CRUCIBLE

DATA SHEET

CPM CRU-WEAR®

Issue #1

CPM CRU-WEAR is an air-hardening tool steel, heat treatable to HRC 60-65. Designed as an CPM upgrade to conventional Cru-Wear and D2, it offers better wear resistance, much greater toughness and higher attainable hardness. Both D2 and CPM CRU-WEAR contain carbides for wear resistance, but CPM CRU-WEAR has more vanadium carbides than D2. Vanadium carbides are harder than chromium carbides and are much more effective in providing wear resistance. CPM CRU-WEAR's higher attainable hardness results from the fact that it contains sufficient tungsten and molybdenum to cause a secondary hardening response, (up to HRC 65), which does not occur in D2. CPM CRU-WEAR tempers at a higher range (900-1050°F) than D2 (400-600°F), so it is more compatible with a wide variety of surface treatments. Finally, because CPM CRU-WEAR is made as CPM, it will resist chipping and breakage more so than most conventionally made tool steels.

Carbon	**1.1%**
Chromium	**7.5%**
Vanadium	**2.4%**
Tungsten	**1.15%**
Molybdenum	**1.6%**

Physical Properties

Elastic Modulus	30 X 10^6 psi	(207 GPa)
Density	0.28 lbs./in^3	(7.8 g/cm^3)

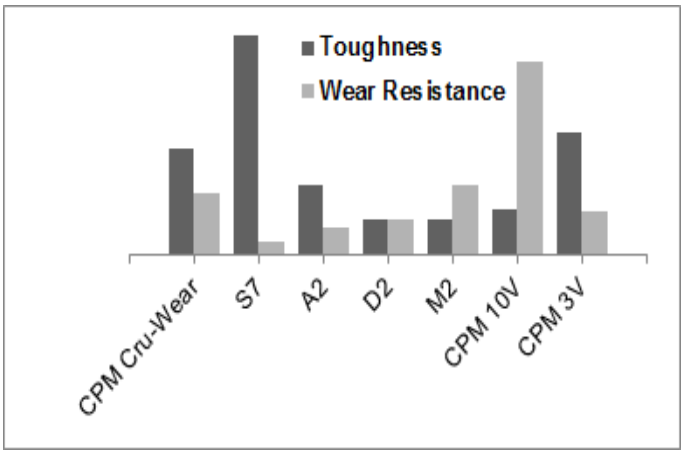
Thermal Conductivity

	BTU/hr-ft-°F	W/m-°K	cal/cm-s-°C
at 200°F (95°C)	13.6	23.5	0.056

Coefficient of Thermal Expansion

	in/in/°F	mm/mm/°C
70-600°F (20-325°C)	6.2X10^{-6}	(11.2X10^{-6})

Tool Steel Comparagraph



Mechanical Properties

Wear Resistance

CPM CRU-WEAR offers better wear resistance than AISI D2, approaching that of AISI M2.

Impact Toughness

CPM CRU-WEAR has much greater toughness than most conventionally made tool steel.
NOTE: Lowering the hardening temperature reduces the grain size and increases toughness.

	Heat Treatment (1) Austenitizing Temperature	HRC	Impact Toughness (2) ft-lb.	(J)
CPM CruWear	1950°F (1065°C)	60	60	80
S7	1750°F (955°C)	57	125	165
A2	1750°F (955°C)	60	40	53
D2	1850°F (1010°C)	60	21	28
M2	2050°F (1120°C)	62	20	27
CPM 10V	1950°F (1065°C)	59	26	35
CPM 3V	1950°F (1065°C)	60	70	95

(1) Heat Treatment: Austenitized as indicated and tempered to hardness

(2) Charpy C Notch Impact Test

Typical Applications

Stamping or Forming Tools	Punches and Dies
Rolls	Blanking Dies
Thread Rolling Dies	Coining Dies
Lamination Dies	Trim Dies
Industrial Knives and Slitters	Shear Blades
Fineblanking Tools	Scrap Choppers
Wear Parts	Tire Shredders
Plastic Injection Feeder Screws and Tips	

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

Machinability

Machinability of CPM CRU-WEAR in the annealed condition is similar to D2 but grindability will be slightly better. Similar grinding equipment and practices are acceptable. "SG" type alumina wheels or CBN wheels have generally given the best performance.

