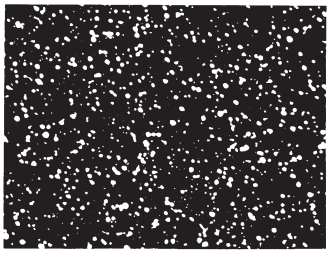
CRUCIBLE

DATA SHEET

CPM 1V is a medium carbon, high alloy tool steel which exhibits high toughness combined with high heat resistance. It is suited for both hot or cold applications which demand high impact toughness and also require moderate wear resistance.

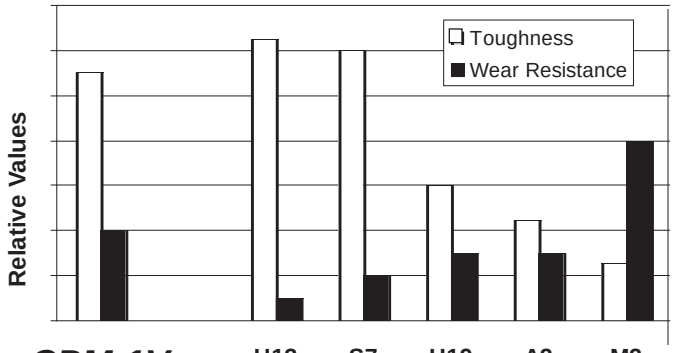
The CPM (Crucible Particle Metallurgy) process produces very homogeneous, high quality steel characterized by superior dimensional stability, grindability, and toughness compared to steels produced by conventional processes.



CPM Steel

Conventional Steel

Tool Steel Comparagraph



CPM 1V	H13	S7	H19	A2	M2
HRC 56	46	57	54	60	62
Impact Toughness ft-lbs 115	130	125	60	40	20

Typical Applications

Hot (Warm) Work

Hot and Warm Forming Dies Hot Shear Dies
Hot Heading Dies Extrusion Dies
Forging Dies and Punches

Cold Work

Cold Heading Dies High Impact
Blanking Dies Punches
Thread Rolling Dies

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

Crucible Industries LLC

CRUCIBLE CPM® 1V®

Issue #2

Carbon	**0.55%**
Chromium	**4.5%**
Vanadium	**1.00%**
Tungsten	**2.15%**
Molybdenum	**2.75%**

Physical Properties

Elastic Modulus	30 X 10^6 psi		(207 GPa)
Density	0.284 lbs./in3		(7.85 g/cm^3)
Thermal Conductivity	BTU/hr-ft-°F	W/m-°K	cal/cm-s-°C
72°F (22°C)	12.64	21.88	5.23X10^{-2}
212°F (100°C)	13.80	23.88	5.70X10^{-2}
572°F (300°C)	14.90	25.80	6.16X10^{-2}
752°F (400°C)	15.46	26.76	6.39X10^{-2}
1004°F (540°C)	16.23	28.09	6.71X10^{-2}

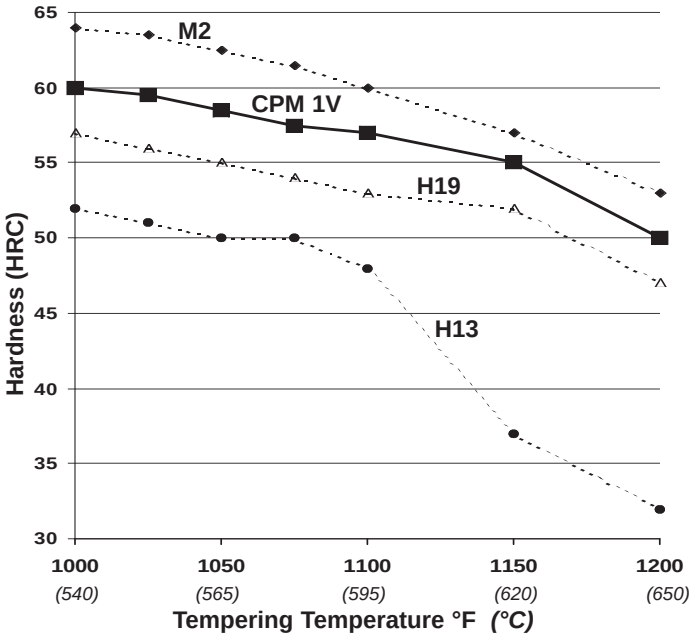
Relative Mechanical Properties

Impact Toughness and Wear Resistance

With its 1% vanadium content, CPM 1V has wear resistance slightly better than A2. Because of its CPM microstructure, 1V has high impact toughness approaching that of the shock-resistant tool steels such as S7.

