CRUCIBLE

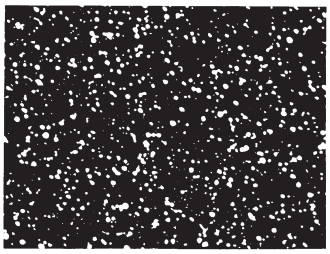
DATA SHEET

CRUCIBLE CPM® 15V®

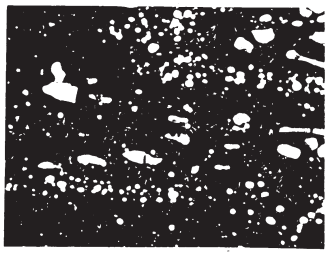
Issue #1

CPM 15V is intended for applications requiring exceptional wear resistance. It has more vanadium carbides in its microstructure than CPM 10V and provides more wear resistance and longer tool life in those applications where 10V has proven to be successful. CPM 15V also offers an alternative to solid carbide where carbide fails by fracture or where intricate tool design makes carbide difficult or risky to fabricate.

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

Carbon	**3.40%**
Chromium	**5.25%**
Vanadium	**14.50%**
Molybdenum	**1.30%**

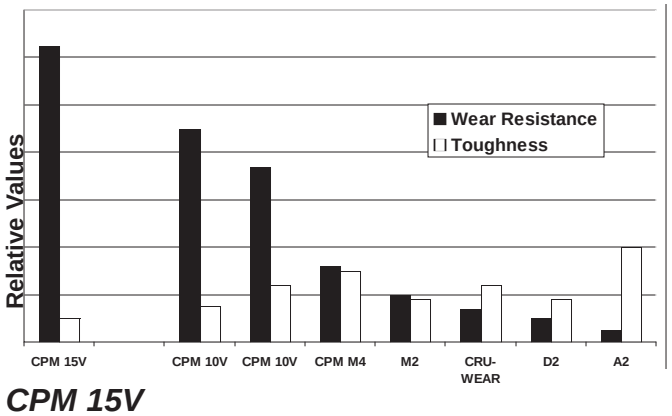
Physical Properties

Elastic Modulus	34 X 10^6 psi	(235 GPa)
Density	0.262 lbs./in3	(7.25 g/cm^3)

Coefficient of Thermal Expansion

°F	°C	in/in/°F X10^{-6}	in/in/°C X10^{-6}
70-200	(21-93)	5.8	10.5
70-500	(21-260)	6.2	11.1
70-800	(21-427)	6.5	11.7
70-1100	(21-593)	6.7	12.1

Tool Steel Comparagraph



CPM 15V

HRC	62	63	60	63	64	60	62	60

Typical Applications

Powder Compaction Tooling: Dies, Core Rods
Plastic Processing Equipment: Barrel Liners, Screw Tips
Industrial Knives: Granulator Blades, Slitter Knives
Dies/Punches for Cold Work:
Forming, Extrusion, Drawing, and Piercing
Woodworking Tools
Ceramic Dies
Wear Parts

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

Mechanical Properties

Wear Resistance

With its nearly 15% vanadium content, CPM 15V has the highest wear resistance of any cold work tool steel available today.

Impact Toughness

The CPM process makes possible the production of high vanadium grades without sacrificing toughness. For example, although both CPM 10V and CPM 15V have significantly higher wear resistance than the conventional high vanadium tool steel D7, they also offer greater toughness. (See Table)

	Heat Treatment(1) Austenitizing Temperature	HRC	Wear Resistance(2) Adhesive	Impact Toughness(3) ft.-lb.	(J)
CPM 15V	**2150°F (1175°C)**	**64**	**124**	**8**	**(11)**
CPM 15V	**2050°F (1120°C)**	**61**	**-**	**9**	**(12)**
CPM 15V	**2050°F (1120°C)**	**58**	**-**	**13**	**(18)**
CPM 10V	**2150°F (1175°C)**	**63**	**90**	**14**	**(19)**
CPM M4	**2120°F (1160°C)**	**63**	**31**	**31.5**	**(43)**
D2	**1850°F (1010°C)**	**60**	**4**	**17**	**(23)**
D7	**1900°F (1040°C)**	**61**	**7**	**6**	**(9)**

(1) Heat Treatment: Austenitized as indicated and tempered to hardness.
(2) Crossed cylinder adhesive wear test (higher number = better wear resistance)
(3) Charpy C-Notch Impact Test (Avg. value)

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Thermal Treatments

Critical Temperature: 1540°F (838°C)

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

Annealing: Heat to 1600°F (870°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 255-277**

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 coolor cool in still air.

Hardening

Preheat: Heat to 1500-1550°F (815-845°C) Equalize. A second pre-heat stage at 1850-1900°F (1010-1040°C) is suggested for vacuum or atmosphere hardening.
Austenitize: 1950-2150°F (1065-1175°C), hold time at temperature 20-30 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: Two times at 1000°F (540°C), 2 hrs. minimum each time. Temper three times for hardening temperatures over 2100°F (1150°C). See Table for data.

Size Change: +0.04/0.05%

Recommended Heat Treatment: For maximum wear resistance, austenitize at 2150°F (1175°C), hold 10 minutes, and quench. Temper 3 times at 1025°F (550°C).

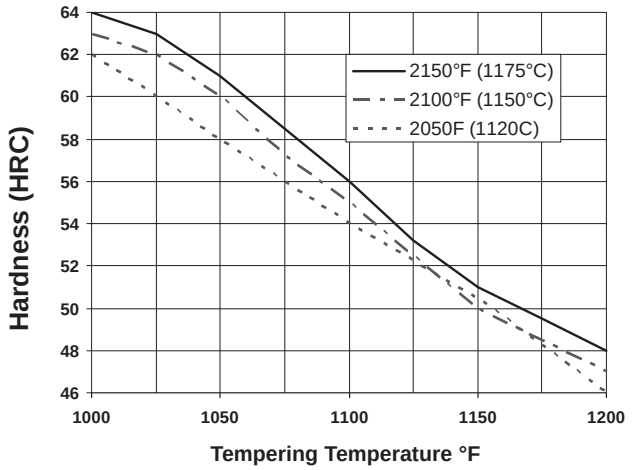
Aim hardness: **HRC 61-63**

Heat Treat Response

Hardness HRC

Tempering Temperature	Austenitizing Temperature 2050°F (1120°C)	2100°F (1150°C)	2150°F (1175°C)
Minimum Time at Austenitizing Temp.	30 minutes	20 minutes	10 minutes
1000°F (540°C)	62	63	64
Optimum for Maximum Toughness and Effective Stress Relieving			
1025°F (550°C)	60	62	63
1050°F (565°C)	58	60	61
1100°F (595°C)	54	55	56
1150°F (620°C)	48	50	51
1200°F (650°C)	46	47	48
Minimum Number of Tempers	2	2	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 15V 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.

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.

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