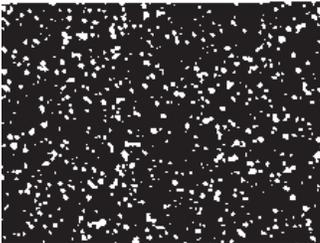


CRUCIBLE

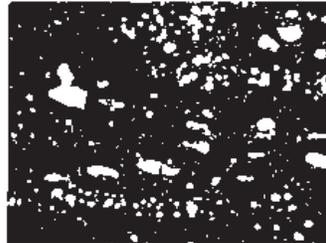
CPM S90V is a unique tool steel made by the Crucible Particle Metallurgy process. It is a martensitic stainless steel with a high volume of vanadium carbides for exceptionally good wear resistance. S90V offers substantial improvements in wear resistance over 440C and D2, and other high chromium tool steels, with corrosion resistance equal to or better than 440C. Its high vanadium content favors the formation of hard vanadium carbides instead of chromium carbides for wear resistance, leaving sufficient chromium in the matrix to provide good corrosion resistance.

The wear and corrosion resistance of S90V make it an excellent candidate to replace 440C, where increased wear is a primary concern. It can replace D2 or other tool steels in applications where improved corrosion resistance is also of benefit.

The CPM process results in a finer, more uniform carbide distribution imparting improved toughness and grindability to high alloy steels. The CPM process also allows the design of more highly alloyed grades which cannot be produced by conventional steelmaking.

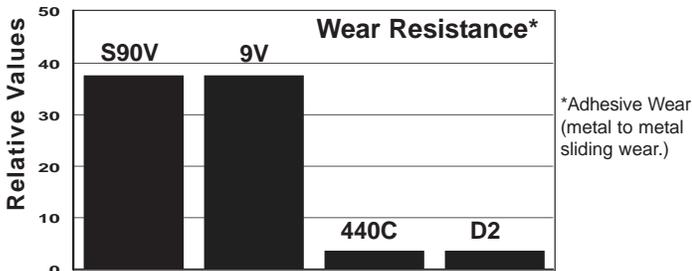


CPM Steel



Conventional Steel

Tool Steel Comparagraph



Typical Applications

- Plastic Injection and Extrusion Feedscrews
- Non-return Valve Components
- Pelletizing Equipment
- Gate and Nozzle Inserts
- Industrial Knives, Slitters, and Cutters
- Long-wearing Specialty Cutlery
- Injection Molds and Inserts
- Wear Components for Food and Chemical Processing
- Bearings, Bushings, Valves, Rolls
- Gear Pumps

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

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DATA SHEET

CRUCIBLE CPM S90V® (CPM 420V®)

Issue #1

Carbon	2.3%
Chromium	14.0%
Vanadium	9.0%
Molybdenum	1.0%

Physical Properties

Elastic Modulus	31X10 ⁶ psi	215 GPa
Density	0.27 lbs/in ³	7.4g/cm ³
Thermal Conductivity @ 200°F (65°C)	10 BTU/hr-ft-°F	17.3 W/m-°K
Coefficient of Thermal Expansion		
°F	°C	
70-400	20-200	6.1 X 10 ⁻⁶ in/in/°F
70-600	20-315	6.4 X 10 ⁻⁶ in/in/°F
		mm/mm/°C
		11.0 X 10 ⁻⁶
		11.5 X 10 ⁻⁶

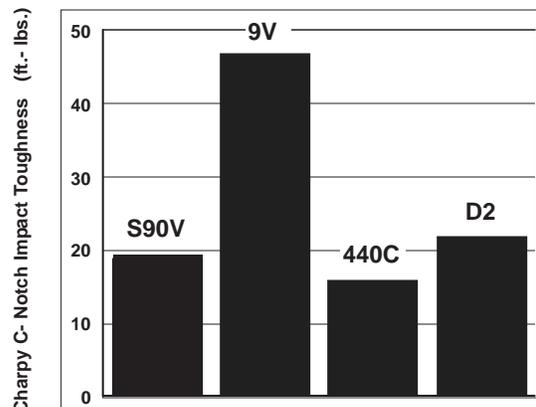
Mechanical Properties

	HARDNESS ⁽¹⁾		IMPACT TOUGHNESS ⁽²⁾		WEAR ⁽³⁾
	HRC	Heat Treatment	ft.-lb.	(Joules)	
CPM S90V	58	(A)	19	(26)	35/40
CPM 9V	55	(B)	47	(63)	35/40
440C	58	(C)	16	(22)	3/4
D2	59	(D)	22	(30)	3/4

- (1) A=Hardened 2050°F (1120°C), double tempered 500°F (260°C)
B=Hardened 2050°F (1120°C), double tempered 1025°F (550°C)
C=Hardened 1900°F (1040°C), double tempered 400°F (204°C)
D=Hardened 1850°F (1010°C), double tempered 600°F (315°C)
- (2) Charpy C-notch impact test
- (3) Crossed-cylinder adhesive wear test (higher number = better wear resistance).

