<table>
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<tr>
<th>ASSAB</th>
<th>UDDEHOLM</th>
<th>REFERENCE STANDARD</th>
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<tbody>
<tr>
<td>ASSAB DF-2</td>
<td>ARNE</td>
<td>AISI</td>
</tr>
<tr>
<td>ASSAB DF-3</td>
<td>O1</td>
<td>O1</td>
</tr>
<tr>
<td>ASSAB XW-S</td>
<td>SVERKER 3</td>
<td>D6 (D3)</td>
</tr>
<tr>
<td>ASSAB XW-10</td>
<td>RIGOR</td>
<td>A2</td>
</tr>
<tr>
<td>ASSAB XW-41</td>
<td>SVERKER 21</td>
<td>D2</td>
</tr>
<tr>
<td>ASSAB XW-42</td>
<td>D2</td>
<td>1.2379</td>
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<td>CARMO</td>
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<tr>
<td>CALMAX</td>
<td>CALMAX</td>
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<td>CALDIE</td>
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</tr>
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<td>ASSAB 88</td>
<td>SLEIPNER</td>
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<tr>
<td>ASSAB PM 23 SUPERCLEAN</td>
<td>VANADIS 23 SUPERCLEAN</td>
<td>(M3:2)</td>
</tr>
<tr>
<td>ASSAB PM 30 SUPERCLEAN</td>
<td>VANADIS 30 SUPERCLEAN</td>
<td>(M3:2 + Co)</td>
</tr>
<tr>
<td>ASSAB PM 60 SUPERCLEAN</td>
<td>VANADIS 60 SUPERCLEAN</td>
<td></td>
</tr>
<tr>
<td>VANADIS 4 EXTRA SUPERCLEAN</td>
<td>VANADIS 4 EXTRA SUPERCLEAN</td>
<td></td>
</tr>
<tr>
<td>VANADIS 6 SUPERCLEAN</td>
<td>VANADIS 6 SUPERCLEAN</td>
<td></td>
</tr>
<tr>
<td>VANADIS 10 SUPERCLEAN</td>
<td>VANADIS 10 SUPERCLEAN</td>
<td></td>
</tr>
<tr>
<td>VANCROP 40 SUPERCLEAN</td>
<td>VANCROP 40 SUPERCLEAN</td>
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</tr>
<tr>
<td>ELMAX SUPERCLEAN</td>
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<td></td>
</tr>
<tr>
<td>ASSAB 618</td>
<td>P20 Mod.</td>
<td>1.2738</td>
</tr>
<tr>
<td>ASSAB 618 HH</td>
<td>P20 Mod.</td>
<td>1.2738</td>
</tr>
<tr>
<td>ASSAB 618 T</td>
<td>P20 Mod.</td>
<td>1.2738 Mod.</td>
</tr>
<tr>
<td>ASSAB 718 SUPREME</td>
<td>IMPAX SUPREME</td>
<td>P20 Mod.</td>
</tr>
<tr>
<td>ASSAB 718 HH</td>
<td>IMPAX HH</td>
<td>P20 Mod.</td>
</tr>
<tr>
<td>NIMAX</td>
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<tr>
<td>MIRRAX 40</td>
<td>MIRRAX 40</td>
<td>420 Mod.</td>
</tr>
<tr>
<td>VIDAR 1 ESR</td>
<td>VIDAR 1 ESR</td>
<td>H11</td>
</tr>
<tr>
<td>UNIMAX</td>
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<td></td>
</tr>
<tr>
<td>CORRAX</td>
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<td></td>
</tr>
<tr>
<td>ASSAB 2083</td>
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<td>1.2083</td>
</tr>
<tr>
<td>STAVAX ESR</td>
<td>STAVAX ESR</td>
<td>420 Mod.</td>
</tr>
<tr>
<td>MIRRAX ESR</td>
<td>MIRRAX ESR</td>
<td>420 Mod.</td>
</tr>
<tr>
<td>POLMAX</td>
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<td></td>
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<tr>
<td>RAMAX HH</td>
<td>RAMAX HH</td>
<td>420 F Mod.</td>
</tr>
<tr>
<td>ROYALLOY</td>
<td>ROYALLOY</td>
<td></td>
</tr>
<tr>
<td>PRODAX</td>
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<tr>
<td>ASSAB PT18</td>
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<td></td>
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<tr>
<td>ASSAB MMXL</td>
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<td>ASSAB MM40</td>
<td></td>
<td></td>
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<tr>
<td>ALVAR 14</td>
<td>ALVAR 14</td>
<td></td>
</tr>
<tr>
<td>ASSAB 2714</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASSAB 8407 2M</td>
<td>ORVAR 2M</td>
<td>H13</td>
</tr>
<tr>
<td>ASSAB 8407 SUPREME</td>
<td>ORVAR SUPREME</td>
<td>H13 Premium</td>
</tr>
<tr>
<td>DIEVAR</td>
<td>DIEVAR</td>
<td></td>
</tr>
<tr>
<td>HOTVAR</td>
<td>HOTVAR</td>
<td></td>
</tr>
<tr>
<td>QRO 90 SUPREME</td>
<td>QRO 90 SUPREME</td>
<td></td>
</tr>
<tr>
<td>FORMVAR</td>
<td>FORMVAR</td>
<td></td>
</tr>
<tr>
<td>ASSAB 705</td>
<td>4340</td>
<td>1.6582</td>
</tr>
<tr>
<td>ASSAB 709</td>
<td>4140</td>
<td>1.7225</td>
</tr>
<tr>
<td>ASSAB 760</td>
<td>1050</td>
<td>1.1730</td>
</tr>
</tbody>
</table>