Temper Resistance

Because of its high alloy composition, CPM 1V has temper resistance similar to high speed steel (M2) and much better than most typical hot work tool steels as shown in the comparative temper curves below.



Specimens double tempered a minimum of 2 hrs. at temperature each temper. M2 austenitized 1975°F (1080°C), CPM 1V austenitized 2000°F (1095°C), H19 austenitized 2100°F (1150°C), H13 austenitized 1850°F (1010°C), and S7 austenitized 1725°F (940°C).

Thermal Treatments

Annealing

Heat to 1600-1650°F(870-900°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 187

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 1550-1600°F (840-870°C) Equalize.

Austenitize: 1950-2000°F (1065-1120°C), hold time at temperature 10-15 minutes. The lower austenitizing temperature of 1950°F (1065°C) provides the best impact toughness.

Quench: 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 maximum attainable toughness for a given hardening treatment.

Temper: Three times at 1000-1025°F (540-550°C), 2 hours minimum each time.

Aim hardness 57-59 HRC.

Surface Treatments

CPM 1V can be nitrided or PVD coated. Due to its hig tempering temperature, it will retain its hardness after such processes, making it a more suitable substrate th A2 or S7. As for most tool steels, higher temperature face treatments, such as CVD, may result in dimensio distortion.

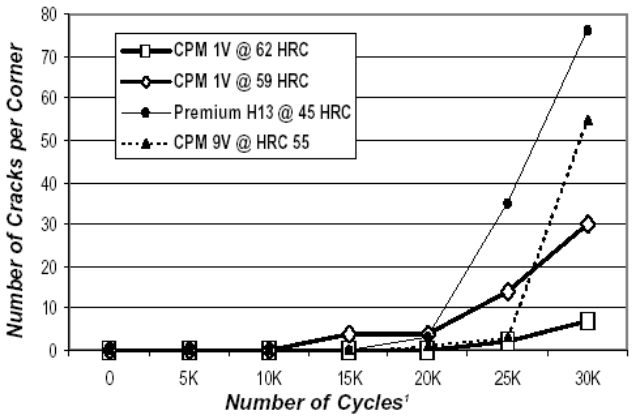
Note: Properties shown throughout this data sheet are typical values. Norma variations in chemistry, size and heat treat conditions may cause deviations fr these values.

Machinability and Grindability

The machinability and grindability of CPM 1V in the annealed condition is similar to that of A2.

Thermal Fatigue

The results of thermal fatigue tests show that CPM 1V offers an improvement over premium quality H13 and CPM 9V. Thermal fatigue tests are used to predict performance in die casting or other applications involving cyclic high temperature exposures.



[1]Specimens were dipped in molten aluminum at 1250°F and water quenched. Every 5000 cycles specimens were microscopically examined for corner cracks.

	HRC	Austenitize	Quench	Temper
CPM 1V	60	2000°F/10 min.	Air	1000°F/2+2hrs.
CPM 1V	59	1950°F/30 min.	Air	1000°F/2+2hrs.
Premium H13	45	1875°F/30 min.	Oil	1130°F/2+2hrs.
CPM 9V	55	2050°F/30 min.	Air	1000°F/2+2hrs.

	Heat Treatment (1) Austenitizing Temperature	HRC	Impact Toughness (2) ft-lb.	(J)
CPM 1V	1875°F (1025°C)	56	115	153
CPM 1V	1950°F (1065°C)	58	105	140
CPM1V	2000°F (1095°C)	60	85	113
CPM1V	2025°F (1110°C)	62	60	80

(1) Heat Treatment: Austenitize as indicated and temper to hardness
(2) Charpy C Notch Impact Test

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DS411 08/15 CPM 1V