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# 全球钢号百科!

## Global Steel Grade Encyclopedia



涵盖的行业或国家与地区类别



国际材料与试验协会

GJB

国家军用标准



动力机械工程师协会

EU

前欧洲标准化

AISI

美国钢铁学会



德国工业标准

AMS

航空航天材料规范



国际标准

JASO

日本汽车标准组织

EN

欧洲标准

JB

机械行业标准

UNS

统一编号系统

UNI

意大利标准



美国机械工程师协会

SS

瑞典标准



国家标准

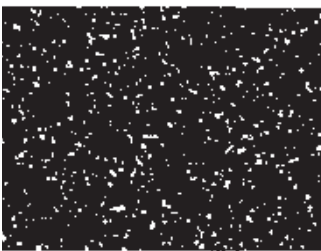


日本工业标准

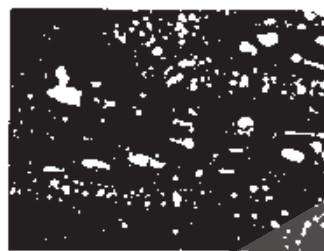
# CPM 9V

CPM 9V is made by the Crucible Particle Metallurgy process. Its composition is a modification of CPM 10V with lower carbon and vanadium to improve toughness and heat check resistance. These enhanced properties permit CPM 9V to perform well in problem applications where high carbon, high chromium tool steels, such as CPM 10V or the high speed steels, lack sufficient toughness or heat check resistance, or where lower alloy tool steels and hot work tool steels lack sufficient wear resistance.

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

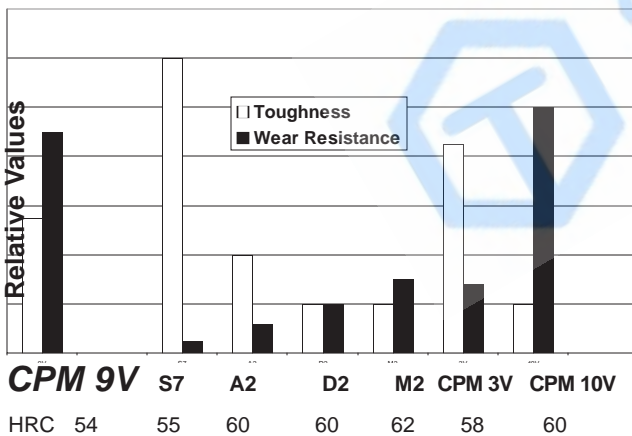


CPM Steel



Conventional Steel

## Tool Steel Comparagraph



## Typical Applications

- Forming Rolls
- Rolling Mill Rolls
- Header Tooling
- Extrusion Tooling
- Pelletizer Blades
- Plasticizing Components: Non-return Valves and Screws
- Punches
- Dies
- Slitter Knives
- Shear Blades
- Granulator Blades

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

## Crucible Industries LLC

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## DATA SHEET

### CRUCIBLE CPM® 9V®

Issue #1

Carbon	1.90%
Chromium	5.25%
Vanadium	9.10%
Molybdenum	1.30%

### Physical Properties

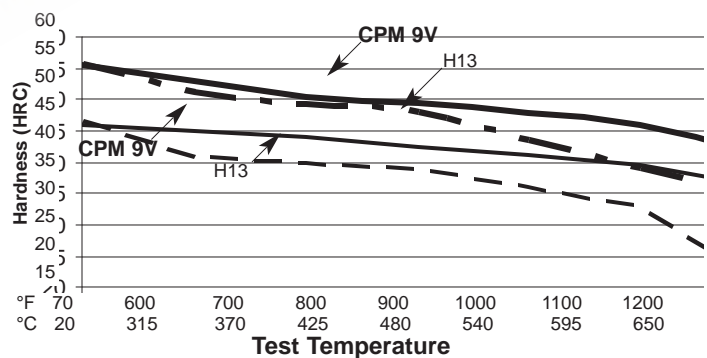
Elastic Modulus	32 X 10 <sup>6</sup> psi	(221 GPa)
Density	.269 lbs./in <sup>3</sup>	(7.455 g/cm <sup>3</sup> )
Thermal Conductivity		
	BTU/hr-ft-°F	W/m-°K cal/cm-s-°C
72°F 22°C	11.83	20.48 4.89 X 10 <sup>-2</sup>
212°F 100°C	12.48	21.60 5.16 X 10 <sup>-2</sup>
392°F 200°C	13.35	23.10 5.52 X 10 <sup>-2</sup>
572°F 300°C	14.59	25.25 6.03 X 10 <sup>-2</sup>
932°F 500°C	14.91	25.81 6.16 X 10 <sup>-2</sup>
1004°F 540°C	15.07	26.08 6.23 X 10 <sup>-2</sup>

### Coefficient of Thermal Expansion

°F	°C	in/in/°F	mm/mm/°C
70 - 200	(20 - 90)	6.15X10 <sup>-6</sup>	(11.07X10 <sup>-6</sup> )
70 - 400	(20 - 200)	6.21X10 <sup>-6</sup>	(11.18X10 <sup>-6</sup> )
70 - 800	(20 - 430)	6.45X10 <sup>-6</sup>	(11.61X10 <sup>-6</sup> )
70 -1200	(20 - 650)	6.59X10 <sup>-6</sup>	(11.86X10 <sup>-6</sup> )

### Mechanical Properties

#### Hot Hardness vs. H13 (Hardness at Indicated Temperature)



#### Heat Check Resistance (Warm Work Applications)

Grade	Hardness HRC	Number of Cycles <sup>(A)</sup>
D2	50	3,000
10V	51	5,000
9V	48	15,000
H13	48	20,000
H19	50	60,000

(A) One cycle consists of immersing the test specimen in 1250°F molten lead for 4 sec., cooling in 180°F water for 2 sec. followed by 8 sec. of air cooling.

