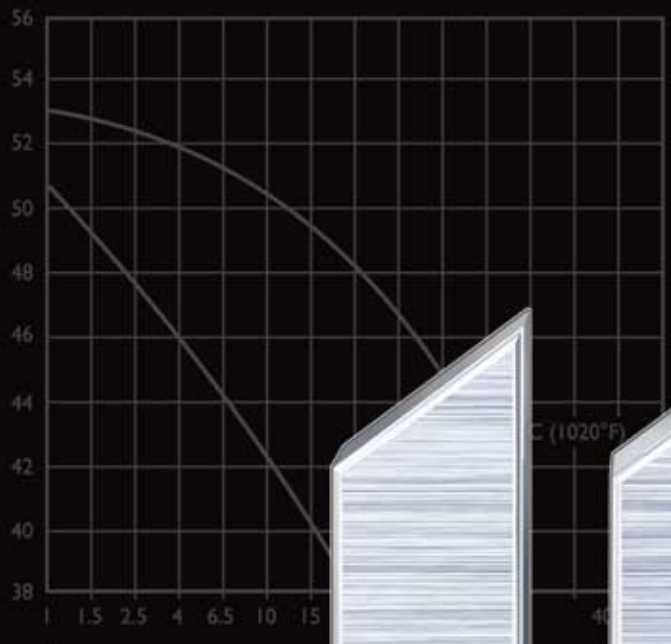
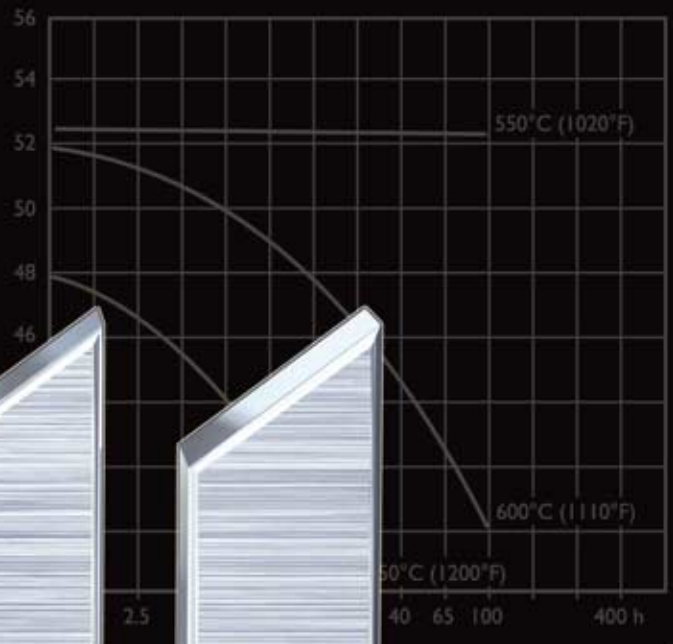
HOLDAX

Prehardened holder steel

COLD WORK | PLASTIC MOULDING | HOT WORK | HIGH PERFORMANCE STEEL





Typical analysis %	C 2,05				Mn 0,8	Cr 4,5	W 0,2
Standard specifikation	AISI D6, (				D3) (W.Nr. 1.2796)		
Delivery condition	Soft anne				o approx. 200 HB		
Colour code	Red						

Temperature	20°C (68°F)			200°C (390°F)	400°C (750°F)
Density kg/m³	7 770			7 650	7 650
lbs/m³	0,281			0,276	0,275
Modulus of elasticity N/mm²	194 000	188 000	178	189 000	173 000
psi	28,1 x 10⁶	27,3 x 10⁶	25,8 x 10⁶	27,4 x 10⁶	25,1 x 10⁶
Coefficient of thermal expansion per °C from 20°C	to 100°C 11,7 x 10⁶	to 200°C 12 x 10⁶	to 400°C 13,0 x 10⁶	to 100°C 12,3 x 10⁶	to 200°C 14 x 10⁶	to 400°C 15,1 x 10⁶
per °F from 68°F	to 212°F 6,5 x 10⁶	to 400°F 6,7 x 10⁶	to 750°F 7,3 x 10⁶	to 212°F 6,1 x 10⁶	to 400°F 6,7 x 10⁶	to 750°F 7,3 x 10⁶
Thermal conductivity W/m °C	-	27	32	20,5	21,5	23,0
Btu in (ft²h°F	-	187	221	142	149	159
Specific heat K/kg °C	455	525	608	460	-	-
Btu/lbs °F	0,109	0,126	0,145	0,110	-	-

General

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

HOLDAX is characterized by
- Excellent machinability
- Good resistance to indentation
- Uniform hardness in all dimensions.

