CPM 10V was the first in the family of high vanadium tool steels made by the Crucible Particle Metallurgy process. Crucible engineers optimized the vanadium content to provide superior wear resistance while maintaining toughness and fabrication characteristics comparable to D2 and M2. Since its introduction in 1978, CPM 10V has become recognized world-wide and sets the standard for highly wear resistant industrial tooling. Its exceptional wear resistance and good toughness make it an excellent candidate to replace carbide and other highly wear resistant materials in cold work tooling applications, particularly where tool toughness is a problem or where cost effectiveness can be demonstrated.

The CPM process produces very homogeneous, high quality steel characterized by superior dimensional stability, grindability, and toughness compared to steels produced by conventional processes.

**Physical Properties**

- **Elastic Modulus**: \(32 \times 10^6\) psi (221 GPa)
- **Density**: 0.268 lbs./in\(^3\) (7.418 g/cm\(^3\))
- **Thermal Conductivity**:
  - 70°F (21°C): 11.78 BTU/hr-ft-°F, 20.39 W/m-°K, 0.0487 cal/cm-s-°C
  - 212°F (100°C): 12.44 BTU/hr-ft-°F, 21.54 W/m-°K, 0.0514 cal/cm-s-°C
  - 572°F (300°C): 14.36 BTU/hr-ft-°F, 24.85 W/m-°K, 0.0593 cal/cm-s-°C
  - 932°F (500°C): 15.19 BTU/hr-ft-°F, 26.30 W/m-°K, 0.0628 cal/cm-s-°C
- **Coefficient of Thermal Expansion**:
  - 70-200°F (21-93°C): 5.96X10^-6 in/in/°F, 10.7X10^-6 mm/mm/°C
  - 70-500°F (21-260°C): 6.18X10^-6 in/in/°F, 11.1X10^-6 mm/mm/°C
  - 70-800°F (21-427°C): 6.54X10^-6 in/in/°F, 11.8X10^-6 mm/mm/°C
  - 70-1100°F (21-593°C): 6.82X10^-6 in/in/°F, 12.3X10^-6 mm/mm/°C

**Mechanical Properties**

**Impact Toughness**

Depending upon the application requirement for hardness, lowering the hardening temperature (underhardening) increases the toughness.

**Relative Values**

- **Toughness**
- **Wear Resistance**

**Typical Applications**

- Stamping or Forming Tools
- Powder Compaction Tooling
- Industrial Knives and Slitters
- Plastic Mold Inserts
- Wear Parts
- Punches and Dies
- Blanking and Piercing Dies
- Woodworking Tools
- Plastic Injection Barrels

**Machinability and Grindability**

Machinability in the annealed condition is similar to T15 high speed steel. Similar grinding equipment and practices used for high speed steels are recommended. "SG" type alumina wheels or CBN wheels have generally given the best performance with CPM steels.

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**Crucible Industries LLC**

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Heat Treat Response

### Hardness HRC

<table>
<thead>
<tr>
<th>Tempering Temperature</th>
<th>Austenitizing Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tempering</td>
<td>As Quenched</td>
</tr>
<tr>
<td>1850°F (1010°C)</td>
<td>61</td>
</tr>
<tr>
<td>1900°F (1040°C)</td>
<td>63</td>
</tr>
<tr>
<td>1950°F (1065°C)</td>
<td>65</td>
</tr>
<tr>
<td>2050°F (1120°C)</td>
<td>65</td>
</tr>
<tr>
<td>2100°F (1150°C)</td>
<td>64.5</td>
</tr>
<tr>
<td>2150°F (1175°C)</td>
<td>63.5</td>
</tr>
<tr>
<td>1000°F (540°C)</td>
<td>56</td>
</tr>
<tr>
<td>1025°F (550°C)</td>
<td>54</td>
</tr>
<tr>
<td>1050°F (565°C)</td>
<td>52</td>
</tr>
<tr>
<td>1100°F (595°C)</td>
<td>49</td>
</tr>
<tr>
<td>1150°F (620°C)</td>
<td>44</td>
</tr>
<tr>
<td>1200°F (650°C)</td>
<td>40</td>
</tr>
</tbody>
</table>

### Optimum for Maximum Toughness and Effective Stress Relieving

- 1025°F (550°C): 54 HRC
- 1050°F (565°C): 52 HRC
- 1100°F (595°C): 49 HRC
- 1150°F (620°C): 44 HRC
- 1200°F (650°C): 40 HRC

Results may vary with hardening method and section size. Salt or oil quenching will give maximum response. Vacuum or atmosphere cooling may result in up to 1-2 HRC points lower.

### Minimum Time at Aust. Temp. and Minimum Number of Tempers

<table>
<thead>
<tr>
<th>Minimum Time at Aust. Temp.</th>
<th>Minimum Number of Tempers</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 min.</td>
<td>2</td>
</tr>
<tr>
<td>45 min.</td>
<td>2</td>
</tr>
<tr>
<td>30 min.</td>
<td>2</td>
</tr>
<tr>
<td>20 min.</td>
<td>3</td>
</tr>
<tr>
<td>15 min.</td>
<td>3</td>
</tr>
<tr>
<td>10 min.</td>
<td>3</td>
</tr>
</tbody>
</table>

### Size Change

- +0.03/0.05%

### Recommended Heat Treatment

- **For the best combination of toughness and wear resistance**, austenitize CPM 10V at 2050°F (1120°C), hold 30-45 minutes, and quench. Temper 3 times at 1025°F (550°C).
- **Aim hardness**: HRC 60. Higher austenitizing temperatures can be used to obtain higher hardness, at a slight decrease in impact resistance. The lower austenitizing temperatures provide the best impact toughness.

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**Surface Treatments**

Because of its high tempering temperatures (>1000°F), CPM 10V is suitable for nitriding, PVD coating or similar surface treatments. CVD coating processes generally exceed the critical temperature and may result in non-predictable dimensional changes.

**Note:** Properties shown throughout this data sheet are typical values. Normal variations in chemistry, size and heat treat conditions may cause deviations from these values.