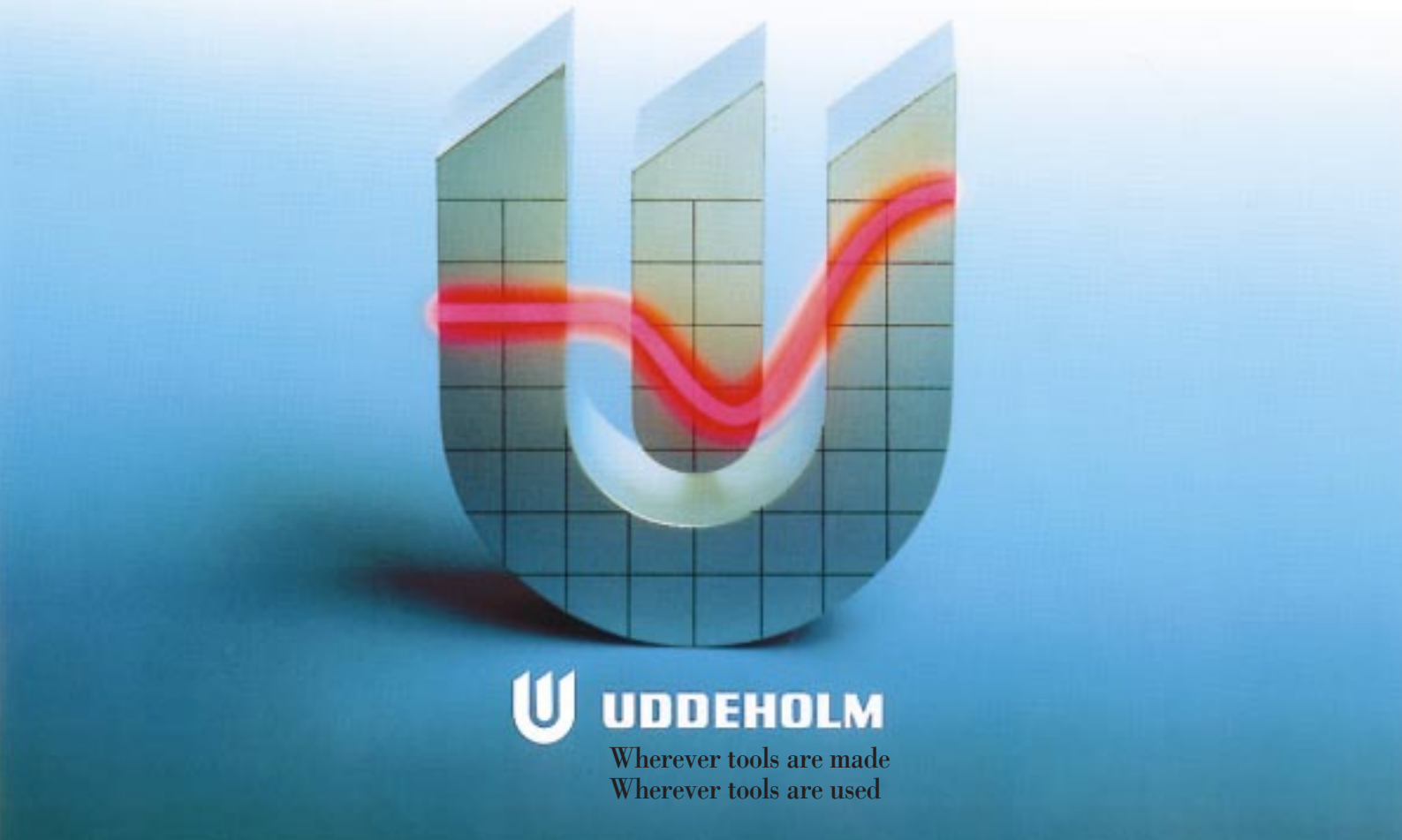
RAMAX® S
Prehardened stainless holder steel



General

RAMAX S is a chromium alloyed stainless holder steel, which is supplied in the hardened and tempered condition.

RAMAX S is characterized by

- Excellent machinability
- Good corrosion resistance
- Uniform hardness in all dimensions
- Good indentation resistance.

These properties combine to give a steel with outstanding production performance. The practical benefits of **good corrosion resistance** in a holder steel can be summarized as follows:

- Lower mould maintenance cost
- Lower production costs since water cooling channels are unaffected by corrosion, ensuring consistent cycle time.

