PRELIMINARY REPORT ON THE NEWEST PARTICLE METALLURGY BLADE MATERIAL

One of the many rewards that goes along with making knives is the opportunity to work with a wide variety of exciting materials. This includes Walrus and Mammoth ivory that have been in limbo in the Arctic tundra for 40,000 years to the newest super steel for a blade. The blade of course is where the cutting takes place and is where the difference between a proud success or a mediocre effort really shows up. This is the area that I really get excited about and I have been fortunate to be one of the first to try the newest steel that has great potential. The new steel is CPM 420V. I first heard about it during a phone conversation with Ed Severson, a metallurgist at Crucible Materials Corporation and a Custom Knife enthusiast. He mentioned that Crucible is coming out with an up grade for 440V and that it would be available late in 96. This steel is produced in the same manner as the whole line of CPM steels. It is based on the Particle Metallurgy Process identical to CPM 440V. The CPM 420V nomenclature is somewhat confusing. It was taken from the 420 series of stainless tool steels that have a similar amount of chromium, about 13-14%. I like to think of it as high vanadium 440V. In any case the chemical composition of 420V as compared to 440V is shown in below

Note: this article was written in 1996. The information is dated but still useful. I have edited the original article for use on this web site. 420V is now referred to as S90V and 440v as S60V. Ed Severson Is no longer at Crucible, Phil

	CARBON	CHROMIUM	VANADIUM	MOLYBDENUM
CPM420V	2.2%	13%	9.0%	1.0%
CPM440V	2.2%	17%	5.5%	.40%

The significant differences are in the Vanadium (almost twice the amount), and Chrome (a little more than D2), and some molybdenum added for resistance to corrosive pitting. The large amount of very hard finely dispersed vanadium carbides is what gives 440V it's outstanding edge holding. The addition of almost twice the vanadium should significantly increase the edge holding in the new steel. Crucible's early tests do substantiate this. Ed sent me an data sheet as a preview. The following description is taken directly from that information

"CPM 420V is a unique tool steel made by the Crucible Particle Metallurgy process. It is designed from a martensitic stainless steel base analysis, with high vanadium and carbon added for exceptionally good wear resistance. CPM 420V offers significant improvements over CPM 440V and other high chromium P/M and conventional tool steels in both wear and corrosion resistance."

Wear Resistance
"The wear and corrosion resistance of CPM 420V make it an excellent candidate to replace CPM 440V or AISI 440C, where increased wear is a primary concern, as well as D2 or other tool steel applications where improved corrosion protection is of benefit. In wear testing, CPM 420V has shown 25% to 50% better wear life than CPM 440V. Both grades offer several times better wear resistance than standard 440C at comparable hardness."

Impact toughness
"CPM 420V offers similar impact toughness (Charpy C notch) to CPM 440V and standard 440C at comparable hardnesses."

Corrosion Resistance
"420V's high vanadium content favors the formation of hard vanadium carbides instead of chromium carbides for wear resistance,thus more free chromium is available to provide corrosion resistance. In laboratory tests CPM 420V's corrosion resistance was about twice as good as CPM 440V."

The material looks very good on paper but how does it actually work out as a finished knife blade? My initial impressions are that is does very well. The expectation is that it should behave similar to CPM 440V in areas of grinding, heat treating and finishing. I received some 0.130 stock from Rade Hawkins in September and immediately ground and heat treated a 9 inch fillet knife. A fillet knife works out very well as a test blade because of the very tough environment it must live in. It must exhibit good bending strength, good ductility, corrosion resistance and edge holding. I used the knife on a couple of fishing trips, and the corrosion resistance is very good around salt water as advertised. The edge holding so far seems to be at least equal to 440V. It may be better but some very careful cutting tests and feedback from other makers will be required before I would be ready to claim a specific percentage improvement over 440V. Grinding is about the same. Finishing on 420V is noticeably tougher than 440V. If you get a deep scratch in it you'll be a while getting it out. I currently have a couple of fillet knives delivered to avid fishermen who will give them a good field test and will then give me an honest assessment. In addition I have supplied material to a couple of maker friends who are in the process of independently evaluating the aspects of its use as a knife blade material.

Heat treating is similar to CPM 440V except that a higher austenizing temperature (2000 F) is required. The data sheet provided by Crucible in fact recommends 2050/2075 F for the best combination of corrosion resistance and toughness. I was limited to 2000 F on the prototype blade because the stainless foil used for scaling protection has a practical limit of about that temperature. The as quenched hardness with forced air cooling was RC-60/61(almost 2 points higher than CPM 440V at the same austenizing temperature). The rest of the process is identical to that already outlined for 440V, including an Ultra Subzero treatment for 4 hours with liquid nitrogen. The final hardness on the initial knife was RC-58 after 3 temper cycles at 450 F. I believe that this steel will exhibit

superior edge holding down to RC 55/56. This range will probably end up yielding the best working hardness. I expect that the lower hardness will produce good bending fracture characteristics similar to those experienced with 440V.

Current availability is very limited. I believe Rade Hawkins has the only supply at this time. The material is furnished from the mill in plate stock that has been cut into 6 inch widths. Rade has thicknesses in 0.130, 0.115, and a limited amount of 0.180.
The cost of the material is about the same as CPM 440V. It is expensive, about twice ATS 34 currently.

I would like to hear from makers who have or will be working with this new steel so that we can build a good technical base of information on the application for custom knife blades. I intend to continue to evaluate it myself including having some photo micro graphs done to validate the above heat treating process and to examine the grain structure. I would hope to do an update as soon as possible incorporating actual field experience and all feed back that comes my way. Crucible indicated that CPM 440V will continue to be available for knife blade stock. Further information and data sheets are available from Ed Severson at Crucible Division office or at the nearest Crucible Materials Service Center.