HEAT TREATMENT RECOMMENDATION
Z-M4 PM®
STANDARD VACUUM

GRADE
Z-M4 PM®

METHOD
Standard Vacuum (4 Bar Minimum Quench Recommended)

RACKING
Parts should be placed in basket with adequate spacing to allow even heating and good exposure to quench gas. Long thin parts should be held in vertical position to maintain flatness/straightness.

HEATING
Use of staged preheating recommended:
- Ramp furnace to 1250±50°F and equalize temperature.
- Use convective heating if possible
- Ramp furnace to 1550±50°F and equalize temperature.
- Ramp furnace to 1950±50°F and equalize temperature.
- Advance to high heat

HARDENING

<table>
<thead>
<tr>
<th>High heat set point</th>
<th>for toughness</th>
<th>for wear resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2070 °F</td>
<td>2165 °F</td>
<td></td>
</tr>
<tr>
<td>Acceptable batching range</td>
<td>2050/2090 °F</td>
<td>2150/2180 °F</td>
</tr>
<tr>
<td>Soaking time in min.</td>
<td>15 - 20 min.</td>
<td>7 - 12 min</td>
</tr>
</tbody>
</table>

QUENCHING
- Back fill to positive pressure (minimum 4-6 bar ideal), and fan quench
- Cool at maximum possible rate until load temperature < 1300°F
- Continue cooling load to room temperature (<120°F)
- Parts should be tempered within 4 hours

QUENCHING

TEMPERING
Select tempering temperature based on hardness specification:

<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>After 2075 °F</th>
<th>After 2165 °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 °F</td>
<td>63-65</td>
<td></td>
</tr>
<tr>
<td>1020 °F</td>
<td>62-64</td>
<td>64-66</td>
</tr>
<tr>
<td>1040 °F</td>
<td>61-63</td>
<td>63-65</td>
</tr>
<tr>
<td>1060 °F</td>
<td>60-62</td>
<td>62-64</td>
</tr>
<tr>
<td>1080 °F</td>
<td>59-61</td>
<td>60-62</td>
</tr>
<tr>
<td>1100 °F</td>
<td>58-60</td>
<td>59-61</td>
</tr>
</tbody>
</table>

Optimum tempering range is 1020 to 1040 °F

TRIPLE TEMPER REQUIRED, THIRD TEMPER RECOMMENDED

1st temper
- Heat parts to selected temperature, equalize and soak 2 hours.
- Cool parts completely to room temperature (<120°F)

2nd and 3rd temper
- Repeat first temper cycle
- Stress relieve
- Heat parts to 950/975 °F, equalize and soak 1 hour
- Stress relieve can be performed after hard finishing and/or EDM operations (vacuum methods preferred on finished tools)

STRESS RELIEVE
- Stress relieve can be performed after hard finishing and/or EDM operations (vacuum methods preferred on finished tools)
Further information regarding our products and locations are available in our image brochure and under www.zapp.com

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