



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](http://www.uddeholm.com)



SS-EN ISO 9001  
SS-EN ISO 14001

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## UDDEHOLM POLMAX

### FOR EXTREME SURFACE FINISH REQUIREMENTS

To meet the most extreme demands on polishability in plastic mould steels, Uddeholm Polmax stands out as one of the cleanest steels available. Thus it offers unparalleled polishability. This high performance grade achieves surface finishes that go well beyond what can be achieved by most other tool steels.

Uddeholm Polmax is also resistant to most corrosion attacks.

Uddeholm Polmax is specifically engineered for cavities, cores, inserts and a broad range of product applications that demand superior surface finish. Examples include optical, medical and CD/DVD applications.

Uddeholm Polmax is a part of the Uddeholm Stainless Concept.

## General

The rapid development in the high-tech area is putting higher and higher demands on the tool steel. Surface finishes, which have not been possible to achieve with ordinary tool steels, are required. For these extreme requirements Uddeholm Polmax is the right choice.

New processes have been developed to meet the increased demands on surface finish. For Uddeholm Polmax methods like ESR (Electro Slag Remelting) and VAR (Vacuum Arc Remelting) are used in order to reduce inclusion levels to minimum amounts.

Characteristics found in Uddeholm Polmax:

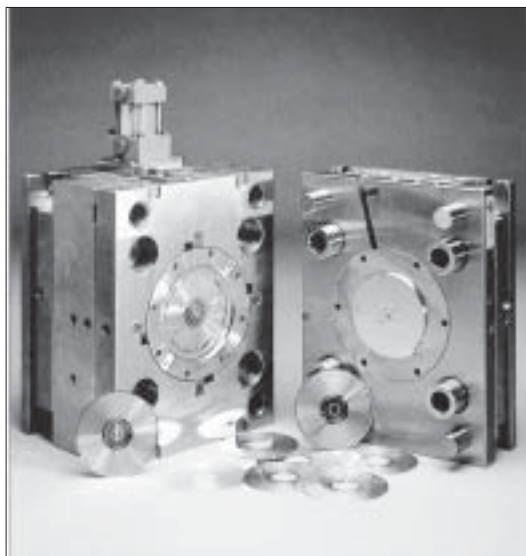
- Excellent polishability
- Good corrosion resistance
- Good wear resistance
- Good machinability
- Good stability in hardening

|                    |                                 |           |           |            |          |
|--------------------|---------------------------------|-----------|-----------|------------|----------|
| Typical analysis % | C<br>0,38                       | Si<br>0,9 | Mn<br>0,5 | Cr<br>13,6 | V<br>0,3 |
| Delivery condition | Soft annealed to approx. 200 HB |           |           |            |          |
| Colour code        | Green/black                     |           |           |            |          |

## Applications

Examples on applications where extreme surface finishes are required:

- Lens moulds
- Moulds for CD, DVD and memory discs
- Moulds for medical applications



## Properties

### Physical data

Hardened and tempered to 52 HRC. Data at room and elevated temperatures.

| Temperature   | 20°C<br>(68°F)                    | 200°C<br>(390°F)                                  | 400°C<br>(750°F)                                  |
|---|-----------------------------------|---|---|
| Density, kg/m <sup>3</sup><br>lbs/in <sup>3</sup>                       | 7 800<br>0,282                    | 7 750<br>0,280                                    | 7 700<br>0,277                                    |
| Coefficient of thermal expansion<br>per °C from 20°<br>per °F from 68°F | –<br>–                            | 11,0 × 10 <sup>-6</sup><br>6,1 × 10 <sup>-6</sup> | 11,4 × 10 <sup>-6</sup><br>6,4 × 10 <sup>-6</sup> |
| Thermal conductivity<br>W/m °C<br>Btu in/ft <sup>2</sup> h °F           | 16<br>110                         | 20<br>138   | 24<br>166   |
| Modulus of elasticity<br>N/mm <sup>2</sup><br>psi                       | 200 000<br>29,0 × 10 <sup>6</sup> | 190 000<br>27,6 × 10 <sup>6</sup>                 | 180 000<br>26,1 × 10 <sup>6</sup>                 |
| Specific heat<br>J/kg °C<br>Btu/lb°F                                    | 460<br>0,110                      | –<br>–  | –<br>–  |

