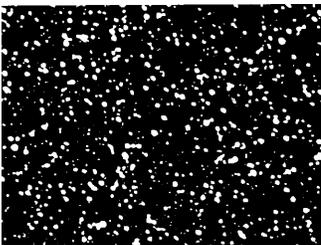


CRUCIBLE

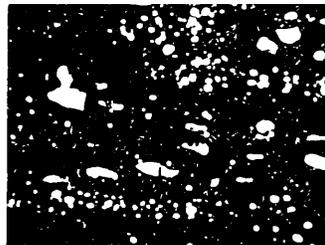
CPM S90V is a unique tool steel made by the Crucible Particle Metallurgy process. It is a martensitic stainless steel with a high volume of vanadium carbides for exceptionally good wear resistance. S90V offers substantial improvements in wear resistance over 440C and D2, and other high chromium tool 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.

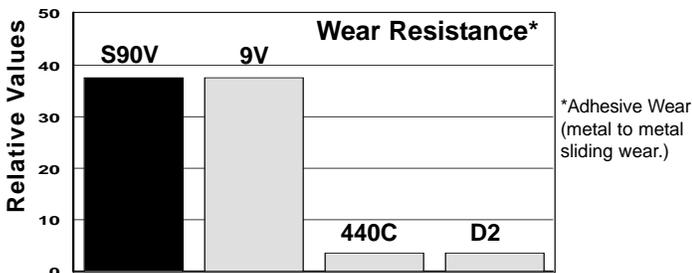


CPM Steel



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.

Crucible...
The Tool Steel Pros®

DATA SHEET

CRUCIBLE CPM S90V® (CPM 420V®)

Issue #8

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	in/in/°F	mm/mm/°C
70-400	20-200	6.1 X 10 ⁻⁶	11.0 X 10 ⁻⁶
70-600	20-315	6.4 X 10 ⁻⁶	11.5 X 10 ⁻⁶

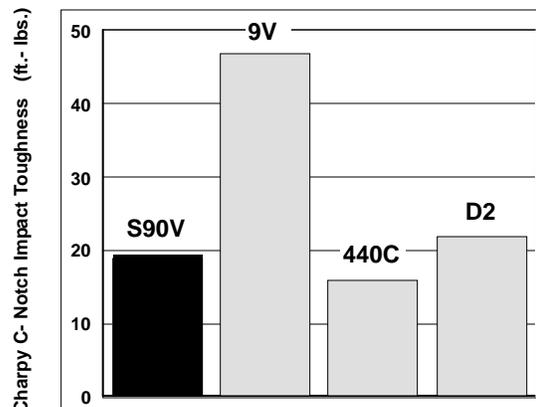
Mechanical Properties

	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.



The CM logo, Crucible, CPM, S90V, 9V, and Tool Steel Pros are trademarks or service marks of Crucible Materials Corporation, Syracuse, NY.

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⁾	
	S90V	440C	D2	
	9/17	29	267	102/117
				109
				411

Notes:

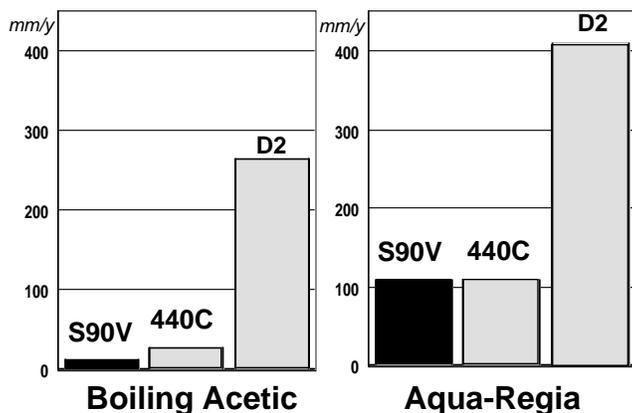
(1) Lower numbers indicate better corrosion resistance. All grades heat treated to about HRC 56/58. Corrosion resistance depends strongly on heat treated condition and specific environment. Results should be used as a qualitative comparison only.

(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. For additional data or metallurgical engineering assistance, consult your local Crucible Service Center.

Service Center Locations

Location	Phone	Toll Free	FAX
Auburn, MA	508-832-5353	800-365-1101	508-832-2217
Charlotte, NC	704-372-3073	800-365-1160	704-342-0985
Chicago, IL	630-378-0093	800-365-1151	630-378-1965
Cincinnati, OH	513-771-1310	800-365-1163	513-771-0119
Cleveland, OH	330-562-3131	800-365-1132	330-562-7818
Columbus, OH	614-262-4959	800-365-1131	614-262-7850
Dallas, TX	817-649-2800	800-365-1168	817-633-8142
Detroit, MI	248-528-0332	800-365-1133	248-528-1977
Grand Rapids, MI	616-554-9699	800-365-1137	616-554-9328
Huntsville, AL	256-772-0201	800-365-1161	256-772-3361
Indianapolis, IN	317-638-4501	800-365-1146	317-634-7375
Los Angeles, CA	714-632-1131	800-365-1179	714-632-1181

Crucible Service Centers

A Division of Crucible Materials Corporation

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.

Location	Phone	Toll Free	FAX
Meadville, PA	814-337-8804	800-365-0530	814-337-8808
Milwaukee, WI	262-781-6710	800-242-0948	262-781-6743
Minneapolis, MN	612-331-6320	800-365-1153	612-331-4137
St. Louis, MO	636-272-7220	877-201-4049	636-978-9559

Canada

Blenheim/Windsor, ONT 519-354-4420 800-265-5293 519-354-4401

Mexico (SISA)

Naucalpan, E. de M. 52-555-576-4011 52-555-359-7567

CRUCIBLE SERVICE CENTERS DIVISIONAL HEADQUARTERS:

Syracuse, NY 315-487-0800 800-365-1185 315-487-0208
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