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The information contained herein 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. Each user of ASSAB products is responsible for making its own determination as to the suitability of ASSAB products and services.

Edition 140919
VANCRON 40 SuperClean

Vancron 40 SuperClean is a nitrided powder tool steel, which means that a “surface coating” is already integrated into the finished tooling material. The result is a tool surface with very low friction that reduces galling or sticking of soft work materials.

In several cold work applications, like forming of e.g., aluminium, stainless steel and mild steel, galling and adhesive wear are often the dominating tooling problems. This could also be the case in powder compacting, cold extrusion and blanking or shearing of different work materials. One common way of coping with this type of problem is to use different kinds of surface coatings like CVD, PVD or TD (Toyota Diffusion).

Vancron 40 SuperClean offers the possibility of eliminating these time-consuming and costly surface coatings. This is achieved in the manufacturing process of Vancron 40 SuperClean by introducing an extra nitriding operation. Our steel mill in Sweden, Uddeholm Tooling, has spent a lot of time and resources in this development, and can now launch a completely new type of PM tool steel with a special kind of internal surface coating.

Benefits for the tool user include improved and consistent quality of the manufactured parts, especially regarding the surfaces. More reliable delivery time and higher utilisation of the production equipment are also benefits, with fewer disturbances and interruptions in production. Further improvements include simplified maintenance, which can often be made in-house as no surface coating is required; and total tool life is increased as well.

The tool maker can produce a high quality tool that does not require any surface coating, which means a shorter delivery time and freedom to make adjustments after heat treatment.

In total, this means that the product quality will be uniform from the first part produced to the last, and that a tool manufactured in Vancron 40 SuperClean will make it easier for you to keep your promises!
Critical tool steel properties

FOR GOOD TOOL PERFORMANCE

In many cold work applications, tools are surface coated to prevent galling and adhesive wear. It is also important that the tools have the right hardness, as well as sufficient ductility and toughness to prevent premature failure.

Vancron 40 SuperClean is a nitrided powder metallurgical tool steel offering an excellent combination of galling resistance and adhesive wear resistance.

FOR TOOL MAKING

- Machinability
- Heat treatment
- Grinding
- Dimensional stability during heat treatment
- Surface treatment

Tool making with highly alloyed tool steels means that machining and heat treatment are often more of a problem than with the lower alloy grades. This can, of course, raise the cost of tool making.

The powder manufacturing route used for Vancron 40 SuperClean means that its machinability is superior to that of similar conventionally produced grades and some highly alloyed cold work tool steels.

The dimensional stability of Vancron 40 SuperClean during heat treatment is good and predictable compared to conventionally produced high alloy steels.

Vancron 40 SuperClean is designed to be used without surface coating as it contains a high amount of low friction vanadium rich nitrides in the matrix.

