The new Crucible CPM S-30V (Stainless 3V) is now a reality. The first production melt was rolled and ready for distribution on the first of November 2001. The best way to charaterize the new steel from Crucible is to quote direct from their preliminary data sheet.

CPM S30V is a martensitic stainless steel specially balanced to insure the formation of vanadium carbides for high wear resistance properties. CPM S30V also offers substantial improvements in toughness over other high hardness materials such as 440C and D2. Corrosion resistance is equal to or better than 440C in various corrosive environments.

Typical Applications

Long-Wearing Specialty Cutlery
Plastic Injection and Extrusion Feed Screws
Non-Return Valve Components
Pelletizing Equipment
Wear Components for Food and Chemical Processing

As anticipated in the previous article I was able to obtain some CPM S-30V and work with it. There has also been some limited feed back from others who have used it. The early impressions that follow are not based on laboratory results but are based on past experience with other stainless blade materials The observations are offered here to serve to characterize a new material and to assist others who may want to use CPM S-30V for either custom or factory production. At this writing Crucible has not finalized testing and the data sheet information is still preliminary.

I had a standing order for the first S-30V and received some stock on November 5 , 2001. This was like Christmas in November for a knife maker. The day I received it I ground a 9 inch fillet blade, heat treated it and had a completed knife to work with the day after. I chose to make a fillet knife because this type of knife has the hardest life in my opinion. Use around salt water will characterize the corrosion resistance in a short time. Edge holding is tested quickly when you are cutting through scales and bones and working against an abrasive cutting board. It has to have a thin flexible blade to ride over the rib bones during the fillet cut. A brittle steel will soon chip out or break under this kind of use. A fillet knife also makes a very handy kitchen knife. It is a natural for boning a chicken breast, slicing the prime rib, or filleting out a grapefruit. Kitchen knives are left wet on the counter and bounce around in a drawer with other utensils so this is another pretty severe test for a new steel. In addition to the fillet knife I made a simple slab handle semi skinner with the new CPM S 30V and two other similar knives out of CPM 3V and CPM S90V. This effort would give me a fresh comparison on the heat treating, grinding and finishing on all three steels. It would allow me to do some cutting and edge holding tests against the new grade. Does the new CPM 30V meet the challenges? The answer is yes, and I am willing to bet that this will be the favorite steel of many knife makers in a short time. Before we get into details let me quickly review what the expectations were.

Edge holding on a level with or better than 154CM/ATS 43 or D2 at the same hardness
A true stainless steel with good to excellent corrosion resistance on a par with 440C or 154CM
Bending strength and impact toughness that is an improvement over ATS-34/154CM and D2. Hopefully approaching A2.
Straight forward heat treating that can be done in a furnace without special controls or ultra high heat capacity.
A particle metallurgy steel with a balanced amount of Vanadium Carbide to provide edge wear resistance without causing significant finishing difficulties.
Good availability in knife blade thickness and reasonable cost.

Edge holding will be proportional to hardness to a large degree. Experience with CPM S-90V, CPM 3V and CPM 10V showed me that with a particle based steel the hardness can be pushed a little higher up the Rockwell scale and still retain enough toughness to prevent edge chipping (CPM S-60V is the exception, it has the best qualities at about RC 56). This is because the particle metallurgy based steels have a very fine grain structure. Given this I opted for RC 61 for the first test knife. At RC 61 it does as well or slightly better than 154CM or ATS 34 at the same hardness. It has the same aggressive cutting nature as CPM 3V. I call this carbide contrast. The softer steel matrix against the much harder carbides provide a toothed profile at the cutting edge as soon a little wear takes place. Steels with a higher percentage of carbides like CPM 10V and CPM S-90V have less initial grab in the cutting medium. They will however reach a plateau and cut for a long time at about the same sharpness.

Corrosion resistance is excellent.. I purposely left the fillet knife uncleaned with a combination of fish slime, salt water and blood in the back of my truck camper shell over night in a damp coastal environment. . There was no evidence of corrosion or pitting the next day. It cleaned up like new. The same thing would be true of 154CM and ATS 34 in my experience. By comparison D-2 ,CPM 3V, and CPM 10V (all have some percentage of chromium) would have shown some evidence of corrosion. Steels like 1095, 52100 and O1 would be badly rusted and pitted. In addition to the fishing trip corrosion test I cut up a grapefruit and left the uncleaned knife on the cutting board overnight. Again no evidence of corrosion on the blade surface

Bending toughness seems to be excellent on this steel. This again can be best characterized with a fillet knife. The 9 inch test knife was ground pretty flexible but it took about 10 lbs of force to bend it 90 degrees from the original position. The blade was left with a slight permanent bend after the force was released. This force is much more than would be needed during a normal fillet operation. The same type of bending takes place on a thin knife edge that is worked hard against the cutting medium.. A good steel heat treated correctly will flex and come black to the original shape like a spring. If it is too soft it will tend to bend and stay bent . If it is too hard the edge will break before it bends very far. My experience indicates that most stainless steels will perform pretty well under a pure bending situation . I use a lot of ATS34 and 154CM for fillet knifes and they act in a similar way. Impact toughness is the real question. This is the main nemesis

of stainless knife steels. The data sheet above indicates that the aim was to produce a steel with toughness exceeding 440C and D2. I didn't make a chopping type knife to experiment with but I did chop a Douglass fir 2X4 in half with the fillet knife. It was hard to put much chopping energy into the task because the knife was so light but there was absolutely no damage evident on the thin blade. Did it make the A-2 toughness target? We will have to wait for the final data from Crucible to see how close it comes but I think in time it will be evident that this steel is the toughest true stainless around.