### Machinability and Grindability

In the annealed condition, the machinability of CPM 9V is comparable to that of M2. Similar grinding equipment and practices used for high speed steels are recommended. "SG" type alumina wheels or CBN wheels have generally given the best performance with CPM steels.

## Thermal Treatments

**Critical Temperature:** 1590°F (865°C)

**Forging:** 2000-2100°F (1095-1150°) Do not forge below 1700°F (930°C). Slow Cool.

**Annealing:** Heat to 1650°F (900°C), hold 2 hours, slow cool no faster than 30°F (15°C) per hour to 1000°F (540°C), then furnace cool or cool in still air to room temperature.

**Annealed Hardness:** About BHN 223-255

### Stress Relieving

**Annealed Parts:** Heat to 1100-1300°F (595-700°C), hold 2 hours, then furnace cool or cool in still air.

**Hardened Parts:** Heat to 25-30°F (15°C) below original tempering temperature, hold 2 hours, then furnace cool or cool in still air.

**Straightening:** Best done warm 400-800°F (200-430°C)

### Hardening

**Preheat:** Heat to 1550-1600°F (845-870°C) Equalize.

Second pre-heat stage at 1850-1900°F (1010-1040°C) suggested for vacuum or atmosphere hardening.

**Austenitize:** 1850-2150°F (1025-1175°C), hold time at temperature 30-45 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 maximum attainable toughness for a given hardening treatment. Vacuum or atmosphere quench rate through 1850-1300°F (1010-705°C) range is critical to achieve optimum heat treat response.

**Temper:** Double temper at 1000°F (540°C) minimum. 2 hours minimum each time. (See Table)

**Size Change:** +0.01%

**Recommended Heat Treatment:** For the best combination of toughness and wear resistance, austenitize 9V at 2050°F (1120°C), hold 30-45 minutes, and quench. Temper 3 times at 1025°F (550°C).

**Aim hardness: 54-56 HRC.** 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.

### Surface Treatments

Because of its high tempering temperatures (>1000°F) CPM 9V 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.

## Heat Treat Response

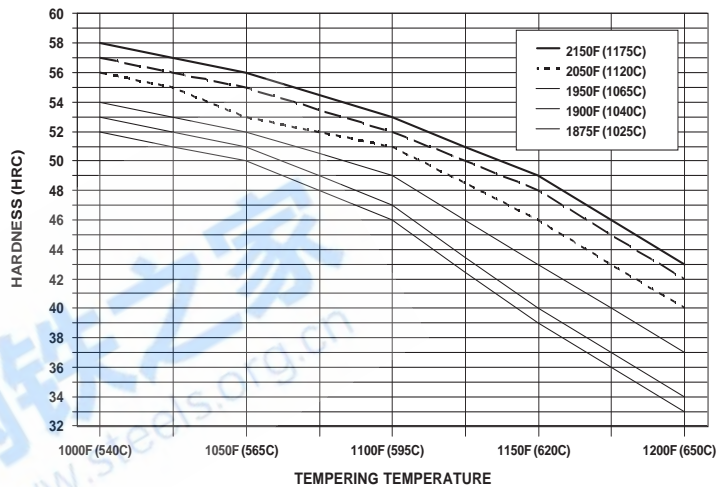
### Hardness HRC

Tempering Temperature	Austenitizing Temperature					
	1875°F (1025°C)	1900°F (1040°C)	1950°F (1065°C)	2050°F (1120°C)	2100°F (1150°C)	2150°F (1175°C)
As Quenched	53	54	56	58	59	61
1000°F (540°C)	52	53	54	56	57	58

Optimum for Maximum Toughness and Effective Stress Relieving						
1025°F (550°C)	51	52	53	55	56	57
1050°F (565°C)	50	51	52	53	55	56
1100°F (595°C)	46	47	49	51	52	53
1150°F (620°C)	39	40	43	46	48	49
1200°F (650°C)	33	34	37	40	42	43

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.

Minimum Time at Aust. Temp.	60 min.	45 min.	30 min.	20 min.	15 min.	10 min.
Minimum Number of Tempers	2	2	2	2	3	3



### Toughness

Depending on the hardness requirement, lowering the hardening temperature (underhardening) increases toughness.

Hardening Temperature	Tempering Temperature	Hardness HRC	Charpy C-Notch ft-lb (J)		Bend Fracture Strength ksi (MPa)	
2150°F (1175°C)	1025°F (550°C)	57	26	35	606	4177
2100°F (1150°C)	1025°F (550°C)	56	36	48	-	-
2050°F (1120°C)	1000°F (540°C)	56	47	63	600	4136
1950°F (1065°C)	1100°F (595°C)	49	74	99	-	-

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.