General

Vancron 40 SuperClean is characterised by:

- Very high adhesive wear resistance
- Very high galling resistance
- Good chipping and cracking resistance
- High compressive strength
- Good through-hardening properties
- Good dimensional stability during hardening
- Very good resistance to tempering back
- Good WEDM properties

<table>
<thead>
<tr>
<th>Typical analysis %</th>
<th>C</th>
<th>N</th>
<th>Si</th>
<th>Mn</th>
<th>Cr</th>
<th>Mo</th>
<th>W</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.1</td>
<td>1.8</td>
<td>0.5</td>
<td>0.4</td>
<td>4.5</td>
<td>3.2</td>
<td>3.7</td>
<td>8.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard specification</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery condition</td>
<td>Soft annealed to approx. 300 HB</td>
</tr>
<tr>
<td>Colour code</td>
<td>Gold / Dark Blue</td>
</tr>
</tbody>
</table>

Applications

Vancron 40 SuperClean is a nitrided powder metallurgical tool steel that can reduce or solve tooling problems like galling, adhesive wear and offers low fiction. Vancron 40 SuperClean is ideal for severe production conditions and/or long run production in applications where surface coated tool steel is needed. The work materials in these applications are often soft/adherent materials such as austenitic and ferritic stainless steels, mild steels, copper, aluminium, etc.

Vancron 40 SuperClean should be used in cold work applications where the predominant failure mechanisms are adhesive wear or galling.

TYPICAL APPLICATIONS

- Blanking and forming
- Cold extrusion
- Deep drawing
- Powder pressing
- An alternative to tooling when coatings and cemented carbide used to be the only solution
Properties

PHYSICAL PROPERTIES

Hardened and tempered to 61 HRC.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>20°C</th>
<th>200°C</th>
<th>400°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density kg/m³</td>
<td>7700</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Modulus of elasticity MPa</td>
<td>236000</td>
<td>227000</td>
<td>213000</td>
</tr>
<tr>
<td>Coefficient of thermal expansion per °C from 20°C</td>
<td>-</td>
<td>11.1 x 10⁻⁴</td>
<td>11.9 x 10⁻⁴</td>
</tr>
<tr>
<td>Thermal conductivity W/m °C</td>
<td>-</td>
<td>21±2</td>
<td>25±0.5</td>
</tr>
<tr>
<td>Specific heat J/kg °C</td>
<td>460</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

COMPRESSIVE STRENGTH

Approximate compressive strength vs. hardness at room temperature.

<table>
<thead>
<tr>
<th>Hardness HRC</th>
<th>Compressive yield strength Rₚ₀.₂ (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
<td>2200</td>
</tr>
<tr>
<td>60</td>
<td>2500</td>
</tr>
<tr>
<td>62</td>
<td>2700</td>
</tr>
<tr>
<td>64</td>
<td>3000</td>
</tr>
</tbody>
</table>

UNNOTCHED IMPACT ENERGY

Unnotched impact energy for ASSAB PM 23 SuperClean, Vancron 40 SuperClean, Vanadis 10 SuperClean, and AISI D2 is shown below.

Products made by powder compacting (pressing).
Vancron 40 SuperClean offers a unique combination of galling resistance, adhesive wear resistance and low friction without the need to be surface coated. This means that you can reduce the amount of lubrication in your powder to be pressed and attain higher density and properties. Vancron 40 SuperClean improves the quality of the green compacts and final powder pressed products (e.g., improved surface quality). Courtesy: Höganäs AB, Sweden and Callo Sintermetall, Sweden.
Heat treatment

**SOFT ANNEALING**
Protect the steel and heat through to 900°C. Then cool in the furnace at 10°C/h to 650°C, then freely in air.

**STRESS RELIEVING**
After rough machining, the tool should be heated through to 600 - 700°C, holding time 2 hours. Cool slowly to 500°C, then freely in air.

**HARDENING**
The hardenability for Vancron 40 SuperClean is equivalent to ASSAB PM 23 SuperClean, which ensures good through-hardening properties during quenching in salt bath or gas quenching in vacuum furnace.

*Preheating in two stages: 600 - 650°C and 850 - 900°C.  
Austenitising temperature: 1000 - 1100°C normally 1020°C.  
Holding time: 30 minutes (10 minutes at 1100°C).  
The tool should be protected against decarburisation and oxidation during hardening.*

In some cases denitriding should also be considered. To avoid loss of nitrogen, which may lower the surface hardness, a minimum of 10 mbar and up to 400 mbar nitrogen overpressure is recommended during hardening. Alternatively the machining allowance could be increased.

