M50 is a general purpose high speed steel
M50 has a good balance of toughness, wear resistance, and red hardness
M50 is used for metal cutting, wood and plastics cutting and cold work tooling

**Typical Chemical Composition**

<table>
<thead>
<tr>
<th>Element</th>
<th>M50 Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>0.80%</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>4.25%</td>
</tr>
<tr>
<td>Vanadium</td>
<td>1.00%</td>
</tr>
<tr>
<td>Chromium</td>
<td>4.00%</td>
</tr>
<tr>
<td>Silicon</td>
<td>0.20%</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.30%</td>
</tr>
</tbody>
</table>

**Tool Steel Properties Comparison**

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

**Physical Properties**

- **Modulus of Elasticity**: $29.5 \text{ psi x } 10^6 \approx 207 \text{ GPa}$
- **Density**: $0.283 \text{ lb/in}^3$
- **Annealed Hardness**: 215-255 Brinell Hardness (BHN)
- **Machinability**: Similar to M2 Tool Steel
Technical Information: M50

**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)**
2025/2075°F for 10-15 minutes 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 2075°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>As Quenched</td>
<td>58</td>
</tr>
<tr>
<td>1000</td>
<td>64</td>
</tr>
<tr>
<td>1025</td>
<td>64</td>
</tr>
<tr>
<td>1050</td>
<td>63</td>
</tr>
<tr>
<td>1075</td>
<td>63</td>
</tr>
<tr>
<td>1100</td>
<td>62</td>
</tr>
</tbody>
</table>

**LONGITUDINAL SIZE CHANGE**
Approximately: plus 0.22%