tempering temperature 180°C (360°F) for small inserts, but preferred minimum is 250°C (480°F). Holding time at temperature minimum 2 hours.

TEMPERING GRAPH

The diagram is valid for small samples 15 x 15 x 40 mm (0.6 x 0.6 x 1.6 in.) austenitized 30 min. at 850°C (1560°F), quenched in air and tempered 2 + 2 hours.



FLAME AND INDUCTION HARDENING

Uddeholm Impax Supreme can be flame or induction hardened to a hardness of approx. 50 HRC. Cooling in air is preferable.

Further information can be obtained from the Uddeholm Technical Services Report “Flame hardening of Uddeholm Impax Supreme”.

NITRIDING AND NITROCARBURIZING

Nitriding gives a hard surface 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. Grinding
4. Nitriding

Following surface hardness and nitriding depths will be achieved after nitriding:

	Temperature		Time	Surface hardness	Depth of case	
	°C	°F	h	HV_1	mm	inch
Gas nitriding	525 525	977 977	20 30	650 650	0.30 0.35	0.012 0.013
Ion-nitriding	480 480	896 896	24 48	700 700	0.30 0.40	0.012 0.016
Nitrocar-burizing	570	1058	2	700	0.10	0.004

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 our technical information “Cutting data recommendations”.

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.	120–170 394–558	170–220 558–722	15–20 49–66
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
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–P30 Coated carbide	P10 Coated carbide or Cermet	–

DRILLING

HIGH SPEED STEEL TWIST DRILL

Drill diameter		Cutting speed, (v_c)		Feed, (f)	
mm	inch	m/min	f.p.m.	mm/r	i.p.r.
–5	–3/16	14–16*	46–52	0.08–0.15	0.003–0.006
5–10	3/16–3/8	14–16*	46–52	0.15–0.25	0.006–0.010
10–15	3/8–5/8	14–16*	46–52	0.25–0.30	0.010–0.012
15–20	5/8–3/4	14–16*	46–52	0.30–0.35	0.012–0.014

* For coated high speed steel drill vc = 24–26 m/min (79–85 f.p.m.)

CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip[1]
Cutting speed, (v_c) m/min f.p.m.	180–200 600–656	120–150 394–492	60–80 197–262
Feed, (f) mm/r i.p.r.	0.05–0.15[2] 0.002–0.006[2]	0.08–0.20[3] 0.003–0.008[3]	0.15–0.25[4] 0.006–0.01[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.	80–150 265–492	150–190 492–623
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	2–4 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	Milling cutter		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed, (v_c) m/min f.p.m.	70–110 230–361	80–120 262–394	15–20[1] 49–66[1]
Feed, (f_z) mm/tooth inch/tooth	0.03–0.20[2] 0.001–0.008[2]	0.08–0.20[2] 0.003–0.008[2]	0.05–0.35[2] 0.002–0.014[2]
Carbide designation, ISO	–	P20–P40	–

[1] For coated high speed steel end mill v_c = 35–40 m/min (115–131 f.p.m.)

[2] 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 brochure “Grinding of Tool Steel”.

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

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). If the tool is to be polished or photo-etched, it is necessary to work with an electrode type of matching composition.

Welding method	TIG	MMA (SMAW)
Working temperature	200–250°C (390–480°F)	200–250°C (390–480°F)
Consumables	IMPAX TIG-WELD	IMPAX WELD
Hardness after welding	300–330 HB	300–330 HB

Further information is given in the Uddeholm brochures “Welding of Tool Steel” and “Uddeholm Impax Weld/TIG-Weld”.

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. 550°C (1020°F). If the steel has been rehardened, the additional tempering temperature should be 25°C (50°F) lower than the last tempering temperature used.

Further information can be obtained from the Uddeholm brochure “EDM of tool steel”.

HARD-CHROMIUM-PLATING

After hard-chromium-plating, the tool should be tempered for approx. 4 hours at 180°C (350°F) within 4 hours of plating in order to avoid hydrogen embrittlement.

PHOTO-ETCHING

Uddeholm Impax Supreme is particularly suitable for texturing by the photo-etching process. Its very low sulphur content ensures accurate and consistent pattern reproduction.

For heavy sections an extra tempering at 550°C (1020°F) before photo-etching is recommended.

POLISHING

Uddeholm Impax Supreme has good polishability in the hardened and tempered condition. After grinding, polishing is undertaken with aluminium oxide or diamond paste.

Note: Each steel grade has an optimum polish-ing time which largely depends on hardness and polishing technique. Over-polishing can lead to a poor surface finish (e.g. an “orange peel” effect).

Further information is given in the Uddeholm publication “Polishing of mould steel”.

FURTHER INFORMATION

Contact your local Uddeholm office for further information on the selection, heat treatment, application and availability of Uddeholm tool steels, including the publication “Steels for moulds”.

Manufacturing solutions for generations to come

SHAPING THE WORLD®

We are shaping the world together with the global manufacturing industry. Uddeholm manufactures steel that shapes products used in our every day life. We do it sustainably, fair to people and the environment. Enabling us to continue shaping the world – today and for generations to come.

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