Vancron 40 SuperClean can be heat treated to give a wide range of hardness. To achieve a hardness between 58 - 65 HRC, the austenitising temperature is varied in the range 950 - 1100°C. The recommended austenitising temperature is 1020°C with 30 minutes holding time, followed by quenching and tempering at 560°C / 3 x 1 h resulting in a hardness of 60 - 62 HRC.

In order to avoid a too low working hardness, it is recommended to austenitise at a higher hardening temperature than normal. If the hardness will be too high, temper down the hardness to the right hardness level.

**QUenching MEDIA**
- N₂ with sufficient overpressure quenching in vacuum furnace
- Martempering bath or fluidised bed at approx. 550°C
- Forced air/gas

**Note 1:** Quenching should be continued until the temperature of the tool reaches approx. 50°C. The tool should then be tempered immediately.

**Note 2:** For applications where maximum toughness is required, use a martempering bath or a furnace with sufficient overpressure.

**TEMPERING**
For cold work applications, tempering should always be carried out at 560°C irrespective of the austenitising temperature. Temper three times for one hour at full temperature. The tool should be cooled to room temperature between the tempers. The retained austenite content will be less than 3% after this tempering cycle.

**DIMENSIONAL CHANGES**
Dimensional changes after hardening and tempering.
*Heat treatment: Austenitising between 950 - 1100°C /30 minutes and tempering 3 x 1 h at 560°C.  
Specimen size: 50 x 50 x 50 mm and 100 x 40 x 20 mm.  
Dimensional changes: growth in length, width and thickness +0.04% to +0.20%.

**SUB-ZERO TREATMENT**
Tools requiring maximum dimension stability in service can be sub-zero treated as follows:

Immediately after quenching, the piece should be sub-zero treated followed by tempering. Vancron 40 SuperClean is commonly sub-zero treated between -150°C and -196°C, although occasionally -70°C to -80°C are used due to constraints of the sub-zero medium and equipment available. Soaking time 1 - 3 hours, followed by tempering at 560°C.

The sub-zero treatment leads to a reduction of the retained austenite content. For a high hardening temperature > 1100°C, we always recommend sub-zero treatment followed by four temperings at 560°C, in order to reduce the retained austenite and improve the dimensional stability.

**Temp = 560°C / 3 x 1 h**

<table>
<thead>
<tr>
<th>Hardness, HRC</th>
<th>Austenitising temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>950</td>
</tr>
<tr>
<td>58</td>
<td>1000</td>
</tr>
<tr>
<td>60</td>
<td>1050</td>
</tr>
<tr>
<td>62</td>
<td>1100</td>
</tr>
</tbody>
</table>

Vancron 40 SuperClean for high performance steel application. Cylinder liner made of Vancron 40 SuperClean and used in a 500cc 4-stroke engine. The low friction and good shape stability contributes to optimised power output. The measured wheel horsepower increased by 3% to 63 bhp.
Surface treatments

Vancron 40 SuperClean is designed to be used without surface coating as it contains a high amount of nitrogen.

Some cold work tools are given a surface treatment in order to reduce friction and increase wear resistance. The most commonly used treatments are nitriding and surface coating with wear resistant layers of titanium carbide and titanium nitride (CVD, PVD).

Normally, Vancron 40 SuperClean does not need to be surface coated by PVD/CVD or nitriding. However, if extremely good resistance to galling is required in severe forming operation, Vancron 40 SuperClean can be surface coated like other PM steels. Recommended treatment is PVD with Ti(CN) or TiAlN.

PVD

Physical vapour deposition, PVD, is a method of applying a wear-resistant coating at temperatures between 200 - 500°C. As Vancron 40 SuperClean is high temperature tempered at 560°C, there is no danger of dimensional changes during PVD coating.

CVD

Chemical vapour deposition, CVD, is used for applying wear-resistant surface coatings at a temperature of around 1000°C. It is recommended that the tools should be separately hardened and tempered in a vacuum furnace after surface treatment.

NITRIDING

A brief immersion in a special salt bath to produce a nitrided diffusion zone of 2 - 20 μm is recommended. This reduces the friction on the nitrided surface of punches and has various other advantages.
Case study

WEAR RESISTANCE

Adhesive wear
Wear resistance comparison.
Component: laboratory test strip.
Tool type: blanking punch.
Tool dimension: 10 x 40 mm.
Work material: 18/8 stainless steel SS 2331 1 mm thick.

