289 Wagaraw Road, Hawthorne NJ 07506
njsteel@njsteelbaron.com
SteelBaron.com
973-949-4140

CPM® S35-VN | Heat Treating

Crucible Industries

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About CPM® S35-VN

CPM S35VN is a martensitic stainless steel designed to offer improved toughness over CPM S30V. It is also easier to machine and polish than CPM S30V. Its chemistry has been rebalanced so that it forms some niobium carbides along with vanadium and chromium carbides. Substituting niobium carbides for some of the vanadium carbides makes CPM S35VN about 15-20% tougher than CPM S30V without any loss of wear resistance. CPM S35VN's improved toughness gives it better resistance to edge chipping. Because both vanadium and niobium carbides are harder and more effective than chromium carbides in providing wear resistance, the CPM stainless blade steels offer improved edge retention over conventional high chromium steels such as 440C and D2.


CPM Steel

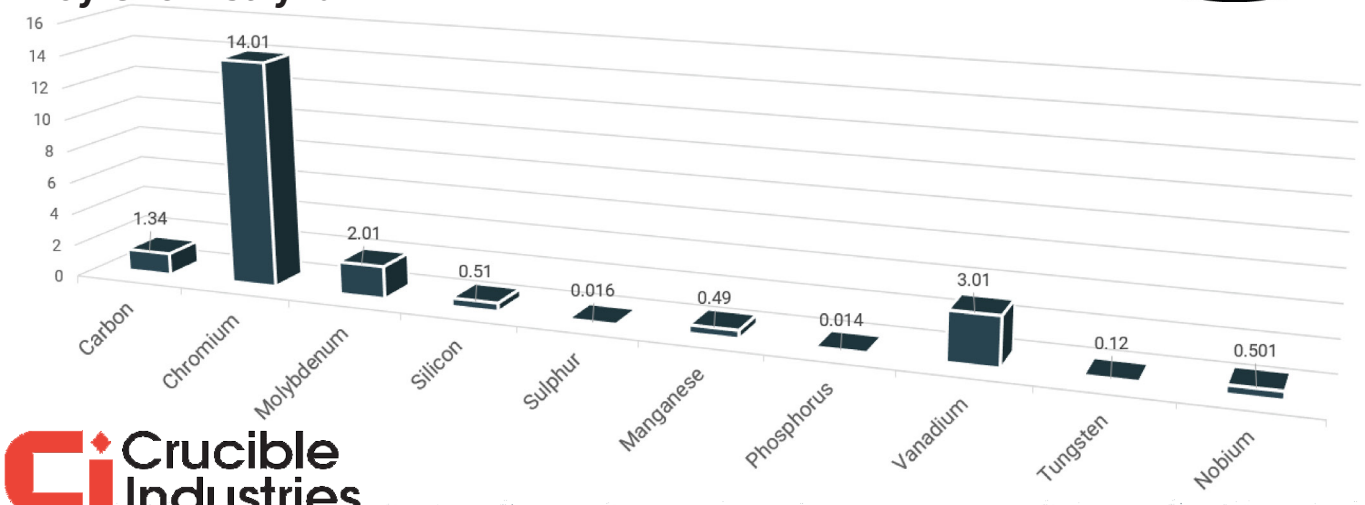
The CPM process produces very homogeneous, high quality steel characterized by superior dimensional stability, grindability, and toughness compared to steels produced by conventional processes.


Conventional Steel

Machinability

In the annealed condition, CPM S35VN is much easier to machine than CPM S90V and easier to machine than CPM S30V. 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

