RAMAX® 2

Prehardened stainless holder steel

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

UDDEHOLM

General

Ramax 2 is a new chromium alloyed stainless holder steel, which is supplied in the hardened and tempered condition.

Ramax 2 is characterized by

- Excellent machinability
- Good corrosion resistance
- Good hardenability
- 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 providing for a shorter machining time

Typical analysis %	Cr-Ni-Mo-V alloyed +Sulphur
Delivery condition	Hardened and tempered to ~ 340 HB
Colour code	Black/brown with white line across

Applications

- Holders/bolsters for plastic moulds.
- Plastic and rubber moulds with low requirements on polishability
- Dies for plastic extrusion
- Constructional parts

Properties

PHYSICAL DATA

Hardened and tempered to 350 HB. Data at room and elevated temperatures.

Temperature	20°C (68°F)	200°C (390°F)
Density kg/m³ lbs/in³	 7 700 0,280	 – –
Modulus of elasticity Mpa psi	 215 000 $31,2 \times 10^6$	 205 000 $29,7 \times 10^6$
Coefficient of thermal expansion per °C from 20°C per °F from 68°F	 – –	 $10,8 \times 10^{-6}$ $6,0 \times 10^{-6}$
Thermal conductivity* W/m °C Btu in/ft² h °F	 – –	 24 166
Specific heat capacity J/kg °C Btu/lb°F	 460 0,110	 –

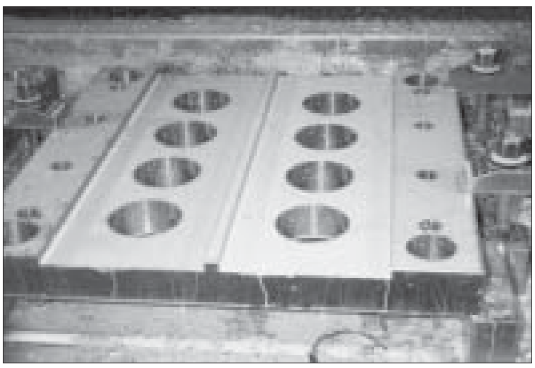
**Thermal conductivity is very difficult to measure. The scatter can be as high as ±15%*

TENSILE STRENGTH

Approximate values. Samples were taken from a bar 255 x 60 mm (10 x 2,4") in length direction. Hardness: 350 HB.

Testing temperature	20°C (68°F)	200°C (390°F)
Tensile strength Rm, MPa psi	 1 140 $1,65 \times 10^5$	 1 020 $1,48 \times 10^5$
Yield strength $Rp_{0,2}$ MPa psi	 990 $1,44 \times 10^5$	 920 $1,33 \times 10^5$
Reduction of area Z, %	46	48
Elongation A_5, %	12	10

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



Holder plate

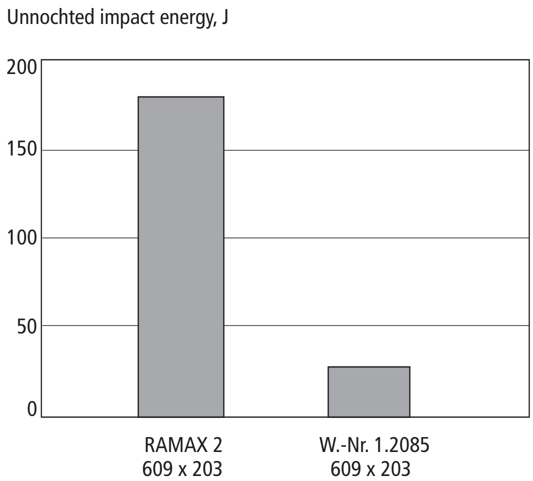
TOUGHNESS/DUCTLITY

Ramax 2 has much higher toughness/ ductility compared to other stainless holders of W.-Nr.1.2085 type.

Approximate room temperature impact strength in the longitudinal direction in the centre is given in the graph below.

Specimen size: 7 x 10 x 55 mm (0,27 x 0,4 x 2,2") unnotched.

Delivery condition: ~350 HB



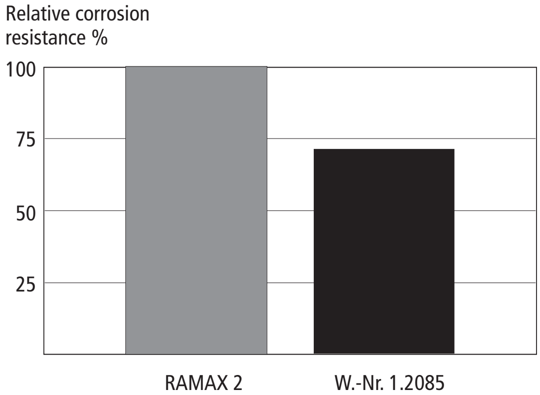
Note: The high sulphur content gives lower mechanical properties in the transverse compared with longitudinal direction.

CORROSION RESISTANCE

Holders made from Ramax 2 will have good resistance to corrosion caused by humid working and storage conditions and when moulding corrosive plastics under normal production conditions

In the graph below values from potentiodynamic polarization curves has been evaluated to show the difference in general corrosion resistance between Ramax 2 and W.-Nr.1.2085.

Specimen size: 20 x 15 x 3 mm (0,8 x 0,6 x 0,12")



Heat treatment

Ramax 2 is intended for use in the as-delivered condition i.e. hardened and tempered to 350 HB.

When the steel is to be heat treated to higher hardness, instructions below are to be followed. *Note;* however that an increased hardness yields a lower toughness.

