- Superplast P20HH is a plastic injection mold steel pre-hardened to 340 HB /36HRC typical hardness.
- Superplast P20HH is used for plastic mold cavities when high hardness level is requested (higher than conventional 300HB steel). It can be polished, providing that lense quality is not requested.
- Superplast P20HH, in spite of its high hardness, maintains very good processing performances. Its specific chemistry is optimized in order to ensure enhanced properties in term of machining and welding (weld repairs can be polished and etched).
- Superplast P20HH can be used in substitution to W1.2738 High Hard, P20 HH and W1.2711. Compared to those conventional grades, it provides outstanding through hardening properties, ensuring perfect hardness consistency through the whole thickness, even for heavy sections (up to 810mm-32”).
- Superplast P20HH exhibits also an improved thermal conductivity, opening the door to substantial operating cost saving of the mold (reduction of injection cycle time).

### Standard
Superplast P20HH - SP P20HH

### Chemical Analysis - % Weight

<table>
<thead>
<tr>
<th>Element</th>
<th>% Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.26</td>
</tr>
<tr>
<td>Mn</td>
<td>1.5</td>
</tr>
<tr>
<td>Ni</td>
<td>≤ 1.0</td>
</tr>
<tr>
<td>Cr</td>
<td>1.6</td>
</tr>
<tr>
<td>Mo</td>
<td>0.7</td>
</tr>
<tr>
<td>S</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

*NOTE: Typical values for a 100 mm (4”) thick plate.*

### Mechanical Properties

<table>
<thead>
<tr>
<th>Hardness (HB)</th>
<th>Y.S. 0.2 MPa (KSI)</th>
<th>UTS MPa (KSI)</th>
<th>EI 5.65 %</th>
<th>Young Modulus GPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>340</td>
<td>970 (141)</td>
<td>1130 (164)</td>
<td>15</td>
<td>210</td>
</tr>
</tbody>
</table>

*NOTE: Typical values for a 100 mm (4”) thick plate. Guaranteed hardness in delivery condition: 320-350 HB for thicknesses between 20 mm (3/4”) and 810 mm (32”).*
Metallurgical Properties

- **Cleanliness**
  Bico Steel uses a combination of processes with electric arc furnace and VOD refining. These facilities allow to reach very low levels of impurities (especially oxygen) which contribute to a very high level of cleanliness.
  Guaranteed cleanliness according to ASTM E45 A method:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤1.5</td>
<td>≤1.5</td>
<td>≤1.0</td>
<td>≤1.5</td>
</tr>
</tbody>
</table>

- **Microstructure**
  Superplast P20HH is delivered in pre-hardened condition. Its microstructure is basically made of a mix of bainite and martensite. The optimized balance of alloying elements confers to Superplast P20HH an excellent hardenability.
  This bainito-martensitic structure is consistent through the whole thickness, ensuring a perfect hardness homogeneity even for very thick blocks (up to 810 mm - 32”).

- **Transformation Points**
  \[
  \begin{align*}
  A^c & = 741 \, (^{1652} \text{°F}) \\
  C^c & = 813 \, (^{1495} \text{°F}) \\
  M^c & = 339 \, (^{642} \text{°F}) \\
  \end{align*}
  \]

- **Reduction of Hard Spots**
  Chemistry of Superplast P20HH is also designed to achieve drastic reduction of segregations, compared to conventional W1.2711, W1.2738HH or P20HH. This is a real advantage for polishing (no waves on large polished surfaces), welding (reduction of cracking sensiti- vity), and machining (no hard spots).

**Heat Treatments**

Superplast P20HH is delivered in pre-hardened condition and consequently, should not be submitted to any further hardening heat treatment. Moreover it is not recommended to harden it to hardnesses higher than 350 HB.

Nevertheless, if for any reason, Superplast P20HH is exposed to a temperature higher than 550°C (1022°F), delivery properties can be affected. It will be then neces- sary to perform a complete heat treatment cycle, including quenching and tempering, to regenerate original mechanical properties.

Following re-heat treatments have to be made:
- Austenitization at around 900°C (1652°F) holding time (1”) of section.
- Quenching in water, oil, gas or air depending on thickness and piece shape.
- Tempering within a temperature range of 500 to 600°C (932 to 1112°F) depending on required hardness.

**Softening Curve**

**CCT Diagram**

**Surface Treatment**

Superplast P20HH is especially adapted for surface treatments like nitriding (ionic or gaseous), coatings (PVD), chrome or nickel plating, ...