The practical benefits of the **excellent machinability** can be summarized as follows:

- Lower mould production costs due to:
  - less wear of the cutting edges in the milling and drilling operations
  - increased cutting speed can be used giving shorter machining time.

RAMAX S is supplied in the premachined condition which offers the following cost saving advantages:

- Less machining needed
- Saving of weight
- Machining tolerances on the nominal size
- Absence of scale minimizes tool and machine wear
- Surfaces free from decarburization.

Typical analysis %	C 0,33	Si 0,35	Mn 1,35	Cr 16,7	S 0,12
Standard specification	(AISI 420 F)				
Delivery condition	Hardened and tempered to ~ 340 HB				
Colour code	Black/brown				

Applications

- Holders/bolsters for plastic moulds. *RAMAX S* in combination with *STAVAX ESR* or *ELMAX* as insert material gives a completely corrosion resistant mould
- Plastic and rubber moulds with low requirements on polishability
- Dies and calibers for plastic extrusion
- Constructional parts.

Properties

PHYSICAL DATA

Hardened and tempered to 340 HB. Data at room and elevated temperatures.

Temperature	20°C (68°F)	200°C (390°F)	400°C (750°C)
Density kg/m^3 lbs/in^3	 7 730 0,279	 7 650 0,276	 7 600 0,275
Modulus of elasticity N/mm^2 psi	 210 000 30,5 x 10^{-6}	 195 000 28,3 x 10^{-6}	 180 000 26,1 x 10^{-6}
Coefficient of thermal expansion per °C from 20°C per °F from 68°F	 – –	 10,7 x 10^{-6} 5,9 x 10^{-6}	 11,9 x 10^{-6} 6,6 x 10^{-6}
Thermal conductivity W/m °C Btu in/ft^2 h °F	 – –	 18 125	 22 153
Specific heat capacity J/kg °C Btu/lb°F	 460 0,11	 – –	 – –

TENSILE STRENGTH

Approximate values. Samples were taken from a round bar 28 mm (1,1"). Hardness: 340 HB.

Testing temperature	20°C (68°F)	200°C (390°F)
Tensile strength Rm, N/mm^2 psi	 1100 159 500	 1000 145 000
Yield strength $Rp_{0,2}$ N/mm^2 psi	 940 136 350	 860 124 800
Reduction of area Z, %	30	30
Elongation A_5, %	10	10

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

CORROSION RESISTANCE

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

Heat treatment

RAMAX S is intended for use in the as-delivered condition i.e. hardened and tempered to 340 HB.

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 860° C (1580° F). Cool at 20° C (35° F) per hour to 650° C (1200° 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 fully soft annealed before hardening.

Preheating temperature: 500–600° C (930–1110° F).
Austenitizing temperature: 1000–1030° C (1830–1890° 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

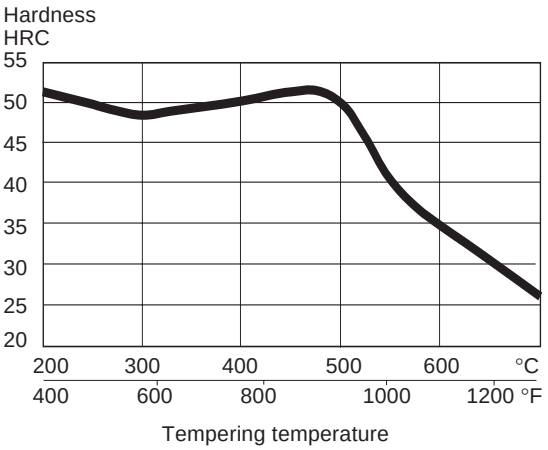
- Circulating atmosphere/gas
- Oil
- Martempering bath 200–550° C (390–1020° F), then cool in air.

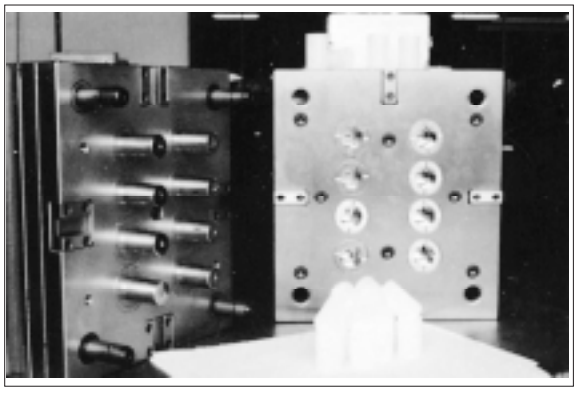
In order to obtain the optimum properties, the cooling rate should be as fast as is concomitant with acceptable distortion. Temper the tool as soon as its temperature reaches 50–70° C (120—160° F).

