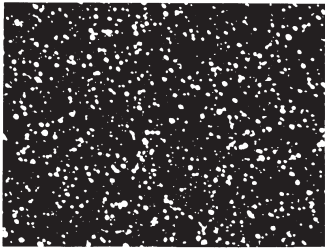


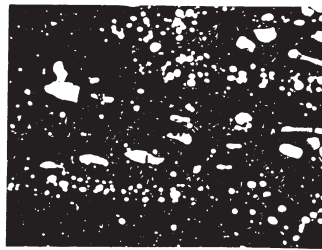
# CRUCIBLE

CPM 3V, made by the Crucible Particle Metallurgy process, is designed to provide maximum resistance to breakage and chipping in a highly wear-resistant tool steel. CPM 3V offers impact toughness greater than A2, D2, Cru-Wear or CPM M4, approaching the levels of S7 and other shock resistant grades, yet it provides excellent wear resistance, high hardness and thermal stability for coatings. Intended to be used at HRC 58-60, CPM 3V can replace high alloy tool steels in wear applications where chronic tool breakage and chipping problems are encountered.

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

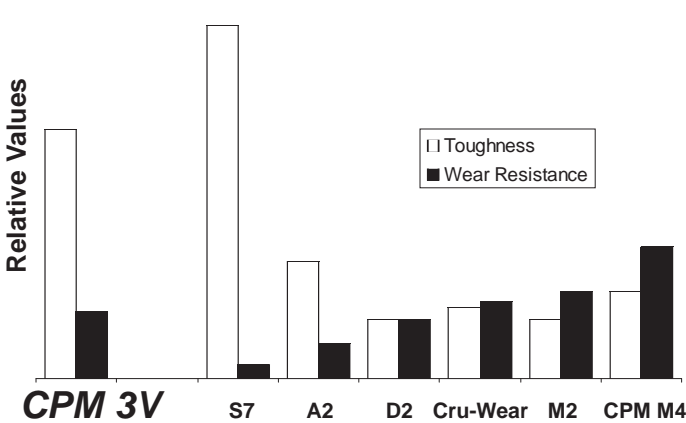


CPM Steel



Conventional Steel

## Tool Steel Comparagraph



## Typical Applications

- |  |                  |
|--|------------------|
| Stamping or Forming Tools                | Punches and Dies |
| Powder Compaction Tooling                | Blanking Dies    |
| Industrial Knives and Slitters           | Shear Blades     |
| Fineblanking Tools                       | Scrap Choppers   |
| Cold Heading Tooling                     | Rolls            |
| Plastic Injection Feeder Screws and Tips |                  |

*Note: These are some typical applications. Your specific application should not be undertaken without independent study and evaluation for suitability.*

# Crucible Industries LLC

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## DATA SHEET

### CRUCIBLE CPM® 3V®

Issue #1

|                   |              |
|-------------------|--------------|
| <b>Carbon</b>     | <b>0.8%</b>  |
| <b>Chromium</b>   | <b>7.5%</b>  |
| <b>Vanadium</b>   | <b>2.75%</b> |
| <b>Molybdenum</b> | <b>1.3%</b>  |

### Physical Properties

|   |                                  |                                      |
|---|----------------------------------|--------------------------------------|
| <b>Elastic Modulus</b>                  | 30 X 10 <sup>6</sup> psi         | (207 GPa)                            |
| <b>Density</b>                          | 0.28 lbs./in <sup>3</sup>        | (7.8 g/cm <sup>3</sup> )             |
| <b>Thermal Conductivity</b>             |                                  |                                      |
| at 200°F (95°C)                         | BTU/hr-ft-°F<br>14               | W/m-°K<br>24.2                       |
|   |                                  | cal/cm-s-°C<br>0.057                 |
| <b>Coefficient of Thermal Expansion</b> |                                  |                                      |
| 70-400°F (20-200°C)                     | in/in/°F<br>5.9X10 <sup>-6</sup> | mm/mm/°C<br>(10.6X10 <sup>-6</sup> ) |

### Mechanical Properties

#### Impact Toughness

The CPM microstructure gives 3V its high impact toughness which approaches that of the shock-resistant tool steels.