### Strength of material

The strength values are to be considered as approximate. The test samples have been hardened in oil from 1025°C (1875°F) and tempered twice to 52 HRC.

|                                  |                                       |
|----------------------------------|---------------------------------------|
| Tensile strength, R <sub>m</sub> | 2050 N/mm <sup>2</sup><br>300 000 psi |
| Yield point, R <sub>p0,2</sub>   | 1610 N/mm <sup>2</sup><br>234 000 psi |

### Corrosion resistance

Uddeholm Polmax is resistant to corrosive attack by water, water vapour, weak organic acids, dilute solutions of nitrates, carbonates and other salts.

A tool made from Uddeholm Polmax will have good resistance to rusting and staining due to humid working and storage conditions and when moulding corrosive plastics under normal production conditions.

Uddeholm Polmax shows the best corrosion resistance when tempered at about 250°C (480°F) and polished to a mirror finish.

# Heat treatment

## Soft annealing

Protect the steel and heat through to 890°C (1630°F). Then cool in the furnace at 20°C (40°F) per hour to 850°C (1560°F), then at 10°C (20°F) per hour to 700°C (1200°F), then freely in air.

## Stress-relieving

After rough machining the tool should be heated through to 650°C (1200°F), holding time 2 hours. Cool slowly to 500°C (930°F), then freely in air.

## Hardening

Preheating temperature: 600–850°C (1110–1560°F)

Austenitizing temperature: 1000–1050°C (1830–1920°F) but usually 1020–1030°C (1870–1885°F)

| Temperature |      | Soaking time*<br>minutes | Hardness before<br>tempering |
|-------------|------|--------------------------|------------------------------|
| °C          | °F   |                          |                              |
| 1020        | 1870 | 30                       | 56 ± 2 HRC                   |
| 1050        | 1920 | 30                       | 57 ± 2 HRC                   |

\* Soaking time = time at hardening temperature after the tool is fully heated through

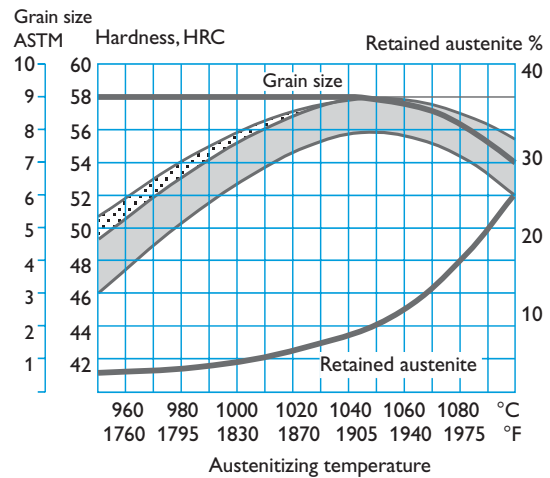
Protect the part against decarburization and oxidation during hardening.

## Quenching media

- Oil
- Martempering bath at 250–550°C (480–1020°F) then cool in air
- Vacuum furnace with sufficient overpressure
- Circulating air or atmosphere

Note: Temper the tool as soon as its temperature reaches 50–70°C (120–160°F).

