CRUCIBLE CPM S90V®
(CPM 420V®)
Issue #1

Carbon 2.3%
Chromium 14.0%
Vanadium 9.0%
Molybdenum 1.0%

Physical Properties
- Elastic Modulus: 31X10^6 psi, 215 GPa
- Density: 0.27 lbs/in^3, 7.4g/cm^3
- Thermal Conductivity @ 200°F (65°C): 10 BTU/hr-ft-°F, 17.3 W/m-°K
- Coefficient of Thermal Expansion:
  - °F °C in/in/°F mm/mm/°C
  - 70-400 20-200 6.1 X 10^-6 11.0 X 10^-6
  - 70-600 20-315 6.4 X 10^-6 11.5 X 10^-6

Mechanical Properties

Impact Toughness
CPM S90V offers higher impact toughness than 440C at comparable hardnernesses.
Corrosion Resistance

Corrosion tests measure the amount of material lost to corrosion. Therefore, lower numbers indicate better corrosion resistance.

Corrosion Test Results in mm/year

<table>
<thead>
<tr>
<th></th>
<th>Boiling 10% Acetic</th>
<th>Dilute Aqua-Regia</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPM S90V</td>
<td>9/17</td>
<td>102/117</td>
</tr>
<tr>
<td>440C</td>
<td>29</td>
<td>109</td>
</tr>
<tr>
<td>D2</td>
<td>267</td>
<td>411</td>
</tr>
</tbody>
</table>

Notes:
(1) Lower numbers indicate better corrosion resistance. All grades heat treated to about HRC 56/58. Corrosion resistance depends strongly on heat treated condition and specific environment. Results should be used as a qualitative comparison only.
(2) 24 hrs.
(3) 5% HNO3 -1% HCl (nitric + hydrochloric acids) at 24°C.

Relative Corrosion Rates
(Lower numbers indicate better corrosion resistance.)

Machinability and Grindability

Due to its high vanadium carbide content, the machinability and grindability of S90V will be slightly more difficult than that of D2 or 440C. Similar grinding equipment and practices are acceptable. SG type alumina wheels or CBN wheels have generally given the best performance with the CPM steels.

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.

Thermal Treatments

Annealing
Heat to 1650°F (900°C), hold 2 hours, slow cool at a maximum rate of 25°F (15°C) per hour to 1100°F (595°C), then furnace cool or cool in still air to room temperature.
Annealed Hardness: Approx. BHN 277

Stress Relieving
Annealed Parts: Heat to 1100-1300°F (595-705°C), hold 2 hours, then furnace cool or cool in still air.
Hardened Parts: Heat to 25-50°F (15-30°C) below original tempering temperature, hold 2 hours, then furnace cool or cool in still air.

Hardening
Austenitize: 2100-2150°F (1150-1175°C)
Hold time at temperature: 20 minutes
Quench: Salt quench, interrupted oil quench, positive pressure gas quench or air cool at a minimum cooling rate of 150°F/min (80°C/min) to below 1000°F (540°C). Cool to below 125°F (50°C) before tempering. For optimum vacuum heat treatment response, a minimum 4 bar gas quench is recommended.
Temper: Double temper at 400-750°F (200-400°C). Hold for a minimum of 2 hrs. each temper. For optimum stress relieving and dimensional stability, S90V may be double tempered at 1000-1025°F (540-550°C), but tempering above 800°F (425°C) may result in some loss of corrosion resistance. A freezing treatment may be employed between the first and second tempers, if desired. Freezing treatments should always be followed by at least one temper.
PLEASE NOTE: Tempering between about 800 and 1000°F (425 and 540°C) is not recommended. All martensitic stainless steels suffer from embrittlement when tempered in this range.

Tempering Temperatures

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Hardness</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>400°-800°F</td>
<td>(200°-425°C)</td>
<td>Best Corrosion Resistance &amp;</td>
</tr>
<tr>
<td>800°-1000°F</td>
<td>(425°-540°C)</td>
<td>Wear Resistance</td>
</tr>
<tr>
<td>1000°F-1025°F</td>
<td>(540°-550°C)</td>
<td>Stress Relieving and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimensional Stability</td>
</tr>
</tbody>
</table>

Aim Hardness: HRC 56/59

Size Change: +0.03 to +0.05%
Size change shown is for a fully martensitic microstructure.
The presence of retained austenite may reduce the net growth. When tempering at 400-750°F (200-400°C), freezing treatments may be necessary to minimize retained austenite.

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