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## CPM® 3-V | Heat Treating

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## CPM® 3-V | Heat Treating

### About CPM® 3-V

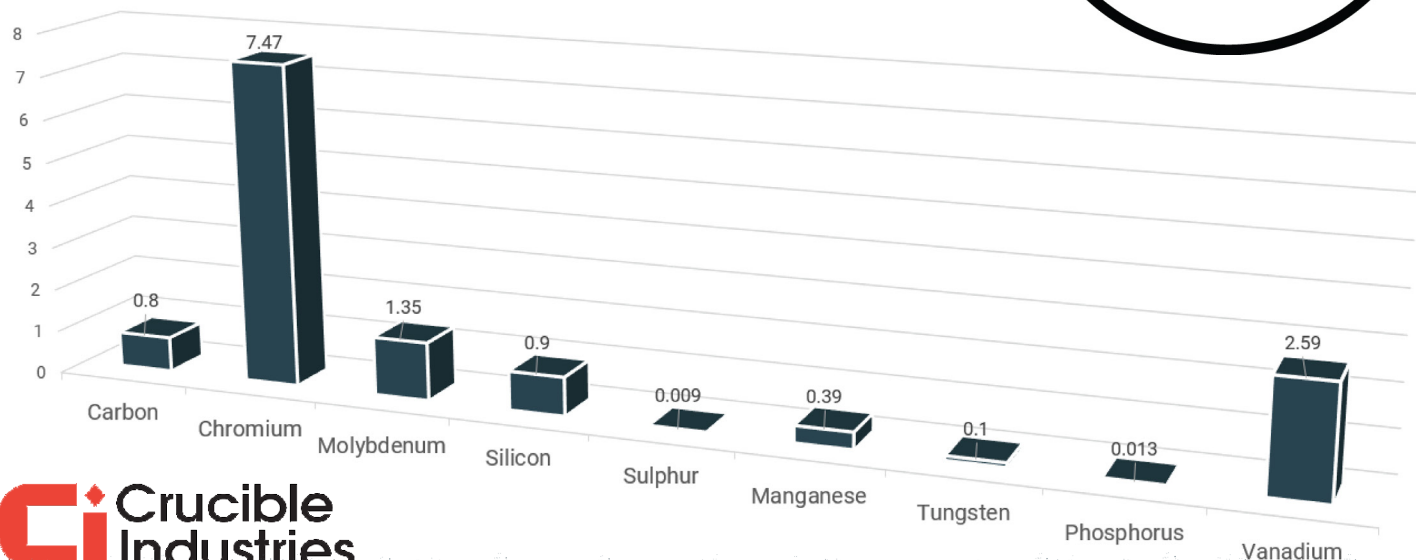
CPM® 3V is a high toughness, wear-resistant tool steel made by the Crucible Particle Metallurgy process. It is designed to provide maximum resistance to breakage and chipping in a high wear-resistance steel. It offers impact resistance greater than A2, D2, Cru-Wear, or CPM® M4, approaching the levels provided by S7 and other shock resistant grades. CPM® 3V is intended to be used at 58/60 HRC in applications where chronic breakage and chipping are encountered in other tool steels, but where the wear properties of a high alloy steel are required.

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

### Machinability

Machinability in the annealed condition is similar to D2 and Cru-Wear. Grindability will be similar as well. Similar grinding equipment and practices are acceptable. 'SG' type alumina wheels or CBN wheels have generally given the best performance with the CPM steels.