HARDNESS, GRAIN SIZE AND RETAINED AUSTENITE AS A FUNCTION OF THE AUSTENITIZING TEMPERATURE

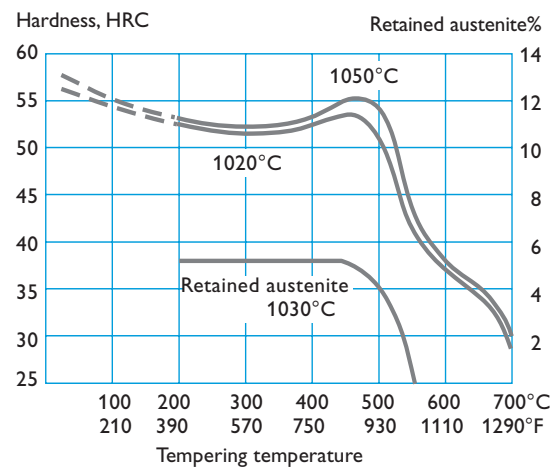


## Tempering

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.

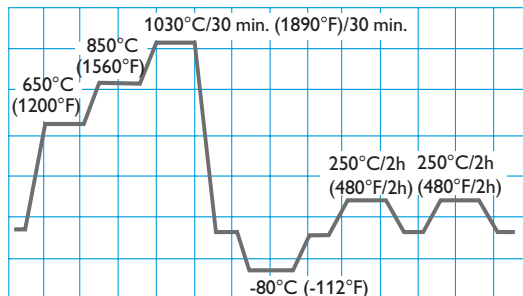
TEMPERING GRAPH



Note that:

- tempering at 250°C (480°F) is recommended for the best combination of toughness, hardness and corrosion resistance
- above curves are valid for small samples, achieved hardness depends on mould size
- a combination of high austenitizing temperature and low tempering temperature <250°C (480°F) gives a high stress level in the mould and should be avoided.

For maximum hardness and best combination of toughness, corrosion resistance and dimension stability during use, following heat treatment cycle is recommended



Subzero cooling is only required when demands on dimension stability during use are very high. Received hardness: 52–54 HRC.

## Polishing

Uddeholm Polmax has extremely good polishability in the hardened and tempered condition.

A slightly different technique is needed when polishing corrosion resistant tool steel compared with conventional tool steel. The main principle is to use smaller steps at the fine-grinding/polishing stages and try to grind to as fine surface as possible before starting the polishing operation. It is also important to stop the polishing operation immediately the last scratch from the former grain size has been removed.

### Practical hints

- Polishing should be carried out in dust- and draught-free places. Hard dust particles can easily contaminate the abrasive and ruin an almost finished surface.
- Each polishing tool should be used for **only one** paste grade and kept in dust-proof container.
- The polishing tools gradually become “impregnated” and improve with use.
- Hands and workpiece should be cleaned carefully between each change of paste grade, the work-piece with a grease solvent and the hands with soap.

- Paste should be applied to the polishing tool in manual polishing, while in machine polishing, the paste should be applied to the workpiece.
- The finer the grain size, the less thinning liquid.
- Polishing pressure should be adjusted to the hardness of the polishing tool and the grade of the paste. For the finest grain sizes, the pressure should only be the weight of the polishing tool.
- Heavy material removal requires hard polishing tools and coarse paste.
- Finish polishing of plastic moulds should be carried out in the release direction.
- Polishing should start in the corners, edges and fillets or the difficult parts of the mould.
- Be careful with sharp corners and edges, so they are not rounded off. Preferably use hard polishing tools.

*Cleanliness in every step of the polishing operation is of such great importance that it can not be over-emphasized.*

## Certificate

To be sure Uddeholm Polmax fulfil the high demands on cleanliness, which is required to obtain good polishability, each bar is individually tested and delivered with certificate.

Chemical composition, soft annealed hardness and microcleanliness are given in the certificate.

