MD®
AISI P20+Ni - ~W.Nr. 1.2738 - ~40CrMnNiMo8-6-4
QUALITY PREHARDENED
MOLD STEEL

TYPICAL APPLICATIONS
• Injection molds up to 30” (760 mm)
• Molds for painted parts
• Compression molds
• Dies for non corrosive plastic extrusion

GENERAL:
Delivery Condition:
Hardened and tempered
Surface Hardness Range:

<table>
<thead>
<tr>
<th>BHN</th>
<th>HRC</th>
<th>N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>285-321</td>
<td>30-34</td>
</tr>
<tr>
<td>High Hard</td>
<td>321-352</td>
<td>34-38</td>
</tr>
</tbody>
</table>

MD® is a prehardened mold steel grade specially designed for improved through hardenability, ease of machining and simple post-production mold maintenance versus standard P20. It has high impact strength and excellent temper resistance. The well-balanced chemistry assures homogeneous hardness and low section hardness loss due to mass.

MD® is forged on our largest presses equipped with wide dies assuring maximum deformation during forging process.

MD® is forged using a special densifying process which assures optimum consolidation of centers.

MD® is melted to a low sulphur content to enhance polishability.

MD® is quenched in water. Best properties in steel are produced with the highest achievable quench severity.

MD® is characterized by:
• Excellent Machinability
• Good polishability
• Excellent weldability
• Improved wear resistance

MD® is 100 % ultrasonic tested to very stringent acceptance levels. It is defect free.

MD® hardenability versus standard grades ensures hardness loss from surface to core to be maintained at a maximum of 4 HRC points on molds up to 30” (760 mm) with deep impressions.

®Finkl Steel Trademark
MATERIAL CHARACTERISTICS
The benefits of improved through hardenability are:
• Stable and continued machining can be performed with (C.N.C.) automatic machines.
• A defect free machined surface can be obtained.
• Dimensional stability of parting lines.

Structure
After hardening and tempering, the structure of MD® consists of tempered martensite to fine bainite.

The benefits of the through hardness combined with a uniform and stable micro-structure are:
• For mold design, consistent properties are assured.
• The machining distortion is minimized in the finished mold.
• A uniform luster can be obtained upon surface polishing.

PROPERTIES MD®
• Cleanliness:

<table>
<thead>
<tr>
<th>Method</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM E45</td>
<td>≤ 1.5</td>
<td>≤ 1.0</td>
<td>≤ 0.5</td>
<td>≤ 1.0</td>
</tr>
<tr>
<td>DIN 50602</td>
<td>K4 ≤ 20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• Physical Properties:

<table>
<thead>
<tr>
<th>Thermal conductivity</th>
<th>Thermal expansion coefficient (10^{-6} \text{ K}^{-1})</th>
<th>Thermal capacity</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>(W.m⁻¹.K⁻¹)</td>
<td>25-100 °C</td>
<td>25-300 °C</td>
<td>25-400°C</td>
</tr>
<tr>
<td>30</td>
<td>12.3</td>
<td>13.7</td>
<td>14.8</td>
</tr>
</tbody>
</table>

• Mechanical Properties: Typical values for a 4” (101.6 mm) thick plate.

<table>
<thead>
<tr>
<th>Hardness range</th>
<th>Hardness BHN (HRC)</th>
<th>Y.S. 0.2 MPa (KSI)</th>
<th>UTS MPa (KSI)</th>
<th>EI (%)</th>
<th>Impact @ RT J (Ft-lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Long.</td>
</tr>
<tr>
<td>285-320 BHN</td>
<td>311 (33)</td>
<td>827 (120)</td>
<td>979 (142)</td>
<td>&gt; 15</td>
<td>111 (82)</td>
</tr>
<tr>
<td>320-355 BHN</td>
<td>331 (36)</td>
<td>924 (134)</td>
<td>1062 (154)</td>
<td>&gt; 15</td>
<td>88 (65)</td>
</tr>
</tbody>
</table>
HEAT TREATMENT

**Attainable Hardness of MD®**
Quenched from 1600 °F (870 °C) and Tempered 4 hours (Size of section – 4” X 4” (101.6 mm X 101.6 mm))

**Stress Relieving**
To minimize distortion in service or during maintenance (welding), it is recommended to stress relieve tooling after roughing stages. Heat uniformly to 850 to 900 °F (454-482 °C) Hold at temperature for one hour per inch (25.4 mm) and air cool.

**Tempering**
Tempering treatments vary for different sizes and applications. The following instructions will provide through tempering:

Heat uniformly at the selected tempering temperatures and hold at temperature for one hour per inch (25.4 mm) of total thickness.

**INDUCTION AND LASER HARDENING**
MD® lends itself to induction or laser hardening of selective surfaces creating a surface hardness of up to 60-63 HRC varying in depth from skin hardness up to 0.125” (3 mm).

**EDM (ELECTRIC DISCHARGE MACHINING)**
This method of machining is widely used on prehardened MD®. However, precaution should be taken since this method of machining leaves a rehardened surface layer (white layer) on the steel. It is advisable to remove this layer.

**HARD-CHROMIUM PLATING**
After hard-chromium plating, the tool should be tempered for a minimum of four (4) hours at 350 °F (180 °C) in order to avoid hydrogen embrittlement. In case of replating, the tool should be tempered after it has been acid stripped.
DATA SHEET
QUALITY PREHARDENED MOLD STEEL
MD®

TEXTURING
For best response to texturing, it is recommended to use grade MD®Xtra for its lower content in segregational elements.

POLISHING
Successful polishing requires talent, patience and experience. But some known basics are:

- Practice extreme cleanliness between steps to avoid carryover of contaminant particles
- Use high quality consumables
- Over polishing is detrimental to the steel surface leading to so called orange-peeling and pitting

<table>
<thead>
<tr>
<th>Grit</th>
<th>180</th>
<th>240</th>
<th>320</th>
<th>400</th>
<th>600</th>
</tr>
</thead>
<tbody>
<tr>
<td>μm</td>
<td>80</td>
<td>60</td>
<td>35</td>
<td>20</td>
<td>8</td>
</tr>
</tbody>
</table>

When the requirements for finish are particularly high (>600 grit), it is recommended to use grade MD®Xtra or MLQ®Xtra.

SIZE MD® REGULAR AND HIGH HARD
(As forged / approx.)

<table>
<thead>
<tr>
<th>Max weight</th>
<th>25,000 kg</th>
<th>55,000 lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max section</td>
<td>1.55 m²</td>
<td>2400 sq in</td>
</tr>
<tr>
<td>Max width</td>
<td>2130 mm</td>
<td>84”</td>
</tr>
<tr>
<td>Max thickness</td>
<td>1245 mm</td>
<td>49”</td>
</tr>
</tbody>
</table>

METALLURGICAL SERVICE
The Metallurgical Laboratory provides standard mechanical properties testing for Tensile Testing (ASTM A 370), Impact Testing (ASTM E 23), Hardness Testing (ASTM E 10, E 18, A 956), Macroetch Testing (ASTM E 381), and other metallurgical testing with certification of results where requested.

Metallurgical facilities are made available to customers through your sales representative to assist in analysis of technical issues that may arise during processing or performance of Finkl forgings. Reports and consultation are offered as a service to customers with the aim of improving product performance.