

# CRUCIBLE

# DATA SHEET

CPM 420V is a unique tool steel made by the Crucible Particle Metallurgy process. It is designed from a martensitic stainless steel base analysis, with high vanadium and carbon added for exceptionally good wear resistance. CPM 420V offers significant improvements over CPM 440V and other high chromium P/M and conventional tool steels in both wear and corrosion resistance.

The wear and corrosion resistance of CPM 420V make it an excellent candidate to replace CPM 440V or AISI 440C, where increased wear is a primary concern, as well as D2 or other tool steel applications where improved corrosion protection is of benefit.

## Typical Applications

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

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

## Mechanical Properties

### Wear Resistance:

In wear testing, CPM 420V has shown 25% to 50% better wear life than CPM 440V. Both grades offer several times better wear resistance than standard 440C.

### Impact Toughness:

CPM 420V offers similar impact toughness (Charpy C notch) to CPM 440V and standard 440C at comparable hardnesses.

### Mechanical properties

	Hardness		Impact		Wear	
	HRC <sup>(1)</sup>		Toughness <sup>(2)</sup>		Adhesive <sup>(3)</sup>	Abrasive <sup>(4)</sup>
			Ft-lbs	(Joules)		
CPM 420V	55/56	A	22	(30)	30/35	55/65
CPM 420V	57	B	12	(16)	35/40	50/60
CPM 440V	55	A	18	(24)	15/25	70/85
CPM 440V	58	B	13	(17)	20/30	60/70
440C	56/57	C	26	(35)	3/4	---
D2	59	D	22	(30)	3/4	---

Notes:

- (1) A = Hardened 1950 F (1065 C),  
 B = Hardened 2050 F (1120 C), double tempered 600 F (315 C)  
 C = Hardened 1900 F (1040 C), double tempered 600 F (315 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)
- (4) Pin abrasion wear loss (lower number = better wear resistance)

**Crucible**  
**Service Centers**

We use this material for very corrosive & abrasive materials.

## CRUCIBLE CPM® 420V

Issue #1

(AISI 420 modified with high vanadium)

Carbon	2.2%
Chromium	13.0%
Vanadium	9.0%
Molybdenum	1.0%

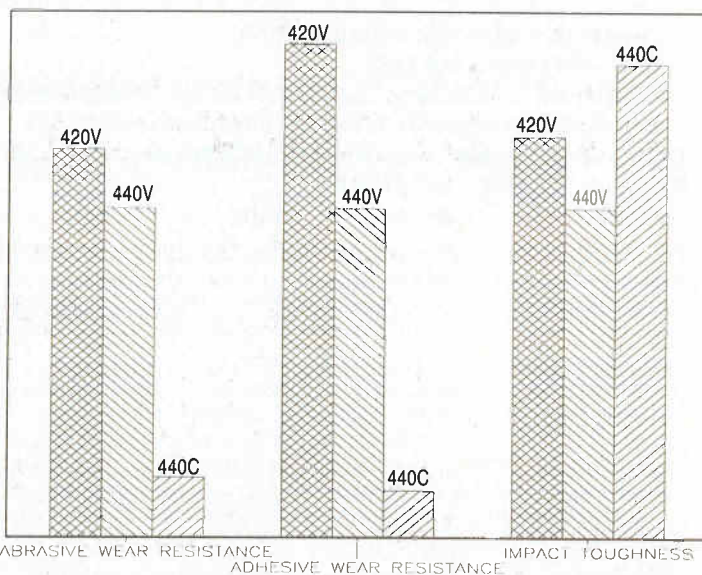


## Physical Properties

	English Units	Metric Units
Elastic Modulus	31 x 10 <sup>6</sup> psi	215 GPa
Specific Gravity	7.40	7.40
Density	0.27 lbs/in <sup>3</sup>	7400 kg/m <sup>3</sup> (7.4 g/cm <sup>3</sup> )
Thermal Conductivity @ 200 F (65 C)	10 BTU/hr-ft-F	17.3 W/m-K (0.041 cal/cm-s-C)
Coefficient of Thermal Expansion		
°F (°C)	in/in/°F	mm/mm/°C
70-400 (20-200)	6.1 x 10 <sup>-6</sup>	11.0 x 10 <sup>-6</sup>
70-600 (20-315)	6.4 "	11.5 "

## Machinability and Grindability

Machinability in the annealed condition is similar to CPM 440V. Grindability will be slightly more difficult due to the higher vanadium carbide content. Similar grinding equipment and practices are acceptable. "SG" type alumina wheels or CBN wheels have generally given the best performance with the CPM steels.



### Relative Wear and Toughness Properties, CPM 420V vs 440V and 440C.

Note: Properties shown throughout this data sheet are typical values. Normal variations in chemistry, size and conditions of heat treatment may cause deviations from these values. For additional data or metallurgical engineering assistance consult your local Crucible Service Center.

## Corrosion Resistance

420V's high vanadium content favors the formation of hard vanadium carbides instead of chromium carbides for wear resistance, thus more free chromium is available to provide corrosion resistance. In laboratory tests, CPM 420V's corrosion resistance was about twice as good as CPM 440V. Corrosion test results comparing CPM 420V, CPM 440V, and conventional 440C are shown below. The tests measure the amount of material lost to corrosion. Lower numbers indicate better corrosion resistance.