### Alloy Chemistry %



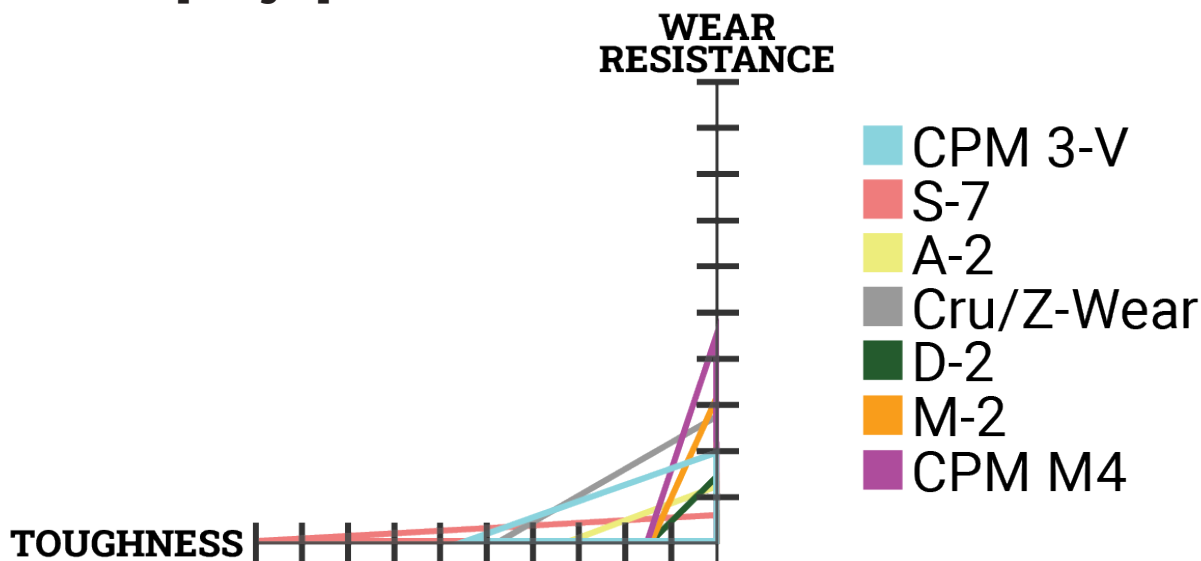


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### About CPM® 3-V

#### Blade Steel Comparagraph



#### Physical Properties

|                 |                           |                          |
|-----------------|---------------------------|--------------------------|
| Elastic Modulus | 30 X 10 <sup>6</sup> psi  | (207 GPa)                |
| Density         | 0.28 lbs./in <sup>3</sup> | (7.8 g/cm <sup>3</sup> ) |

#### Thermal Conductivity

|                 | BTU/hr-ft-°F | W/m-°K | cal/cm-s-°C |
|-----------------|--------------|--------|-------------|
| at 200°F (95°C) | 14.0         | 24.2   | 0.057       |

#### Coefficient of Thermal Expansion

|                         | in/in/°F              | mm/mm/°C              |
|-------------------------|-----------------------|-----------------------|
| t70-400°F (20 to 200°C) | 5.90X10 <sup>-6</sup> | 10.6X10 <sup>-6</sup> |





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### Heat Treating

#### Important - Before Treating

- Knives should be cleaned by washing with soapy water and then either placed into foil pouch or coated with high temperature anti-scale/decarburization compound prior to heat treat if not using Oxygen free heat treat equipment.
- Skipping stages such as pre-heating and equalizing or cryo will result in lower hardness, higher amounts of Retained Austenite (RA), impaired stain resistance or other issues. Ramp AFAP (as fast as possible) between preheating and austenizing temps.
- Clamping flat after quench during cryo or tempering recommended to avoid thermal shock induced warp.
- **Figures represent quenching under positive pressure with aluminum plates and compressed air to at or below 125°F / 50°C--alternative quenching methods may present lower hardness, high RA, or other issues.**



#### Pre-Heat/Equalizing

1,550°F / 845°C  
Hold 10-15 minutes



#### Austenizing Temperature

1,950°F / 1065°C  
Soak 30 minutes



#### Expected RC (as quenched prior to cryo)

60Rc (62 after Cryo)

#### Cryogenic Treatment

- A cryogenic treatment is recommended to convert retained austenite, and can either be done before or after the first temper cycle.
- Liquid Nitrogen is recommended for the needed -280°F / -137°C
- Submerge in sub-zero treatment 10 hours depending on thickness and number of blades.
- **A cryogenic treatment can be done immediately done after quench, but it is recommended blades be clamped flat to avoid thermal shock induced warp--cryo treatment should always be followed by a tempering cycle.**







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### Heat Treating

#### Tempering

- Once blade is quenched and near ambient temperature, blades should be tempered accordingly, the times suggested are to ensure even, consistent temperature.
- Figures supplied are as representative of industrial standards.
- **If using a small toaster oven or household kitchen oven for tempering, using a blade holding rack made from kiln furniture, a roasting tray lined with fine sand, or similar large object will help retain thermal mass to reduce wide swinging temperatures as the device fluctuates trying to maintain temperature.**
- **Note: Final hardness values vary based on initial as-quenched hardness and percentage of conversion to Martensite. Only reliable testing methods, e.g. calibrated Rockwell hardness tester, can provide actual hardness values--hardness calibrated files and chisels are relative testing methods and inaccurate for true hardness value reading.**
- Temper twice for 2hrs.



| Temperature:   | Hardness (2 hour x2 guideline): |
|----------------|---------------------------------|
| 975°F / 523°C  | 61                              |
| 1000°F / 537°C | 60-59                           |

- The included Heat Treat Schedule on this page is formulated based upon Industry standards and data from ASM International, Crucible and other foundry spec sheets, and Kevin Cashen (independent researcher, ferroalloy metallurgist, and bladesmith of Matherton Forge).





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### Heat Treating Disclaimer

- Suggested heat treatment are based on the recommended specifications for use in ovens, high temp salts, and similarly, properly calibrated equipment; and in line with proper industrial standards for quenching. Deviation from industry standards for schedules, equipment, quenching mediums; and hardness testing equipment may result in varied results. The supplied information on this page is on a generalized scale with the above mentioned standards and methods, which is why soak times and similar aspects may vary in time length to include a margin for the available heat treating equipment and steel cross section.
- If you are unsure if you have the necessary means to heat treat on-site, we recommend professional heat treating services provided by Peters Heat Treat or Bos Heat treating; or industry specific services by knife material dealers such as TruGrit or Texas Knifemaker's Supply--check with suppliers to see if they offer HT services and ensure they follow industry standards.
- NJSB LLC is not liable or responsible if proper industry heat treating protocols are not applied; particularly and especially if sending to an independent heat treat provider if they do not follow the intended heat treat schedule or standards for that particular steel; or damage they cause while in their possession.