<table>
<thead>
<tr>
<th>Component</th>
<th>Tool type</th>
<th>Tool dimension</th>
<th>Work material</th>
<th>Wear resistance (µm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM 4V</td>
<td>Blanking punch</td>
<td>10 x 40 mm</td>
<td>18/8 SS 2331</td>
<td>10 000</td>
</tr>
<tr>
<td>Vanadis 4 Extra</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vancron 40 SuperClean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESULTS

Cold forming die for producing stainless steel part for pump housing. Courtesy: Grundfos A/S, Denmark.

TRIBOLOGICAL PROPERTIES

<table>
<thead>
<tr>
<th>Steel / Surface coating</th>
<th>VANADIS 23</th>
<th>VANADIS 10</th>
<th>VANCRON 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part produced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>83 000</td>
<td>1 900 000</td>
<td>&gt;18 000 000</td>
<td></td>
</tr>
<tr>
<td>Hardness HRC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure mechanism</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Galling</td>
<td>Still running</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Machining recommendations

The cutting data below are to be considered as guiding values and as starting points for developing your own best practice.

**Condition: Soft-annealed condition ~300 HB**

### TURNING

<table>
<thead>
<tr>
<th>Cutting data parameters</th>
<th>Turning with carbide</th>
<th>Turning with HSS*</th>
<th>Turninig with HSS†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting speed ((v_c)) m/min</td>
<td>Rough turning</td>
<td>Fine turning</td>
<td>Fine turning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 5</td>
<td>110 - 160</td>
<td>160 - 200</td>
<td>20 - 25</td>
</tr>
<tr>
<td>5 - 10</td>
<td>12 - 14*</td>
<td>0.05 - 0.2</td>
<td>0.05 - 0.3</td>
</tr>
<tr>
<td>10 - 15</td>
<td>12 - 14*</td>
<td>0.10 - 0.2</td>
<td></td>
</tr>
<tr>
<td>15 - 20</td>
<td>12 - 14*</td>
<td>0.20 - 0.25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>K20 Coated carbide*</td>
<td>K15 Coated carbide* or cermet*</td>
<td>-</td>
</tr>
</tbody>
</table>

1 High speed steel

* Use a CVD coating

### DRILLING

**High speed steel twist drill**

<table>
<thead>
<tr>
<th>Drill diameter (\text{mm})</th>
<th>Cutting speed ((v_c)) m/min</th>
<th>Feed ((f)) mm/r</th>
<th>Carbide designation ISO</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 5</td>
<td>12 - 14*</td>
<td>0.05 - 0.10</td>
<td>K20</td>
</tr>
<tr>
<td>5 - 10</td>
<td>12 - 14*</td>
<td>0.10 - 0.20</td>
<td>-</td>
</tr>
<tr>
<td>10 - 15</td>
<td>12 - 14*</td>
<td>0.20 - 0.25</td>
<td>K15 Coated carbide* or cermet*</td>
</tr>
<tr>
<td>15 - 20</td>
<td>12 - 14*</td>
<td>0.25 - 0.35</td>
<td>-</td>
</tr>
</tbody>
</table>

1 For coated HSS drill, \(v_c\) ~ 22 - 24 m/min

### MILLING

#### Face and square shoulder milling

<table>
<thead>
<tr>
<th>Cutting data parameters</th>
<th>Milling with carbide</th>
<th>Type of milling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rough milling</td>
<td>Fine milling</td>
</tr>
<tr>
<td>Cutting speed ((v_c)) m/min</td>
<td>80 - 100</td>
<td>100 - 120</td>
</tr>
<tr>
<td>Feed ((f)) mm/tooth</td>
<td>0.2 - 0.4</td>
<td>0.1 - 0.2</td>
</tr>
<tr>
<td>Depth of cut ((a_p)) mm</td>
<td>2 - 4</td>
<td>≤ 2</td>
</tr>
<tr>
<td>Carbide designation ISO</td>
<td>K20 Coated carbide*</td>
<td>K15 Coated carbide* or cermet*</td>
</tr>
</tbody>
</table>