Alloy Chemistry %



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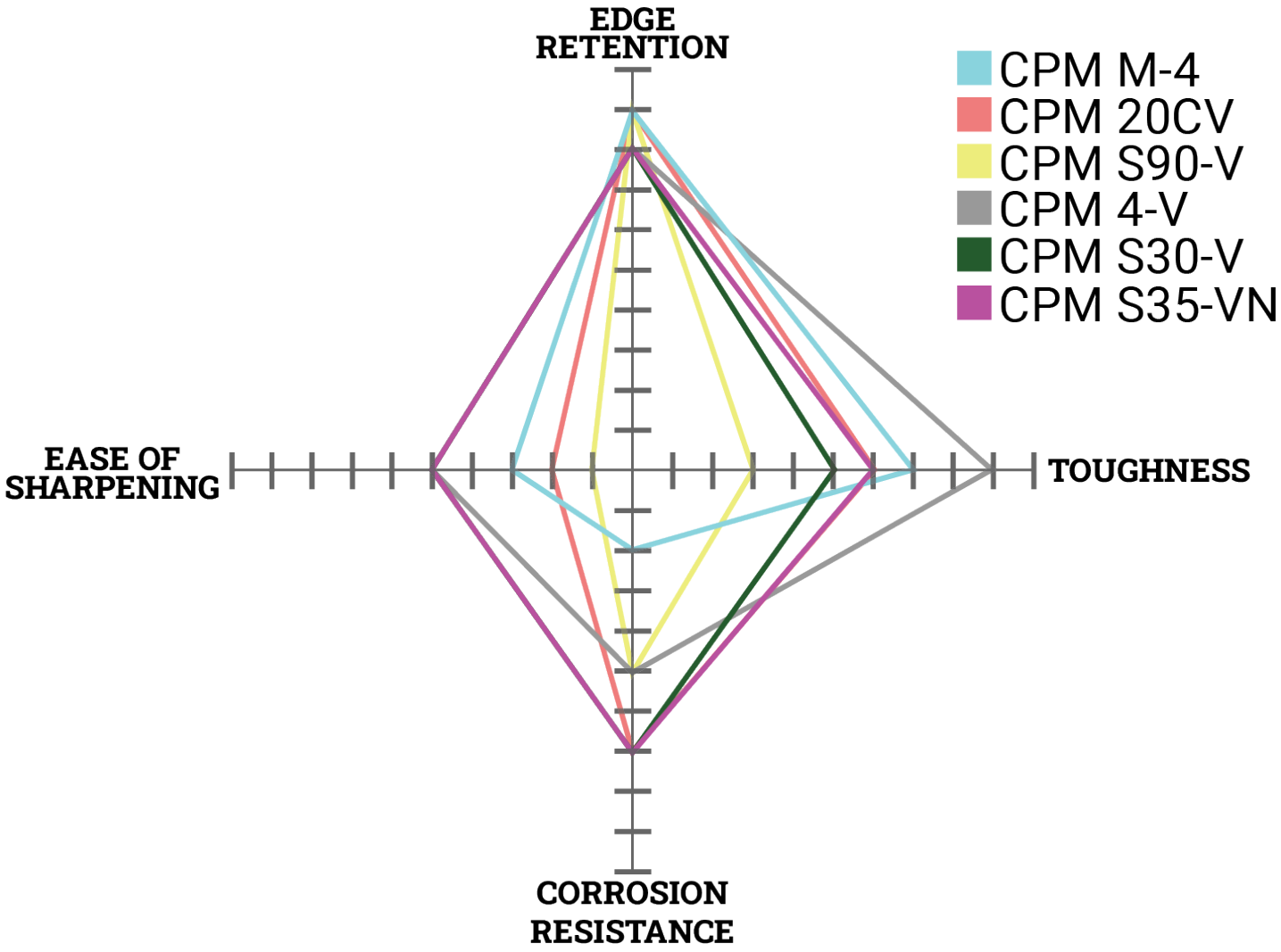
Blade Steel Comparagraph



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About CPM® S35-VN

Physical Properties

Elastic Modulus	32 X 10^6 psi	(221GPa)
Density	0.27 lbs./in^3	(7.47 g/cm^3)

Thermal Conductivity

	BTU/hr-ft-°F	W/m-°K	cal/cm-s-°C
at 200°F (93°C)	10	17.31	4.13X10^{-2}

Coefficients of Thermal Expansion

	in/in/°F	mm/mm/°C
70 to 400°F (20 to 200°C)	6.10X10^{-6}	11.0X10^{-6}
70-600°F (20-315°C)	6.4X10^{-6}	11.5X10^{-6}

Mechanical Properties

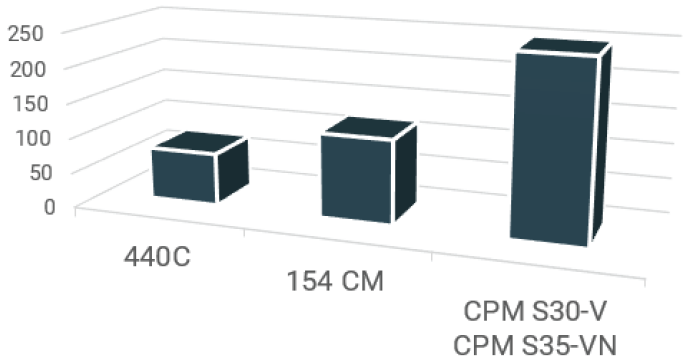
Toughness

Although the longitudinal toughness of all four of these grades is about 25-28 ft. lbs., the transverse toughness of the CPM grades is four or more times that of 440C and 154CM. The higher transverse toughness results indicate that CPM S35VN and CPM S30V are much more resistant to chipping and breaking in applications which may encounter side loading. In knifemaking, the higher transverse toughness makes CPM especially good for bigger blades.

Edge Retention (CATRA Testing Relative to 440C)

Grade	%
CPM S35-VN	145
CPM S30V	145
154CM	120
440C	100

Corrosion Retention



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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	Austenizing Temperature	Expected RC (as quenched prior to cryo)
1,550°F / 845°C Hold 10-15 minutes	1,950°F / 1065°C Soak 15-30 minutes	62Rc (63 after Cryo)

Cyrogenic Treatment

• A cryogenic treatment is recommended to convert retained austenite, and can either be done before or after the first temper cycle.
• While liquid nitrogen is preferred, a sub zero bath with dry ice and kerosene will suffice for -100°F / -74°C.
• Submerge in sub-zero treatment 1-4 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):
300°F / 149°C	62
400°F / 204°C	61
600°F / 316°C	59

- Manufacturers warn against tempering at 800°F / 425°C and above as sensitization will result in reduction of toughness and corrosion resistance.
- **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.