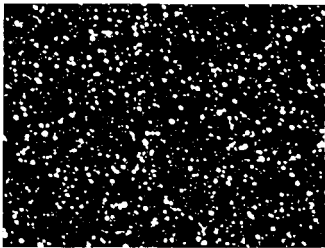


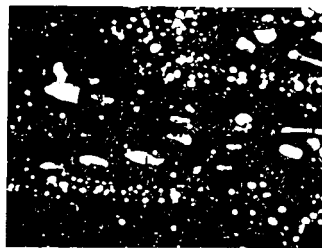
# CRUCIBLE

CPM 3V is a new tool steel made by the Crucible Particle Metallurgy process, designed to provide maximum resistance to breakage and chipping in a highly wear-resistant 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, while providing 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.

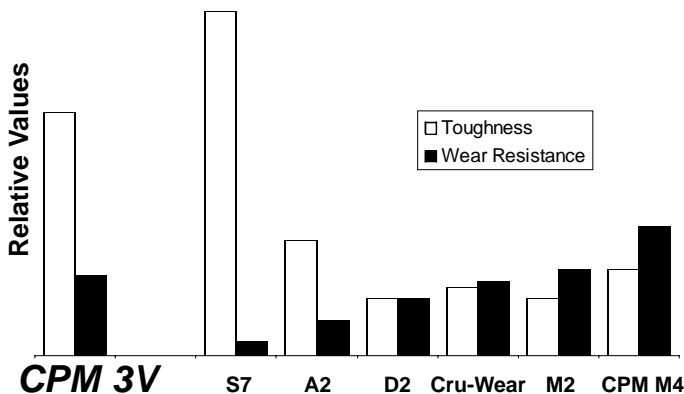


CPM Steel



Conventional Steel

## Tool Steel Comparagraph



## Typical Applications

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

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

**Crucible...**  
**The Tool Steel Pros®**

## DATA SHEET

### CRUCIBLE CPM® 3V®

Issue #5

<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 14	W/m-°K 24.2
		cal/cm-s-°C 0.057
<b>Coefficient of Thermal Expansion</b>		
70-400°F (20-200°C)	in/in/°F 5.9X10 <sup>-6</sup>	mm/mm/°C (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.

#### Wear Resistance

The vanadium content imparts 3V with excellent wear resistance, similar to that of M2 high speed steel.

	Heat Treatment <sup>(1)</sup> Austenitizing Temperature	HRC	Impact Toughness <sup>(2)</sup> ft.-lb. (J)	Wear Resistance <sup>(3)</sup> Adhesive
CPM 3V	1875°F (1025°C)	58	85 (113)	6
CPM 3V	1950°F (1065°C)	60	70 (95)	7
CPM 3V	2050°F (1120°C)	62	40 (53)	8
S7	1750°F (955°C)	57	125 (165)	1
A2	1750°F (955°C)	60	40 (53)	2-3
D2	1850°F (1010°C)	60	21 (28)	3-4
Cru-Wear	1950°F (1065°C)	62	30 (40)	5-6
M2	2050°F (1025°C)	62	20 (27)	8-10
CPM M4	2050°F (1025°C)	62	32 (43)	20-25

(1) Heat Treatment: Austenitized as indicated and tempered to hardness.

(2) Charpy C-Notch Impact Test

(3) Crossed cylinder adhesive wear test (higher number = better wear resistance)

### Relative Mechanical Properties

The combination of wear resistance and toughness offered by CPM 3V make it an excellent alternative to shock-resistant grades such as S7 or A9 in applications where they wear out too quickly. Or, it can replace wear-resistant grades such as A2, D2, Cru-Wear, or CPM M4 in applications where they tend to fail by impact, i.e. chipping or breaking. CPM 3V offers the highest impact toughness of any tool steel with this range of wear resistance.

*The Crucible logo, Crucible, CPM, 3V, Cru-Wear, Crucible Particle Metallurgy, and The Tool Steel Pros are trademarks of the Crucible Materials Corporation, Syracuse, NY.*

## 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. For additional data or metallurgical engineering assistance, consult your local Crucible Service Center.*

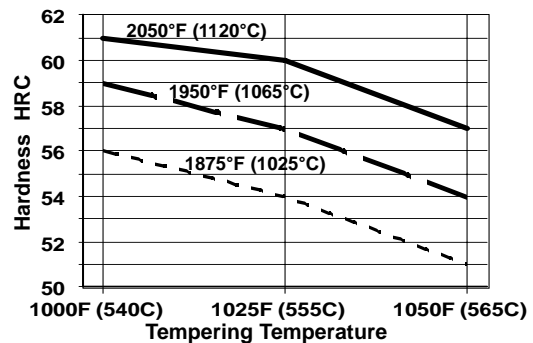
### Service Center Locations

Location	Phone	Toll Free	FAX
Auburn, MA	508-832-5353	800-365-1101	508-832-2217
Charlotte, NC	704-372-3073	800-365-1160	704-342-0985
Chicago, IL	630-378-0093	800-365-1151	630-378-1965
Cincinnati, OH	513-771-1310	800-365-1163	513-771-0119
Cleveland, OH	330-562-3131	800-365-1132	330-562-7818
Columbus, OH	614-262-4959	800-365-1131	614-262-7850
Dallas, TX	817-649-2800	800-365-1168	817-633-8142
Detroit, MI	248-528-0332	800-365-1133	248-528-1977
Grand Rapids, MI	616-554-9699	800-365-1137	616-554-9328
Huntsville, AL	256-772-0201	800-365-1161	256-772-3361
Indianapolis, IN	317-638-4501	800-365-1146	317-634-7375
Los Angeles, CA	323-775-7344	800-365-1179	310-830-9784

## 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
As Quenched	58	62	63
1000°F (540°C)	56	59	61
1025°F (555°C)	54	57	60
1050°F (565°C)	51	54	57
Minimum Number of Tempers	3	3	3

*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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Location	Phone	Toll Free	FAX
Meadville, PA	814-337-8804	800-365-0530	814-337-8808
Milwaukee, WI	262-781-6710	800-242-0948	262-781-6743
Minneapolis, MN	612-331-6320	800-365-1153	612-331-4137
St. Louis, MO	636-272-7220	877-201-4049	636-978-9559
<b>Canada</b>			
Wallaceburg, ONT	519-627-2245	800-265-5293	519-627-2247
<b>Mexico</b>			
Monterrey, N.L.	52-818-351-7220		52-818-351-2981
Naucalpan, E de M	52-555-576-4011		52-555-360-1865

### CRUCIBLE SERVICE CENTERS DIVISIONAL HEADQUARTERS:

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