Technical Information: PM M48

PM M48 is a tungsten/molybdenum-cobalt-vanadium super high speed steel. PM M48 is produced using the PM (powder metallurgy) process. The grade has an excellent combination of high red hardness and high wear resistance. PM steels have better grindability and toughness vs conventionally produced steels.

### Typical Chemical Composition

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>1.50%</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>5.25%</td>
</tr>
<tr>
<td>Vanadium</td>
<td>3.10%</td>
</tr>
<tr>
<td>Chromium</td>
<td>3.75%</td>
</tr>
<tr>
<td>Tungsten</td>
<td>9.75%</td>
</tr>
<tr>
<td>Cobalt</td>
<td>8.50%</td>
</tr>
</tbody>
</table>

### SBSM High Speed Steel Properties Comparison

- **Toughness**
- **Red Hardness**
- **Wear Resistance**

### Physical Properties

- **Modulus of Elasticity** \( \frac{31 \text{ psi}}{10^6} = 207 \text{ GPa} \)
- **Density** \( 0.298 \text{ lb/in}^3 \)
- **Annealed Hardness** \( 245-275 \text{ Brinell Hardness (BHN)} \)
- **Machinability** Similar to M42 High Speed Steel
Technical Information: PM M48

Heat Treatment

Annealing
Heat to 1600°F, hold two hours
Slow cool 20°F/hour to 600°F
Then air or furnace cool to room temperature

Stress Relieving
Performed prior or after machining to minimize distortion in heat treating
1100/1200°F, hold two hours
Then air cool to room temperature

Hardening
Salt bath, protective atmosphere, or vacuum furnace equipment preferred.

High Heat (Austenitizing)
2100/2200°F for 5 to 10 minutes at heat.
Higher Austenitizing temperatures require less time at heat

Quench
Salt bath quench to 1000-1100°F, equalize, then air cool to 150°F.
Vacuum or atmosphere quench rate of a minimum 50 degrees F per minute down to 1200°F is critical to achieve best heat treat response.
Temper immediately following quench

Tempering
Minimum 1000°F tempering temperature required.
Double tempering is required, triple tempering recommended.
Air cool to room temperature between tempers.

Typical Heat Treat Response

<table>
<thead>
<tr>
<th>Tempering Temp °F</th>
<th>Hardening Temp 2100°F</th>
<th>Hardening Temp 2150°F</th>
<th>Hardening Temp 2200°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>As Quenched</td>
<td>68</td>
<td>67</td>
<td>66</td>
</tr>
<tr>
<td>1000</td>
<td>67</td>
<td>68</td>
<td>69</td>
</tr>
<tr>
<td>1025</td>
<td>66</td>
<td>67</td>
<td>68</td>
</tr>
<tr>
<td>1050</td>
<td>65</td>
<td>67</td>
<td>68</td>
</tr>
<tr>
<td>1075</td>
<td>64</td>
<td>66</td>
<td>67</td>
</tr>
<tr>
<td>1100</td>
<td>63</td>
<td>65</td>
<td>66</td>
</tr>
</tbody>
</table>

Longitudinal Size Change
Approximately: plus 0.22%