Heating the steel higher than 550°C (1022°F) has to be avoided.
Machinability

- Miling

Chemistry of Superplast P20HH is optimized to achieve improved machinability compared to conventional W1.2738 HH, W1.2711 and P20HH. Consequently Superplast P20HH offers large possibilities of cost saving by shortening of machining time in milling (roughing). Example of cutting parameters for a Ø 40 mm tool with a carbide coated Ø 12 mm insert:

**NOTE:** Machining parameters for carbide coated tools (TIC/TIN/TICN).

<table>
<thead>
<tr>
<th>Cutting speed $V_c$ (m/min)</th>
<th>Feed fz (mm/tooth)</th>
<th>Radial depth $a_e$ (mm)</th>
<th>Axial depth $a_p$ (m/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roughing</td>
<td>150-300</td>
<td>0.1-0.5</td>
<td>12-30</td>
</tr>
<tr>
<td>Finishing</td>
<td>150-300</td>
<td>0.015-0.2</td>
<td>0.2-1.5</td>
</tr>
</tbody>
</table>

- Drilling/Gun Drilling

<table>
<thead>
<tr>
<th>$V_c$ (m/min)</th>
<th>Ø mm 10-15</th>
<th>Ø mm 15-20</th>
<th>Ø mm 20-25</th>
<th>Ø mm 25-30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling with Boring Tools</td>
<td>55-100</td>
<td>0.1-0.18</td>
<td>0.14-0.20</td>
<td>0.17-0.25</td>
</tr>
</tbody>
</table>

Very often, hard spots cause problems, especially during gun drilling of cooling channels. It results very often in broken tools, decreased cutting parameters to reduce vibrations and noise.

Low carbon content of Superplast P20HH reduces substantially the risk of hard spots, leading to a much better reliability and efficiency during gun drilling.

**E.D.M.**

Superplast P20HH is suitable, in delivery conditions for all EDM processes (electrode or wire cutting)

In order to guarantee a good surface aspect recommendations here below shall be followed.

For EDM with electrodes, finishing steps shall be done with adapted parameters.

If the cavity is left with an EDM surface it is necessary to perform a stress relieving at 530°C (986°F) or to perform a polishing in order to remove completely the white layer created by EDM. When the cavity is textured, polishing is absolutely necessary before chemical etching.
**Polishing**

Superplast P20HH is suitable for polishing of mold cavities. It is a non ESR/VAR grade; consequently, neither lens quality nor optical polishing can be expected. Nevertheless Superplast P20HH fits perfectly with diamond paste finish 6Qm minimum. This level of polishing meets American standard SPI, A2 rating.

Very often, pin holes and/or orange peel arise from wrong polishing method. Good surface finish leads to the use of very stringent polishing procedure; it is of the utmost importance to respect following rules.

Roughing & EDM’ing can damage surface microstructure: work-hardening, EDM white layer which are not compatible with fine polishing. It is necessary to use real finishing parameters (milling or EDM’ing) on surfaces to be polished to get rid of those disturbed microstructures.

Start polishing with high grit (i.e.: grit 120(*) paper or stone) to remove completely any trace of damaged surface microstructure.

Start polishing on clean surfaces free of deep scratches or marks.

When changing from one number to another, change polishing direction by minimum 45°. Stop polishing immediately when scratches from previous polishing disappear.

Do not apply high pressure during polishing especially at last stages during fine polishing (don’t try to increase pressure to reduce polishing time).

Clean carefully the piece with alcohol or distillated water between each polishing steps. Remove all steel dust and abrasive grain before changing to an other number.

Do not use worn papers, change to new one frequently. Do not use too much grits. For example 5 or 6 grits are enough to polish down to 6 μm (from fine milled surface).

**Applications**

All injection molds demanding high mechanical properties
- Long series
- High injection pressures
- Compression molds

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**NOTE:** Example of polishing procedure:
Grit 120 – 240 – 600 – 1200 paper or stone - Diamond paste 9 Qm – 6 Qm
In case of problem (orange peel for example) it is necessary to restart again the full process back to first polishing step.

**Welding**

Weld repair ability is one of the major strength of Superplast P20HH. Its specific chemistry allows polishing or etching of welded areas. When a welded area has to be polished, it is necessary to use special consumable (SP P20HH weld E), available from our SP P20HH distributors or from Bico Steel.

If stresses are important in the mold, pre-and postheating temperature must be increased up to 175°C (347°F) Pre-and post heating are required to avoid any risk of cracking just after welding. Post welding heat treatment is required to homogenize hardness between base metal, Heat Affected Zone and melting zone, in order to be compatible with polishing or texturing.

**Polished Zone & Etched Zone**

| Pre-Heating | 150 °C (302 °F) |
| Post-Heating | 150 °C (302 °F) – 2h |
| PWHT | 550 °C (1022 °F) – 2h |

**Dimensional Programme**

<table>
<thead>
<tr>
<th>Thicknesses</th>
<th>Widths</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 810 mm</td>
<td>up to 32”</td>
</tr>
<tr>
<td>up to 32”</td>
<td>up to 2000 mm</td>
</tr>
</tbody>
</table>

**NOTE:** Example of polishing procedure:
Grit 120 – 240 – 600 – 1200 paper or stone - Diamond paste 9 Qm – 6 Qm
In case of problem (orange peel for example) it is necessary to restart again the full process back to first polishing step.

**Applications**

All injection molds demanding high mechanical properties
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**NOTE:** Technical data and information are to the best of our knowledge at the time of printing. However, they may be subject to some slight variations due to our ongoing research program on steels. Therefore, we suggest that information be verified at time of enquiry or order.

Furthermore, in service, real conditions are specific for each application. The data presented here are only for the purpose of description, and considered as guarantees when written formal approval has been delivered by our company.