

UDDEHOLM RAMAX HH

Uddeholm Ramax HH provides several benefits:

- The product offers uniform hardness in all dimensions combined with excellent indentation resistance.
- It is a corrosion resistant grade which prevents clogging of the water cooling channels that could otherwise affect cycle time consistency.

Uddeholm Ramax HH is supplied at a hardness level that is higher than other corrosion resistant prehardened grades, resulting in a more durable mould and a longer life time.

By combining Uddeholm Ramax HH with one of our other products within the Stainless Concept, you can create a completely stainless mould.

Uddeholm Ramax HH is a part of the Uddeholm Stainless Concept.

Ramax® is a trade mark registered in the European Union and in the U.S.

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

Uddeholm Ramax HH is characterized by

- Good corrosion resistance
- Uniform hardness even in large dimensions
- Good indentation resistance
- Good machinability

These properties combine to give a steel with outstanding production performance. The practical benefits of **good corrosion resistance** 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 benefit of the **relatively high hardness** for a prehardened grade can be summarized as:

- less indentations
- less wear

leading to lower mould maintenance cost and longer life.

| Typical analysis % | C | Si | Mn | Cr | Mo | Ni | V | S | +N |
|--------------------|------------------------------------|-----|-----|------|-----|-----|-----|-----|----|
| | 0.12 | 0.2 | 1.3 | 13.4 | 0.5 | 1.6 | 0.2 | 0.1 | |
| 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 ~340 HB. Data at room and elevated temperatures.

| Temperature | 20°C (68°F) | 200°C (390°F) |
|--|-----------------------------------|---|
| Density kg/m ³ lbs/in ³ | 7 700 0.280 | – – |
| Modulus of elasticity Mpa psi | 215 000 31.2 × 10 ⁶ | 205 000 29.7 × 10 ⁶ |
| Coefficient of thermal expansion per °C from 20°C per °F from 68°F | – – | 10.8 × 10 ⁻⁶ 6.0 × 10 ⁻⁶ |
| Thermal conductivity* W/m °C Btu in/ft ² 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 × 60 mm (10 × 2.4") in length direction. Hardness: ~340 HB.

| Testing temperature | 20°C (68°F) | 200°C (390°F) |
|------------------------------------|---------------------------------|---------------------------------|
| Tensile strength Rm MPa psi | 1 140 1.65 × 10 ⁵ | 1 020 1.48 × 10 ⁵ |
| Yield strength Rp0.2 MPa psi | 990 1.44 × 10 ⁵ | 920 1.33 × 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.



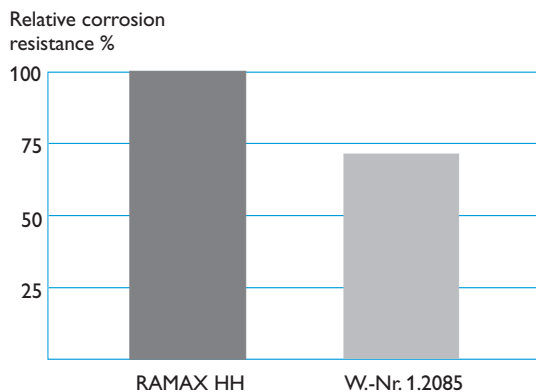
Holder plate.

Corrosion resistance

Holders made from Uddeholm Ramax HH 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 Uddeholm Ramax HH and W.-Nr.1.2085.

Specimen size: 20 x 15 x 3 mm (0.8 x 0.6 x 0.12")



Heat treatment

Uddeholm Ramax HH 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 are to be followed.

However, note 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

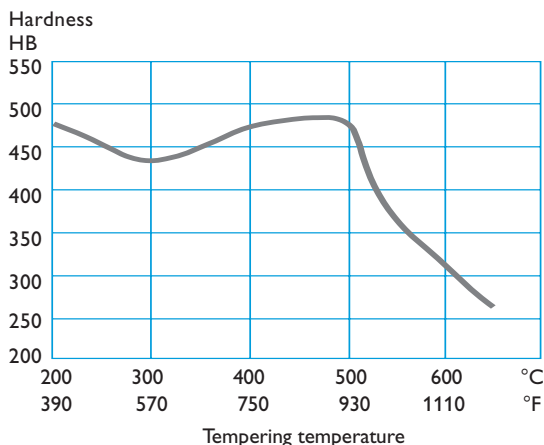
In order to obtain the optimum properties, the cooling rate should be as fast as possible within acceptable distortion limits. Temper the tool as soon as its temperature reaches 50–70°C (120–160°F).

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



Machining 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 the Uddeholm publication "Cutting data recommendations".

Turning

| Cutting data parameters | Turning with carbide | | Turning with HSS Fine turning |
|---|------------------------------------|---------------------------------------|----------------------------------|
| | Rough turning | 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 | – |

HSS = High Speed Steel



Machinability is a critical property during manufacturing of holder plates.

