Technical Information: M42

**M42 is a molybdenum/tungsten/cobalt super high speed steel.**

M42 may be heat treated to 68 HRC making it ideal for use in special purpose cutting tools and applications requiring high wear resistance.

### Typical Chemical Composition

<table>
<thead>
<tr>
<th>Element</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>1.10%</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>9.50%</td>
</tr>
<tr>
<td>Vanadium</td>
<td>1.15%</td>
</tr>
<tr>
<td>Cobalt</td>
<td>8.00%</td>
</tr>
<tr>
<td>Chromium</td>
<td>3.75%</td>
</tr>
<tr>
<td>Silicon</td>
<td>0.30%</td>
</tr>
<tr>
<td>Tungsten</td>
<td>1.60%</td>
</tr>
</tbody>
</table>

### High Speed Steel Properties Comparison

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

### Physical Properties

- **Modulus of Elasticity**: $30 \text{ psi} \times 10^6$ (207 GPa)
- **Density**: $0.289 \text{ lb/in}^3$
- **Annealed Hardness**: 225-269 Brinell Hardness (BHN)
- **Machinability**: Similar to T15 Tool Steel

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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)
2075/2175°F for 5 to 15 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 2075°F</th>
<th>Hardening Temp 2125°F</th>
<th>Hardening Temp 2175°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>As Quenched</td>
<td>66</td>
<td>66</td>
<td>64</td>
</tr>
<tr>
<td>1000</td>
<td>65</td>
<td>67</td>
<td>68</td>
</tr>
<tr>
<td>1025</td>
<td>64</td>
<td>66</td>
<td>68</td>
</tr>
<tr>
<td>1050</td>
<td>62</td>
<td>65</td>
<td>66</td>
</tr>
<tr>
<td>1100</td>
<td>57</td>
<td>60</td>
<td>63</td>
</tr>
<tr>
<td>1150</td>
<td>53</td>
<td>56</td>
<td>59</td>
</tr>
</tbody>
</table>

Longitudinal
Size Change

Approximately: plus 0.25%