* Use a CVD coating

### End milling

<table>
<thead>
<tr>
<th>Cutting data parameters</th>
<th>Type of milling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Solid carbide</td>
</tr>
<tr>
<td>Cutting speed ((v_c)) m/min</td>
<td>40 - 50</td>
</tr>
<tr>
<td>Feed ((f)) mm/tooth</td>
<td>0.01 - 0.2¹</td>
</tr>
<tr>
<td>Carbide designation ISO</td>
<td>-</td>
</tr>
</tbody>
</table>

¹ For coated HSS end mill, \(v_c\) ~ 20 - 30 m/min

² Depending on radial depth of cut and cutter diameter

³ Use a CVD coating

### GRINDING

#### Wheel recommendation

<table>
<thead>
<tr>
<th>Type of grinding</th>
<th>Annealed condition</th>
<th>Hardened condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face grinding straight wheel</td>
<td>A 46 HV</td>
<td>B151 R50 B3¹ A 46 HV</td>
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<tr>
<td>Face grinding segments</td>
<td>A 36 GV</td>
<td>A 46 GV</td>
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<tr>
<td>Cylindrical grinding</td>
<td>A 60 KV</td>
<td>B151 R50 B3¹ A 60 KV</td>
</tr>
<tr>
<td>Internal grinding</td>
<td>A 60 JV</td>
<td>B151 R75 B3¹ A 60 IV</td>
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<tr>
<td>Profile grinding</td>
<td>A 100 IV</td>
<td>B126 R100 B6¹ A 100 IV</td>
</tr>
</tbody>
</table>

¹ If possible, use CBN wheels for this application
Electrical discharge machining

Tools of Vancron 40 SuperClean can be produced with Electrical Discharge Machining (EDM) as long as the EDM layer is carefully removed. Fine grinding and polishing, and retempering the tool at approx. 535°C is recommended.

Due to the extremely high nitrogen content in the steel, there are some general recommendations to be followed.

**POWER SETTINGS**

A coarse pass with high power can result in release of nitrogen from the steel causing pitting.

As a general rule of thumb, the EDM’ing of Vancron 40 SuperClean should be done with medium or fine passes using lower power setting.

**FLUSHING**

N-alloyed PM steels put higher demands on the flushing conditions. The On/Off time ratio should be low, i.e., shorter On time and longer Off time.

A general rule of thumb is that Off time should be twice the On time. When possible, use flushing through the electrode or through holes in the work piece. Higher viscosity of the dielectric liquid is also preferable due to better transportation of removed particles (can also give shorter EDM time and better surface finish).

**ELECTRODES**

For rough EDM operations graphite electrodes are recommended, preferably of high quality (small grain size, and/or Cu impregnated). A switched polarity might reduce sticking on electrode if that happens. For fine EDM use Cu or W/Cu electrodes. When Graphite electrodes must be used in fine EDM, high quality (small grain size, and/or Cu impregnated) is recommended.

Further information

For further information, i.e., steel selection, heat treatment, application and availability, please contact our ASSAB office nearest to you.

Pump components manufactured by Grundfos A/S in a tool made of Vancron 40 SuperClean.

Relative comparison of ASSAB cold-work tool steels

**MATERIAL PROPERTIES AND RESISTANCE TO FAILURE MECHANISMS**

<table>
<thead>
<tr>
<th>ASSAB grade</th>
<th>Hardness/Resistance to plastic deformation</th>
<th>Machinability</th>
<th>Grindability</th>
<th>Dimension stability</th>
<th>Resistance to Abrasive wear</th>
<th>Adhesive wear</th>
<th>Fatigue cracking resistance</th>
<th>Ductility/Resistance to chipping</th>
<th>Toughness/gross cracking</th>
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<td>ASSAB DF-3</td>
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</tbody>
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Choosing the right steel is of vital importance. ASSAB engineers and metallurgists are always ready to assist you in your choice of the optimum steel grade and the best treatment for each application. ASSAB not only supplies steel products with superior quality, we offer state-of-the-art machining, heat treatment and surface treatment services to enhance steel properties to meet your requirement in the shortest lead time. Using a holistic approach as a one-stop solution provider, we are more than just another tool steel supplier.

ASSAB and Uddeholm are present on every continent. This ensures you that high-quality tool steels and local support are available wherever you are. Together we secure our position as the world’s leading supplier of tooling materials.

For more information, please visit www.assab.com