We were hoping for a material that would be straightforward to heat treat similar to A2 or CPM 3V. In spite of the additional alloy this objective was met. Again quoting from the preliminary data sheet here are the recommendations for heat treating.

Hardening
Austenitize: 1900-2000°F (1065-1092°C)
Hold time at temperature 15-30 minutes.
Quench: Air or pressure gas quench (2 bar minimum) to below 125°F (50°C) or salt or interrupted oil quench to below 1000°F (540°C) then air cool to below 125°F (50°C).
Temper: Double temper at 400-750°F (200-400°C). Hold for a minimum of 2 hours each temper. For optimum stress relieving CPM S30V may be tempered at 1000-1025°F (540-550°C).
A freezing treatment may be used between the first and second tempers. Freezing treatments help to attain maximum harden ability and must always be followed by at least one temper.
Aim Hardness: 58-61 HRC

This material can be hardened a little higher than 154CM or ATS 34 because of the inherent toughness of the particle metallurgy structure. It is my opinion that it could be used successfully at RC 62 for a "high performance" slicing type hunting knife. There is no question that the target was met on ease of heat treating. I was able to get RC 61 with 1970 F austenitizing and 400 F tempering temperatures with an air quench.
As quenched hardness was 63. I did a subzero in Liquid Nitrogen directly after the air quench down to room temperature. This was followed by two temper cycles at 400F for two hours each cycle. I haven't tried it yet but from the data sheet it looks like one could temper at around 1000 F and take advantage of the secondary hardening increase typical of alloy steels of this type. It may be possible to end up with a final hardness of RC 62 at the cost of some corrosion resistance.
Compared to CPM S-90V or CPM 10V this stuff is a pleasure to work with. It grinds in the annealed state much like any other stainless steel. It feels a little gummy and gets hot quick if you don't have a sharp belt. If you are used to working with non- stainless then it might seem a little tougher to grind. After it is hardened to 60/61 it acts a lot like CPM 3V. Like all the CPM steels with a high percentage of Vanadium Carbide the final finishing operations take more effort that 154CM or D-2 for example. A hand rubbed satin finish or a 240 grit belt finish is the best choice for all of these grades of steels.

Forget about a mirror polish unless you want to be there all day. CPM 30V however takes about half the effort that it takes for this last step on CPM S90V. In this area also the target was met. High wear resistance at the cutting edge with out an insane amount of effort for the final finish.

Crucible offers a range of rolled sheet stock in various thicknesses that will finish in the most often used knife blade dimensions. The stock I received in November was 0.140 inches thick. This finishes after removing the scale to about the 0.125 range. They plan to stock small quantities of CPM S-30V for knife blade use at the Dallas Texas Service Center. Prices vary depending on the amount ordered but expect to pay about 30 % more than the cost of 154CM. Availability and cost are important items and it looks like expectations have been met in this area.

The table below compares the chemistries of some of the above mentioned steels

BLADE STEEL	CPM S30V	CPM S60V	CPM S90V	154CM	CPM 3V	A2
Carbon	1.50	2.15	2.30	1.05	0.80	1.00
Chromium	14.00	17.00	14.00	14.0	7.50	5.25
Vanadium	4.00	5.50	9.00	0.00	2.75	0.25
Molybdenum	2.00	0.40	1.00	4.00	1.30	1.10
Manganese	*	0.40	*	0.50	*	0.85
Silicon	*	0.40	*	0.30	*	0.35

* not included in steel company data sheets

CPM S30V has met all the expectations set forth in the initial introductory article. In addition one can say that it is just a very pleasant and forgiving steel to work with. It's going to end up with the reputation of being the toughest stainless out there, with very good edge holding and cutting ability. Crucible Materials Corporation has introduced 3 winners in the last 10 years. CPM S-90V, CPM 3V and now CPM S-30V. CPM 3V is still the undisputed toughness champ even surpassing some carbon steels like A-2. CPM S-90V was introduced as an upgrade for CPM S-60V and met all the targets of improved corrosion resistance and toughness. It has the reputation of being hard on heat treating equipment and is a bear to finish but is still the best edge holding stainless steel going. In time CPM S-30V may hold the place as the best all purpose "work horse stainless steel. It could edge out (pun intended) more widely known stainless steels like ATS 34, 154CM, BG-42 440C, and many of the Japanese proprietary grades. With all these choices available knife makers have never had it so good. It's also a boon for the knife buying public. There is now one more excellent steel available for that elusive "high performance" knife.