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 is valid for small samples quenched in air. Austenitizing temperature: 1030° C (1890° F), 30 min. Holding time: 2 + 2 h.





Holder block in RAMAX S and mould inserts in STAVAX ESR. An ideal combination for long production runs.

Machining

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 the Uddeholm publication "Cutting data recommendation".

TURNING

Cutting data parameters	Turning with carbide		Turning with high speed steel
	Rough turning	Fine turning	Fine turning
Cutting speed (v_c) m/min.	110–160	160–210	18–23
f.p.m.	360–525	525–690	59–75
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	0,002–0,01
Depth 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–P30	P10	–
US	C6–C5 Coated carbide	C7 Coated carbide or cermet	

MILLING

Face and square shoulder milling

Cutting data parameters	Milling with carbide	
	Rough milling	Fine milling
Cutting speed (v_c) m/min	110–160	160–200
f.p.m.	360–525	525–656
Feed (f_z) mm/tooth	0,2–0,4	0,1–0,2
inch/tooth	0,008–0,016	0,004–0,008
Depth of cut (a_p) mm	2–5	≤2
inch	0,08–0,2	≤0,08
Carbide designation ISO	P20–P40	P10–P20
US	C6–C5 Coated carbide	C6–C7 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	70–100	100–140	30–35[1]
f.p.m.	230–328	328–460	98–115[1]
Feed (f_z) mm/tooth	0,006–0,20[2]	0,06–0,20[2]	0,01–0,35[2]
inch/tooth	0,0002–0,008[2]	0,002–0,008[2]	0,0004–0,014[2]
Carbide designation ISO	K10, P40	P15–P40	–
US	C3, C5	C6–C5	

[1] *For coated HSS end mill $v_c \approx 50$ m/min. (≈164 f.p.m).*
[2] *Depending on radial depth of cut and cutter diameter.*

DRILLING

High speed steel twist drill

Drill diameter inch	Drill diameter mm	Cutting speed (v_c) f.p.m.	Cutting speed (v_c) m/min	Feed (f) i.p.r.	Feed (f) mm/r
–3/16	≤5	49*	15*	0,002–0,004	0,05–0,10
3/16–3/8	5–10	49*	15*	0,004–0,008	0,10–0,20
3/8–5/8	10–15	49*	15*	0,008–0,010	0,20–0,25
5/8–3/4	15–20	49*	15*	0,010–0,012	0,25–0,30

** For coated HSS drill $v_c = 25$ m/min. (82 f.p.m.).*

Carbide drill

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Brazed carbide[1]
Cutting speed (v_c) m/min	180–200	90–110	60–90
f.p.m.	590–656	295–360	197–295
Feed (f) mm/r	0,05–0,15[2]	0,10–0,25[2]	0,15–0,25[2]
i.p.r.	0,002–0,006[2]	0,004–0,01[2]	0,006–0,01[2]

[1] *Drill with internal cooling channels and brazed tip.*
[2] *Depending on drill 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	Wheel recommendation
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 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	STAVAX TIG-WELD	STAVAX WELD
Hardness after welding	54–56 HRC	54–56 HRC
Weld hardness after tempering 2 x 1 h at 570°C* (1060°F)	41–43 HRC	41–43 HRC

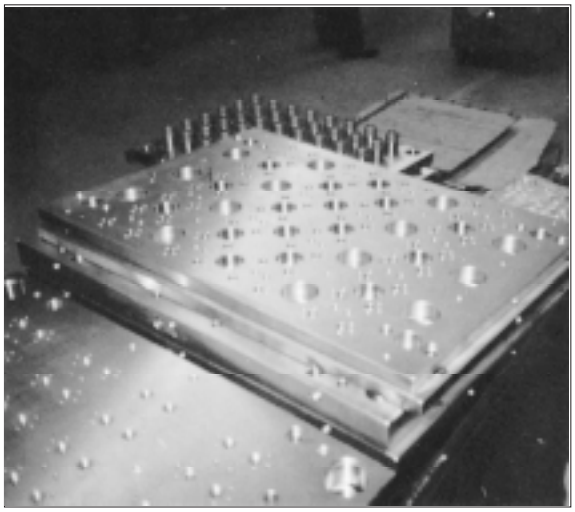
**) A higher tempering temperature will decrease the hardness of the base material.*

RAMAX S 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”.



Holder block in RAMAX S.