HOLDAX is 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.

Typical analysis %	C 0,40	Si 0,4	Mn 1,5	S 0,07	Cr 1,9	Mo 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 diecasting dies
- Plastics and rubber moulds with low requirements on polishability
- Support plates
- Constructional parts.

Deep cavities are quickly and easily machined in holder blocks made of HOLDAX, due to its excellent machining properties.

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 x 10^{-6} 6,1 x 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 x 10^6	 195 000 28,3 x 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	800–1100 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 strenght are approx. 100 N/mm^2 lower than at room temperature.

Compressive strength

Yield strength, Rc0,2	850–1000 N/mm^2 123 000–145 000 p.s.i.

The high sulphur content gives worse mechanical properties in the transverse direction compared with the longitudinal direction.

Heat treatment

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

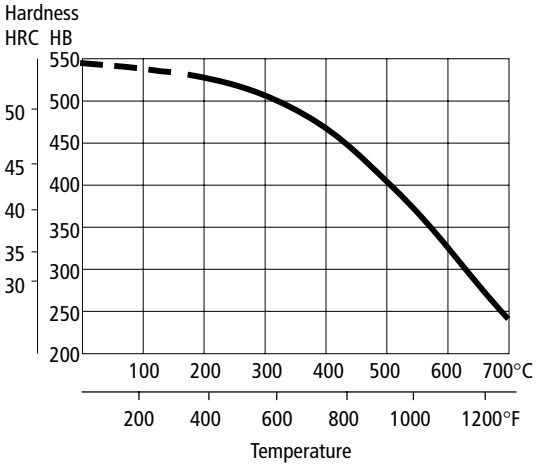
- Forced air/atmosphere (only for small tools)
- Oil
- Martempering bath 450–550°C (840–1020°F) max. 4 min., then cool in forced air.

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 min.
Holding time: 2 + 2 h.



FLAME AND INDUCTION HARDENING

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 wil be achieved after nitriding/nitrocarburizing.

	Temperature °C	Temperature °F	Time h	Surface hardness HV	Depth of case approx. mm	Depth of case approx. 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
Nitrocar-burizing –gas	580	1060	2,5	600	0,25	0,010
–salt bath	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
	Rough turning	Fine turning	Fine turning
Cutting speed (v_c) m/min.	140–190	190–240	20–25
f.p.m.	460–620	620–790	65–80
Feed (f) mm/r	0,2–0,4	0,05–0,2	0,05–0,3
i.p.r.	0,008–0,016	0,002–0,008	0,002–0,012
Dept of cut (a_p) mm	2–4	0,5–2	0,5–3
inch	0,08–0,16	0,02–0,08	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 mm	Drill diameter inch	Cutting speed (v_c) m/min	Cutting speed (v_c) f.p.m.	Feed (f) mm/r	Feed (f) 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.	120–150	200–220	70–90
f.p.m.	390–490	655–720	230–295
Feed (f) mm/r	0,05–0,25[2]	0,10–0,25[2]	0,15–0,25[2]
i.p.r.	0,002–0,010[2]	0,004–0,010[2]	0,006–0,010[2]

[1] *Drill with internal cooling channels and brazed carbide tip.*
[2] *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.	80–150	150–190
f.p.m.	260–490	490–620
Feed (f_z) mm/tooth	0,2–0,4	0,1–0,2
in/tooth	0,008–0,016	0,004–0,008
Dept of cut (a_p) mm	2–4	–2
inch	0,08–0,16	–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.	70–110	80–120	20–25[1]
f.p.m.	230–360	260–390	65–80[1]
Feed (f_z) mm/tooth	0,03–0,20[2]	0,08–0,20[2]	0,05–0,35[2]
in/tooth	0,001–0,008	0,003–0,008	0,002–0,014
Carbide designation ISO	K10, P40	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 46 LV
Internal grinding	A 46 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

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 steels, including the publication "Steels for Moulds".