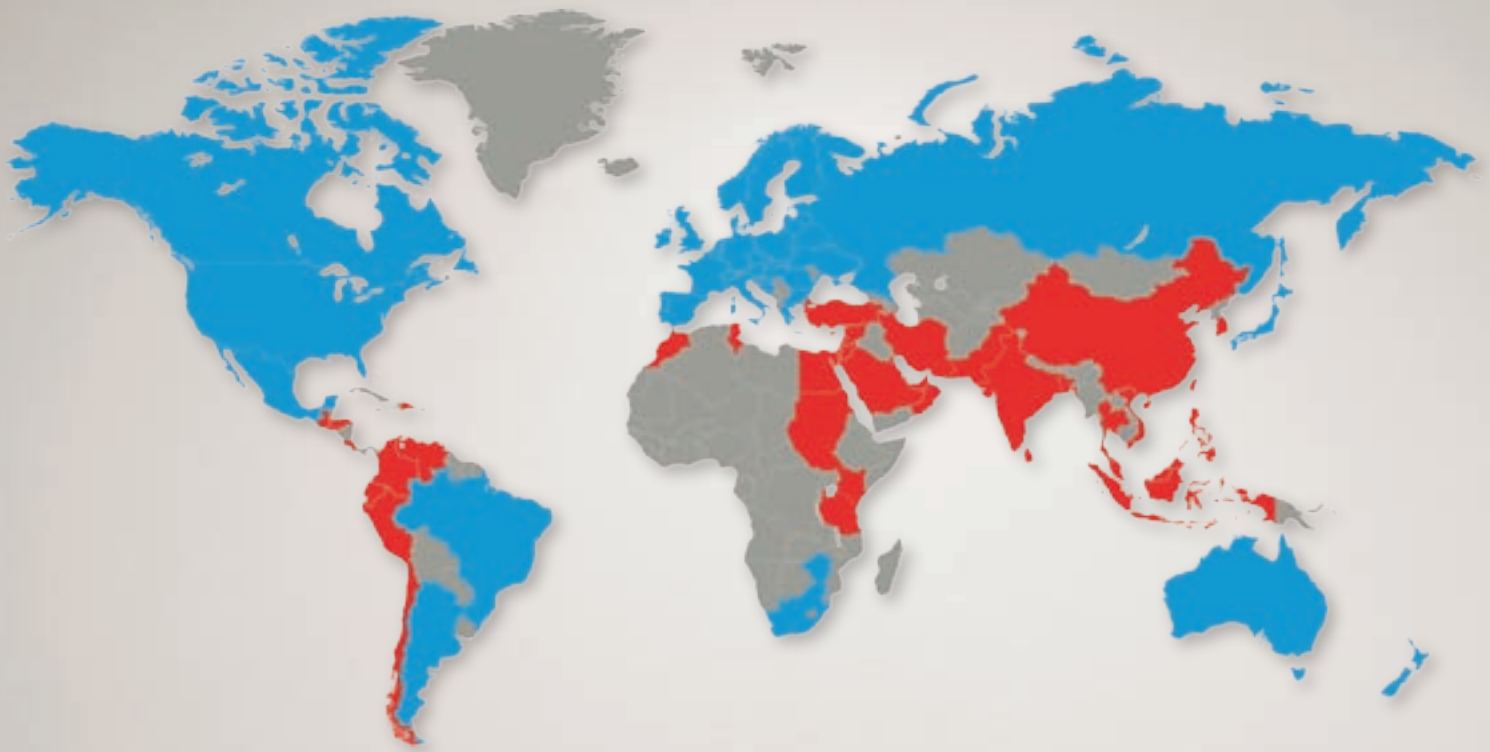
Microcleanliness is rated according to ASTM E45 Method A, a well established standard method taking into consideration the amount of sulphides, oxides, silicates and globular inclusions.

*Maximum inclusion level approved, according to ASTM E-45 Method A, Plate I-r*

| A |   | B   |   | C |   | D   |     |
|---|---|-----|---|---|---|-----|-----|
| T | H | T   | H | T | H | T   | H   |
| 0 | 0 | 1,0 | 0 | 0 | 0 | 1,0 | 0,5 |

## Further information

Please contact your local Uddeholm office for further information on the selection, heat treatment, application and availability of Uddeholm tool steels.



## 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 various parts of the world. 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 various parts of the world. 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](http://www.uddeholm.com) or [www.assab.com](http://www.assab.com)

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