Impact Toughness

CPM S90V offers higher impact toughness than 440C at comparable hardnesses.



Corrosion Resistance

Corrosion tests measure the amount of material lost to corrosion. Therefore, *lower numbers indicate better corrosion resistance.*

Corrosion Test Results ⁽¹⁾ in mm/year	Boiling 10% Acetic ⁽²⁾		Dilute Aqua-Regia ⁽³⁾	
	CPM S90V	440C	D2	
	9/17	29	267	102/117
				109
				411

Notes:

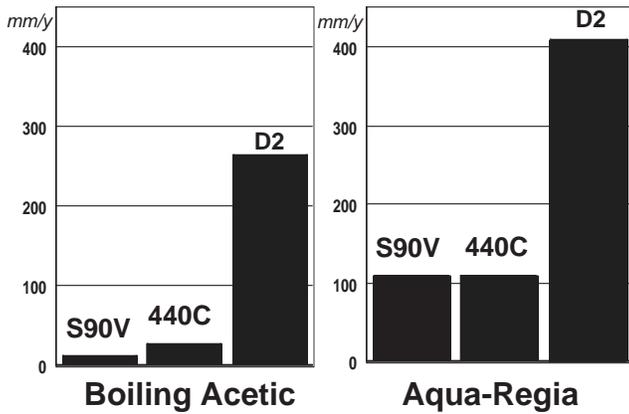
(1) Lower numbers indicate better corrosion resistance. All grades heat treated to about HRC 56/58. Corrosion resistance depends strongly on heat treated condition and specific environment. Results should be used as a qualitative comparison only.

(2) 24 hrs.

(3) 5% HNO₃ -1% HCl (nitric + hydrochloric acids) at 24°C.

Relative Corrosion Rates

(Lower numbers indicate better corrosion resistance.)



Machinability and Grindability

Due to its high vanadium carbide content, the machinability and grindability of S90V will be slightly more difficult than that of D2 or 440C. Similar grinding equipment and practices are acceptable. SG type alumina wheels or CBN wheels have generally given the best performance with the CPM steels.

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.

Thermal Treatments

Annealing

Heat to 1650° F (900°C), hold 2 hours, slow cool at a maximum rate of 25° F (15°C) per hour to 1100° F (595°C), then furnace cool or cool in still air to room temperature

Annealed Hardness: Approx. BHN 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 cool or cool in still air.

Hardening

Austenitize: 2100-2150°F (1150-1175°C)

Hold time at temperature: 20 minutes

Quench: Salt quench, interrupted oil quench, positive pressure gas quench or air cool at a minimum cooling rate of 150°F/min (80°C/min) to below 1000°F (540°C). Cool to below 125°F (50° C) before tempering. For optimum vacuum heat treatment response, a minimum 4 bar gas quench is recommended.

Temper: Double temper at 400-750° F (200-400°C). Hold for a minimum of 2 hrs. each temper. For optimum stress relieving and dimensional stability, S90V may be double tempered at 1000-1025° F (540-550°C), but tempering above 800°F (425°C) may result in some loss of corrosion resistance. A freezing treatment may be employed between the first and second tempers, if desired. Freezing treatments should always be followed by at least one temper.

PLEASE NOTE: Tempering between about 800 and 1000°F (425 and 540°C) is not recommended. All martensitic stainless steels suffer from embrittlement when tempered in this range.

Tempering Temperatures

400°- 800°F (200°-425°C)	Best Corrosion Resistance & Wear Resistance
800°-1000°F (425°-540°C)	AVOID THIS RANGE (Embrittlement)
1000°-1025°F (540°-550°C)	Stress Relieving and Dimensional Stability

Aim Hardness: HRC 56/59

Size Change: +0.03 to +0.05%

Size change shown is for a *fully martensitic microstructure.*

The presence of retained austenite may reduce the net growth. When tempering at 400-750°F (200-400°C), freezing treatments may be necessary to minimize retained austenite.



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