UDDEHOLM IMPAX SUPREME

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

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”.
Edition 7, revised 09.2014, not printed

The latest revised edition of this brochure is the English version, which is always published on our web site www.uddeholm.com
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

Properties

Physical data

<table>
<thead>
<tr>
<th>Temperature</th>
<th>20°C (68°F)</th>
<th>200°C (390°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, kg/m³</td>
<td>7 800</td>
<td>7 750</td>
</tr>
<tr>
<td></td>
<td>lbs/in³</td>
<td>0.282</td>
</tr>
<tr>
<td>Coefficient of thermal expansion per °C from 20°C</td>
<td>12.7 x 10⁻⁵</td>
<td></td>
</tr>
<tr>
<td>per °F from 68°F</td>
<td>7.0 x 10⁻⁵</td>
<td></td>
</tr>
<tr>
<td>Thermal conductivity W/m °C</td>
<td>–</td>
<td>28</td>
</tr>
<tr>
<td>Btu in² h⁻¹ °F</td>
<td>–</td>
<td>194</td>
</tr>
<tr>
<td>Modulus of elasticity N/mm²</td>
<td>205 000</td>
<td>200 000</td>
</tr>
<tr>
<td>psi</td>
<td>13 380</td>
<td>12 960</td>
</tr>
<tr>
<td>29.7 x 10⁶</td>
<td>29.0 x 10⁶</td>
<td></td>
</tr>
<tr>
<td>Specific heat capacity J/kg °C</td>
<td>460</td>
<td>–</td>
</tr>
<tr>
<td>Btu/lb °F</td>
<td>0.110</td>
<td>–</td>
</tr>
</tbody>
</table>

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

Mechanical properties

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 temperature and hardness variation within the delivery hardness range.

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
**UDDEHOLM IMPAX SUPREME**

**TENSILE STRENGTH**

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

Hardness: 325 HB.

<table>
<thead>
<tr>
<th>Testing temperature</th>
<th>20°C (68°F)</th>
<th>200°C (390°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate tensile strength $R_m$ N/mm²</td>
<td>1020</td>
<td>930</td>
</tr>
<tr>
<td>Yield strength $R_p0.2$ N/mm²</td>
<td>900</td>
<td>800</td>
</tr>
</tbody>
</table>

**COMPRESSIVE STRENGTH**

| Compressive yield strength $R_{c0.2}$ 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 treated 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 temperature.

**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**

- 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 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) 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”.

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**Testing temperature**

- 20°C (68°F)
- 200°C (390°F)

**Ultimate tensile strength** $R_m$ N/mm²

- 1020
- 930

**Yield strength** $R_p0.2$ N/mm²

- 900
- 800

**Compressive yield strength** $R_{c0.2}$ N/mm²

- 850–1000
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:

<table>
<thead>
<tr>
<th>Process</th>
<th>Temperature °C</th>
<th>°F</th>
<th>Time h</th>
<th>Surface hardness HV1</th>
<th>Depth of case mm</th>
<th>Inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas nitriding</td>
<td>525</td>
<td>977</td>
<td>20</td>
<td>650</td>
<td>0.30</td>
<td>0.012</td>
</tr>
<tr>
<td>Ion-nitriding</td>
<td>480</td>
<td>896</td>
<td>24</td>
<td>700</td>
<td>0.30</td>
<td>0.012</td>
</tr>
<tr>
<td>Nitrocarburizing</td>
<td>570</td>
<td>1058</td>
<td>2</td>
<td>700</td>
<td>0.10</td>
<td>0.004</td>
</tr>
</tbody>
</table>

Cutting data recommendations
The cutting data below are to be considered as guiding values which must be adapted to existing local conditions.

<table>
<thead>
<tr>
<th>Type of drill</th>
<th>Cutting data parameters</th>
<th>Indexable insert</th>
<th>Solid carbide</th>
<th>Carbide tip 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting speed, (v_c)</td>
<td>m/min f.p.m.</td>
<td>180–200</td>
<td>120–150</td>
<td>60–80</td>
</tr>
<tr>
<td>Feed, (f)</td>
<td>mm/r i.p.r.</td>
<td>0.05–0.15</td>
<td>0.08–0.20</td>
<td>0.15–0.25</td>
</tr>
</tbody>
</table>

Drilling
HIGH SPEED STEEL TWIST DRILL

<table>
<thead>
<tr>
<th>Drill diameter mm</th>
<th>Cutting speed, (v_c) m/min</th>
<th>Feed, (f) mm/r</th>
<th>i.p.r.</th>
</tr>
</thead>
<tbody>
<tr>
<td>–5</td>
<td>14–16</td>
<td>0.08–0.15</td>
<td>0.003–0.006</td>
</tr>
<tr>
<td>5–10</td>
<td>14–16</td>
<td>0.15–0.25</td>
<td>0.006–0.010</td>
</tr>
<tr>
<td>10–15</td>
<td>14–16</td>
<td>0.25–0.30</td>
<td>0.010–0.012</td>
</tr>
<tr>
<td>15–20</td>
<td>14–16</td>
<td>0.30–0.35</td>
<td>0.012–0.014</td>
</tr>
</tbody>
</table>

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

CARBIDE DRILL

Milling
FACE AND SQUARE SHOULDER MILLING

<table>
<thead>
<tr>
<th>Cutting data parameters</th>
<th>Milling with carbide</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rough milling</td>
</tr>
<tr>
<td>Cutting speed, (v_c)</td>
<td>m/min f.p.m.</td>
</tr>
<tr>
<td>Feed, (f)</td>
<td>mm/tooth inch/tooth</td>
</tr>
<tr>
<td></td>
<td>mm</td>
</tr>
<tr>
<td>Depth of cut, (a_p)</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>inch</td>
</tr>
<tr>
<td>Carbide designation ISO</td>
<td>P20–P40 Coated carbide</td>
</tr>
</tbody>
</table>
Further information is given in the Uddeholm brochures “Welding of Tool Steel” and “Uddeholm Impax Weld/TIG-Weld”.

## Electrical-discharge machining

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 polishing time which largely depends on hardness and polishing technique. Overpolishing 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”.

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### END MILLING

<table>
<thead>
<tr>
<th>Cutting parameters</th>
<th>Solid carbide</th>
<th>Carbide indexable insert</th>
<th>High speed steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting speed, (v_c) m/min</td>
<td>70–110</td>
<td>80–120</td>
<td>15–20*</td>
</tr>
<tr>
<td>f.p.m.</td>
<td>230–361</td>
<td>262–394</td>
<td>49–66*</td>
</tr>
<tr>
<td>Feed, (f_z) mm/tooth</td>
<td>0.03–0.20*</td>
<td>0.08–0.20*</td>
<td>0.05–0.35*</td>
</tr>
<tr>
<td>inch/tooth</td>
<td>0.001–0.008*</td>
<td>0.003–0.008*</td>
<td>0.002–0.014*</td>
</tr>
</tbody>
</table>
| Carbide designation, ISO | – | P20–P40 | –

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

* Depending on radial depth of cut and cutter diameter

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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.