### Corrosion test results <sup>(1)</sup>

	Salt Spray <sup>(2)</sup>	Aqua-Regia <sup>(3)</sup>	Acetic Acid <sup>(4)</sup>
CPM 420V	5/15	250/500	60/200
CPM 440V	20/35	900/1100	350/450
440C	5/15	500/600	---

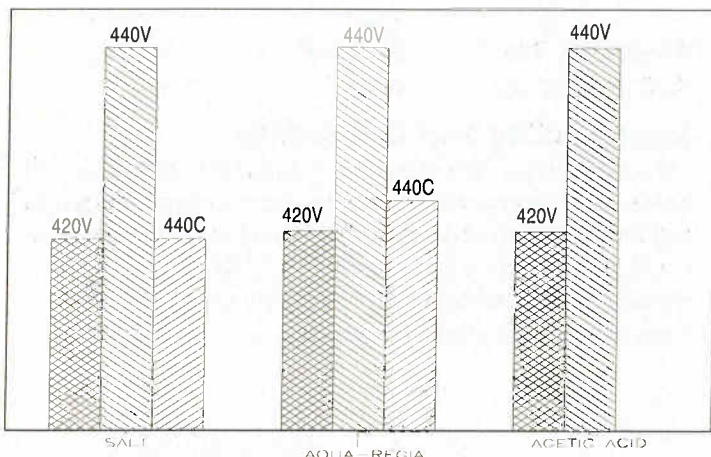
#### Notes:

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

(2) - # pits/in<sup>2</sup>, in solutions of 2% and 5% NaCl (salt water) @ 95F (35C)

(3) - mils/month, in 5% HNO<sub>3</sub> - 1% HCl (nitric-hydrochloric acid), room temp

(4) - mils/month, in 10% CH<sub>3</sub>COOH (acetic acid), boiling



Relative Corrosion Rate in Various Media,  
CPM 420V vs 440V and 440C

(Normalized to 440V; center bar = corrosion rate in 440V in each test; lower corrosion rate means better corrosion resistance.)

## Thermal Treatments

### Annealing

Heat to 1650 F (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 275.

### 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:** 2050-2150 F (1120-1175 C), hold time (at temperature) 10-30 minutes

**Quench:** air or positive pressure quench (2 bar min) 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 heat treatment is suggested if practical because a high quench rate will ensure maximum attainable toughness for a given hardening treatment.

**Temper:** two times at 400-750 F (205-400 C), 2 hours minimum each time.

**Aim hardness:** HRC 56-59

**Size change:** + 0.03/0.05 %

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.

**Recommended heat treating** for best combination of corrosion resistance, toughness, and wear resistance:

**Austenitize 2050/2075 F (1120/1135 C), hold 20/30 minutes, temper twice at 500-600 F (260-315 C), aim hardness 56-58 HRC.**

Improved impact toughness can be achieved using lower hardening temperatures, at a slight decrease in attainable hardness. Highest hardness may be attained by hardening at 2100/2150 F (1150/1175 C). Tempering between about 800 and 1100 F (425 and 595 C) is not recommended. All martensitic stainless steels suffer from a loss of corrosion resistance when tempered in this range.

## Service Center Locations

Location	Telephone	WATS	FAX
ATLANTA, GA	(770) 969-9325	(800) 365-1158	(770) 969-7910
AUBURN, MA	(508) 832-5353	(800) 365-1101	(508) 832-2217
CHARLOTTE, NC	(704) 372-3073	(800) 365-1160	(704) 342-0985
CHICAGO, IL	(312) 772-0300	(800) 365-1151	(312) 772-2010
CINCINNATI, OH	(513) 771-1310	(800) 365-1163	(513) 771-0119
CLEVELAND, OH	(216) 562-3131	(800) 365-1132	(216) 562-7818
COLUMBUS, OH	(614) 771-1333	(800) 365-1131	(614) 771-7918
DALLAS, TX	(817) 640-7777	(800) 365-1168	(817) 633-8142
DAVENPORT, IA	(319) 386-1060	(800) 365-1152	(319) 386-0515
DETROIT, MI	(810) 528-0332	(800) 365-1133	(810) 528-1977
GRAND RAPIDS, MI	(616) 554-9699	(800) 365-1137	(616) 554-9328
HUNTSVILLE, AL	(205) 772-0201	(800) 365-1161	(205) 772-3361
INDIANAPOLIS, IN	(317) 638-4501	(800) 365-1146	(317) 634-7375
JACKSONVILLE, FL	(904) 262-8447	(800) 365-1159	(904) 262-3995

Location	Telephone	WATS	FAX
KENILWORTH, NJ	(908) 964-0440	(800) 365-1116	(908) 964-8155
LOS ANGELES, CA	(310) 522-9187	(800) 365-1179	(310) 830-9784
MEADVILLE, PA	(814) 337-8804	(800) 365-0530	(814) 337-8808
MILWAUKEE, WI	(414) 781-6710	(800) 242-0948	(414) 781-6743
MINNEAPOLIS, MN	(612) 331-6320	(800) 365-1153	(612) 331-4137
MONTERREY, MEX.	(8) 336 90 03		(8) 336 26 68
MONTREAL, QUE	(514) 365-4060	(800) 363-8756	(514) 365-9350
NASHVILLE, TN	(615) 361-6699	(800) 365-1162	(615) 360-3742
PHILADELPHIA, PA	(610) 834-9240	(888) 365-1118	(610) 834-9245
ROCHESTER, NY	(716) 254-4320	(800) 365-1128	(716) 254-4616
TORONTO, ONT	(905) 793-1600	(800) 263-2367	(905) 793-1660
VANCOUVER, BC	(604) 525-0544		(604) 520-3596
WALLACEBURG, ONT.	(519) 627-2245	(800) 365-5293	(519) 627-2247
DIVISION OFFICES	(315) 487-0800	(800) 365-1185	(315) 487-4028

**Crucible Service Centers**  
A Division of Crucible Materials Corporation

**Quality on Time**