|          | Heat Treatment <sup>(1)</sup><br>Austenitizing<br>Temperature | HRC | Impact<br>Toughness <sup>(2)</sup><br>ft.-lb. (J) |
|----------|---|-----|---|
| CPM 3V   | 1875°F (1025°C)   | 58  | 85 (113)  |
| CPM 3V   | 1950°F (1065°C)   | 60  | 70 (95)   |
| CPM 3V   | 2050°F (1120°C)   | 62  | 40 (53)   |
| S7       | 1750°F (955°C)  | 57  | 125 (165)   |
| A2       | 1750°F (955°C)  | 60  | 40 (53)   |
| D2       | 1850°F (1010°C)   | 60  | 21 (28)   |
| Cru-Wear | 1950°F (1065°C)   | 62  | 30 (40)   |
| M2       | 2050°F (1025°C)   | 62  | 20 (27)   |
| CPM M4   | 2050°F (1025°C)   | 62  | 32 (43)   |

(1) Heat Treatment: Austenitized as indicated and tempered to hardness.  
(2) Charpy C-Notch Impact Test

#### Wear Resistance

Due to the vanadium carbides in its microstructure, CPM 3V has excellent wear resistance, similar to that of D2.

#### Relative Mechanical Properties

The unique combination of wear resistance and toughness offered by CPM 3V make it an excellent alternative to S7 or A2 in applications where they wear out too quickly. It can also replace wear-resistant grades such as D2, Cru-Wear, M2 or CPM M4 in applications where they tend to fail by impact, chipping or breaking. CPM 3V offers the highest impact toughness of any tool steel with this range of wear resistance.

## Thermal Treatments

**Annealing:** Heat to 1650°F(900°C), hold 2 hours, slow cool no faster than 25°F (15°C) per hour to 1100°F (595°C), then furnace cool or cool in still air to room temperature.

**Annealed Hardness: About BHN 241**

### 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

**Preheat:** Heat to 1500-1550°F (815-845°C) Equalize.

**Austenitize:** 1875-2050°F (1025-1120°C), hold time at temperature 20-45 minutes.

**Quench:** Air or positive pressure quench (2 bar minimum) to below 125°F (50°C), or salt or interrupted oil quench to about 1000°F (540°C), then air cool to below 125°F (50°C). Salt bath treatment, if practical, will ensure the maximum attainable toughness for a given hardening treatment.

**Temper:** Three times at 1000-1050°F (540-565°C), 2 hours minimum each time.

**Size Change:** +0.03/0.05%

**Recommended Heat Treatment:** For the best combination of toughness and wear resistance, austenitize at 1950°F (1065°C), hold 30-45 minutes, and quench. Temper 3 times at 1000°F (540°C).

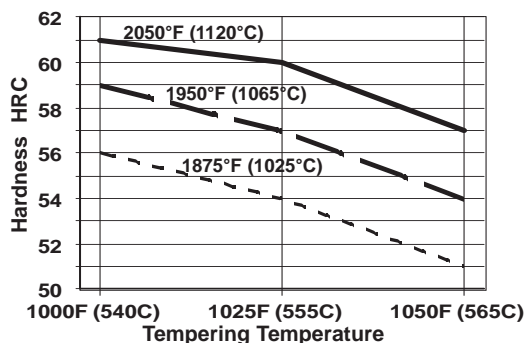
**Aim hardness: HRC 58-60** Higher austenitizing temperatures can be used to obtain higher hardness, at a slight decrease in impact resistance. The lower austenitizing temperatures provide the best impact toughness.

*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.*

## Heat Treat Response

| Tempering Temperature               | Hardness HRC              |                 |                 |
|-------------------------------------|---------------------------|-----------------|-----------------|
|                                     | Austenitizing Temperature |                 |                 |
|                                     | 1875°F (1025°C)           | 1950°F (1065°C) | 2050°F (1120°C) |
| Minimum Time at Austenitizing Temp. | 45 minutes                | 30 minutes      | 20 minutes      |
| <b>As Quenched</b>                  | <b>58</b>                 | <b>62</b>       | <b>63</b>       |
| <b>1000°F (540°C)</b>               | <b>56</b>                 | <b>59</b>       | <b>61</b>       |
| <b>1025°F (555°C)</b>               | <b>54</b>                 | <b>57</b>       | <b>60</b>       |
| <b>1050°F (565°C)</b>               | <b>51</b>                 | <b>54</b>       | <b>57</b>       |
| <b>Minimum Number of Tempers</b>    | <b>2</b>                  | <b>3</b>        | <b>3</b>        |

*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.*



### Surface Treatments

Because of its high tempering temperatures (>1000°F) CPM 3V 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.

### Machinability and Grindability

Machinability in the annealed condition is similar to D2 and CRU-WEAR, but grindability will be slightly better. Similar grinding equipment and practices are acceptable. "SG" type alumina wheels or CBN wheels have generally given the best performance with CPM steels.



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