SOFT ANNEALING

Protect the steel and heat through to 740°C (1365°F). Cool at 15°C (30°F) per hour to 550°C (1020°F), then freely in air.

STRESS RELIEVING

After rough machining the tool should be heated through to max. 530°C (985°F), holding time 2 hours, then cool freely in air.

HARDENING

Note: The steel should be annealed before hardening.
Preheating temperature: 500–600°C (930–1110°F).
Austenitizing temperature: 980–1020°C (1795–1870°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

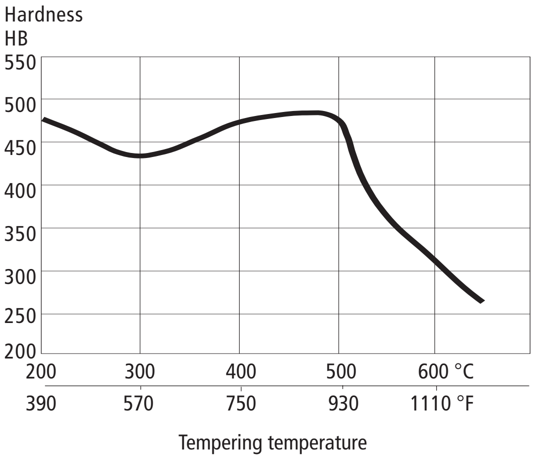
- Oil
- Fluidized bed or salt bath at 250–550°C (480–1020°F), then cool in air blast
- Vacuum with sufficient positive pressure
- High speed gas/circulating atmosphere

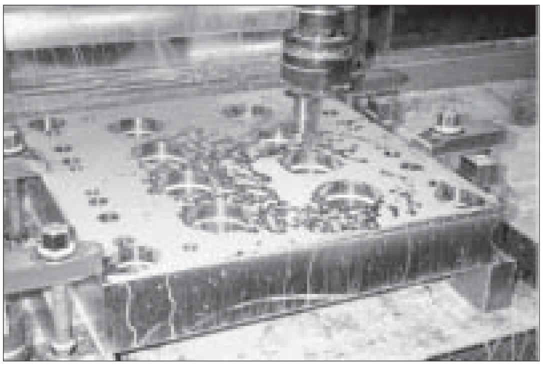
In order to obtain the optimum properties, the cooling rate should be as fast is possible within acceptable distortion limits. Temper the tool as soon as its temperature reaches 50–70°C (120–160°F).

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 250°C (480°F). Holding time at temperature minimum 2 hours.

Austenitizing temperature: 1000°C (1830°F), 30 min.
Holding time: 2 + 2h





Machinability is a critical property during manufactring of holder plates.

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: Rough turning	Turning with carbide: Fine turning	Turning with high speed steel: Fine turning
Cutting speed (v_c) m/min. f.p.m.	110–160 360–525	160–210 525–690	18–23 59–75
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 0,002–0,01
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 US	P20–P30 C6–C5 Coated carbide	P10 C7 Coated carbide or cermet	–

MILLING

Face and square shoulder milling

Cutting data parameters	Milling with carbide: Rough milling	Milling with carbide: Fine milling
Cutting speed (v_c) m/min f.p.m.	110–160 360–525	160–200 525–656
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	2–5 0,08–0,2	≤2 ≤0,08
Carbide designation ISO US	P20–P40 C6–C5 Coated carbide	P10–P20 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	–	P15–P40	–
US		C6–C5	

[1] For coated HSS end mill v_c = 50–55 m/min. (164–180 f.p.m)
[2] Depending on radial depth of cut and cutter diameter

DRILLING

High speed steel twist drill

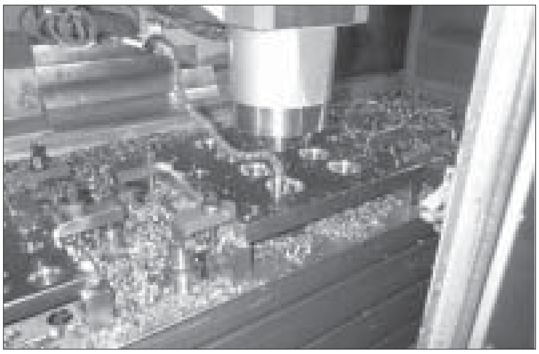
Drill diameter inch	Drill diameter mm	Cutting speed (v_c) f.p.m.	Cutting speed (v_c) m/min	Feed (f) i.p.r.	Feed (f) mm/r
–3/16	≤5	46–52*	14–16*	0,002–0,004	0,05–0,10
3/16–3/8	5–10	46–52*	14–16*	0,004–0,008	0,10–0,20
3/8–5/8	10–15	46–52*	14–16*	0,008–0,010	0,20–0,25
5/8–3/4	15–20	46–52*	14–16*	0,010–0,012	0,25–0,30

** For coated HSS drill v_c = 24–26 m/min. (79–85 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 (GTAW)		MMA (SMAW)
Working temperature	200–250°C (390–480°F)		200–250°C (390–480°F)
Welding consumables	STAVAX TIG-WELD	Austenitic stainless steel Type ER312	Austenitic stainless steel Type ER312
Hardness after welding	54–56 HRC	28–30 HRC	28–30 HRC
Hardness after tempering 2 x 2h at 530°C (990°F)	50–52 HRC	28–30 HRC	28–30 HRC
1 x 2h at 600°C (1220°F)	41–43 HRC	–	–

A tempering temperature higher than 530°C (990°F) causes a reduction of the base material hardness. Tempering at 600°C (1220°F) reduce the hardness of the base material with 2–3 HRC

Ramax 2 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".

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