CRUCIBLE

DATA SHEET

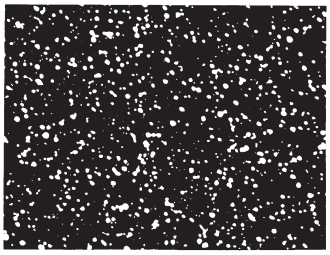
CRUCIBLE CPM® 3V®

Issue #2

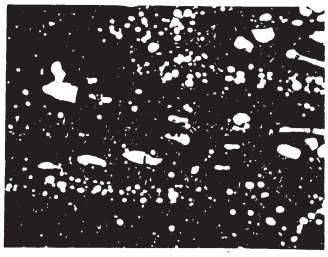
CPM 3V, made by the Crucible Particle Metallurgy process, is designed to provide maximum resistance to breakage and chipping in a highly wear-resistant tool steel. CPM 3V offers impact toughness greater than A2, D2, CPM Cru-Wear or Z-Wear PM and CPM M4, approaching the levels of S7 and other shock resistant grades, yet it provides 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.

Carbon	**0.8%**
Chromium	**7.5%**
Vanadium	**2.75%**
Molybdenum	**1.3%**

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

Physical Properties

Elastic Modulus	30 X 10^6 psi	(207 GPa)
Density	0.28 lbs./in^3	(7.8 g/cm^3)

Thermal Conductivity

	BTU/hr-ft-°F	W/m-°K	cal/cm-s-°C
at 200°F (95°C)	14	24.2	0.057

Coefficient of Thermal Expansion

	in/in/°F	mm/mm/°C
70-400°F (20-200°C)	5.9X10^{-6}	(10.6X10^{-6})

Mechanical Properties

Impact Toughness

The CPM microstructure gives 3V its high impact toughness which approaches that of the shock-resistant tool steels.

	Heat Treatment (1) Austenitizing Temperature	HRC	Impact Toughness (2) ft-lb.	(J)
CPM 3V	1875°F (1025°C)	58	85	113
CPM 3V	1950°F (1065°C)	60	70	95
CPM 3V	2050°F (1120°C)	62	40	53
S7	1750°F (955°C)	57	125	165
A2	1750°F (955°C)	60	40	53
D2	1850°F (1010°C)	60	21	28
CPM CruWear/ Z-Wear PM	1950°F (1065°C)	60	60	80
M2	2050°F (1120°C)	62	20	27
CPM M4	2050°F (1120°C)	62	32	43

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

(2) Charpy C Notch Impact Test

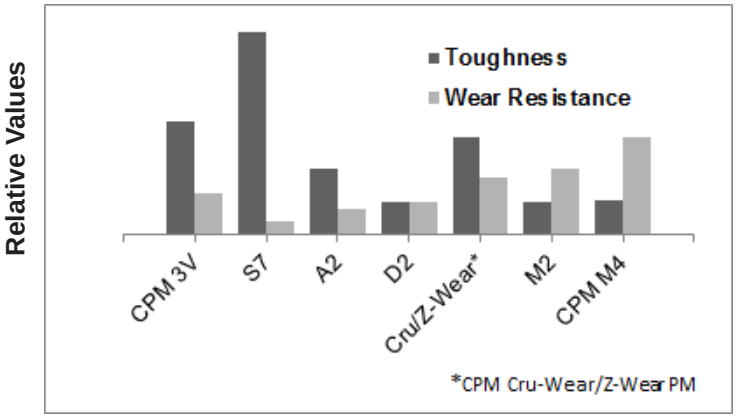
Wear Resistance

Due to the vanadium carbides in its microstructure, CPM 3V has excellent wear resistance, similar to that of D2.

Relative Mechanical Properties

The unique combination of wear resistance and toughness offered by CPM 3V make it an excellent alternative to S7 or A2 in applications where they wear out too quickly. It can also replace wear-resistant grades such as D2, CPM Cru-Wear or PM Z-Wear, M2 and CPM M4 in applications where they tend to fail by impact, chipping or breaking. CPM 3V offers the highest impact toughness of any tool steel with this range of wear resistance.

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 Industries LLC

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).

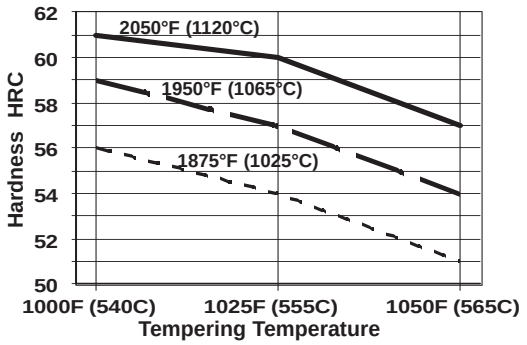
Aim hardness: HRC 58-60 Higher austenitizing temperatures can be used to obtain higher hardness, at a slight decrease in impact resistance. The lower austenitizing temperatures provide the best impact toughness.

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.

Heat Treat Response

	Hardness HRC		
	Austenitizing Temperature		
Tempering 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	2	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 CPM 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.

Crucible Industries LLC
575 State Fair Blvd., Solvay, NY 13209
www.crucible.com
800-365-1180 315-487-4111

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