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. | 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 C7–C6 Coated carbide or cermet |

END MILLING

| Cutting data parameters | Type of milling | | |
|--|--|--|---|
| | Solid carbide | Carbide indexable insert | HSS |
| Cutting speed (v_c) m/min f.p.m. | 70–100 230–328 | 100–140 328–460 | 30–35 ¹⁾ 98–115 ¹⁾ |
| Feed (f_z) mm/tooth inch/tooth | 0.006–0.20 ²⁾ 0.0002–0.008 ²⁾ | 0.06–0.20 ²⁾ 0.002–0.008 ²⁾ | 0.01–0.35 ²⁾ 0.0004–0.014 ²⁾ |
| Carbide designation ISO US | – | P15–P40 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 | | Cutting speed (v_c) | | Feed (f) | |
|----------------|----------|-------------------------|--------|-------------|-----------|
| inch | mm | f.p.m. | m/min | i.p.r. | 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 | Carbide tipped ¹⁾ |
| Cutting speed (v _c) m/min f.p.m. | 180–200 590–656 | 90–110 295–360 | 60–90 197–295 |
| 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”)

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 JV |

Polishability

As other sulphurized steel the polishability is affected by the higher amount of sulphide inclusions and for that reason Uddeholm Ramax HH should only be used in tools with low to moderate demands on polishability.

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) | |
| Welding consumables | STAVAX TIG-WELD | Austenitic stainless steel Type ER312 | Austenitic stainless steel Type E312 |
| 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 | – | – |

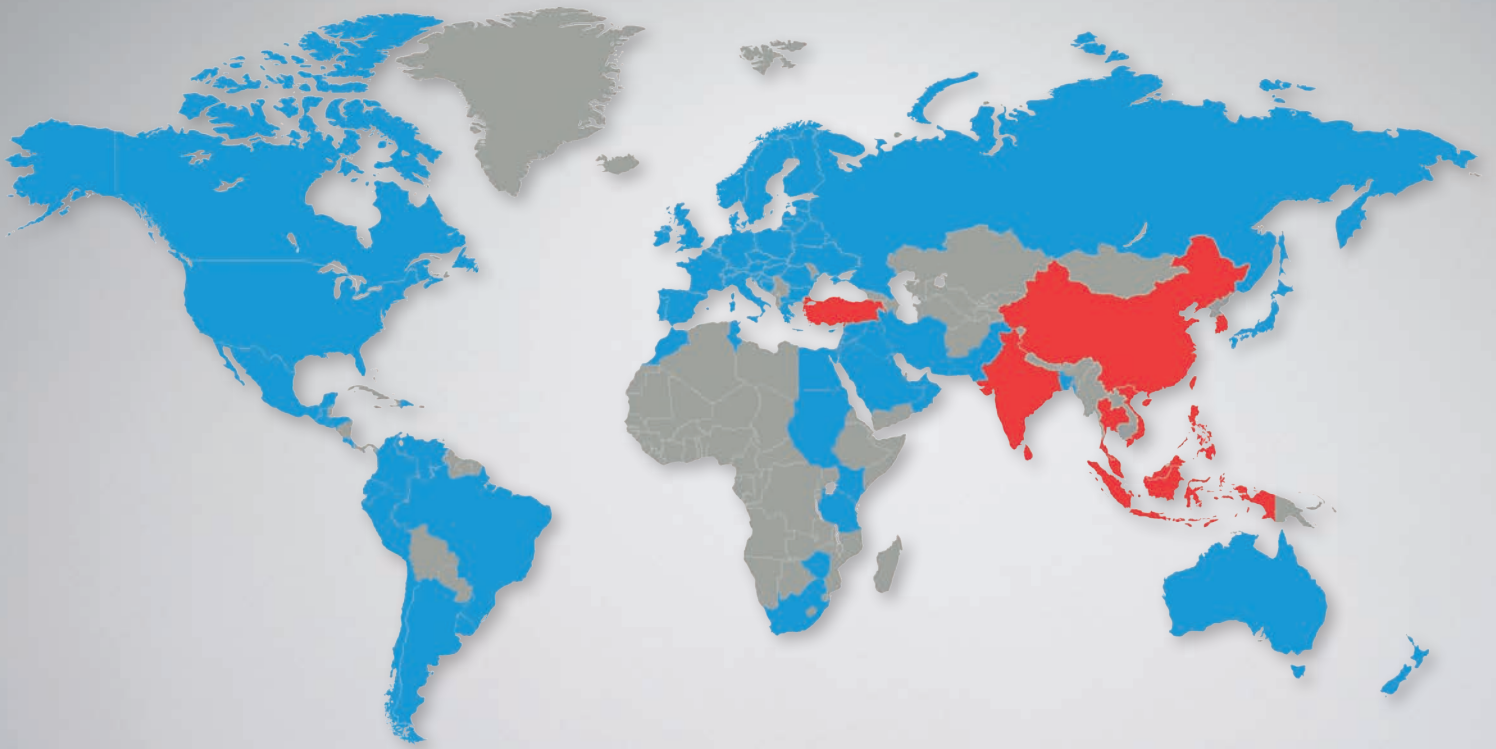
* A tempering temperature higher than 530°C (990°F) causes a reduction of the base material hardness. Tempering at 600°C (1220°F) reduce the hardness of the base material with 2–3 HRC.

Uddeholm Ramax HH 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 wholly-owned subsidiary and 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 wholly-owned subsidiary and 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.

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