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Thermal Treatments

Annealing: Heat to 1550-1650°F (840-900°C), hold 2 hours, slow cool 50°F (25°C) per hour to 1200°F (650°C).

Annealed Hardness: About BHN 225/255

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°F (15°C) below the original tempering temperature, hold 2 hours, then furnace cool or cool in still air.

Hardening

It is customary to use two furnaces: one furnace to pre-heat and the second furnace to austenitize. This ensures that the transition from the pre-heat temperature to the austenitizing temperature occcurs fairly rapidly.
Preheat: Heat to 1550-1600°F (840-870°C) Equalize.
Austenitize: 1850-2050°F (1010-1120°C), Hold time at temperature 20-45 minutes.
Quench: Air or positive pressure quench (2 bar minimum) to below 125°F (50°C) Salt bath treatment, if practical will ensure the maximum attainable toughness for a given hardening treatment.
Temper: 900-1050°F (480-565°C).
Double tempering is mandatory, and triple tempering is recommended. Cool to room temperature in between tempers. Temper 2 hours minimum each time or at least 1 hour per inch (25mm) of thickness for sections over 2" (50mm) thick.

Size Change: Approx. +0.15%

Recommended Heat Treatment: For the best combination of toughness and wear resistance, austenitize at 1950°F (1065°C). Temper 3 times at 1000°F (540°C).

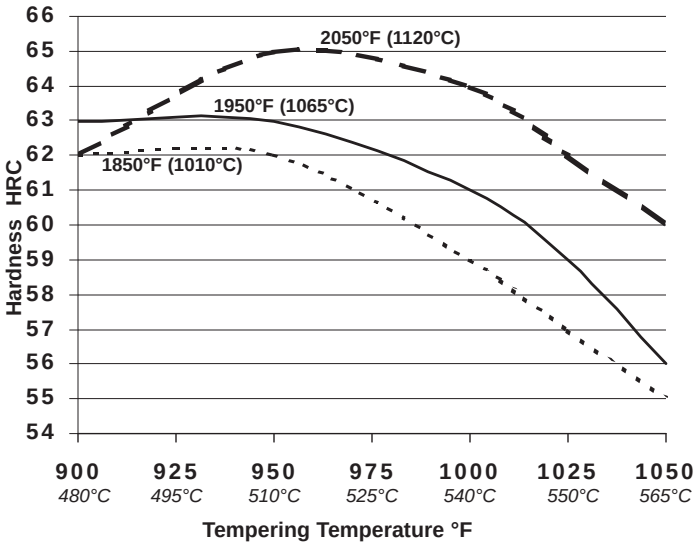
Aim hardness: HRC 62 Higher austenitizing temperatures can be used to obtain higher hardness, at a slight decrease in impact resistance. The lower austenitizing temperatures provide the best impact toughness.

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.

Heat Treat Response

	Hardness HRC		
	Austenitizing Temperature		
Tempering Temperature	1850°F (1010°C)	1950°F (1065°C)	2050°F (1120°C)
Minimum Time at Austenitizing Temp.	45 minutes	30 minutes	20 minutes
As Quenched	63-65	63-65	62-64
900°F (480°C)	61-63	62-64	61-63
950°F (510°C)	61-63	62-64	64-66
1000°F (540°C)	57-59	60-62	63-65
1025°F (550°C)	56-58	58-60	61-63
1050°F (565°C)	54-56	55-57	59-61

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 (900-1050°F) CPM CRU-WEAR is suitable for nitriding, PVD coating or similar surface treatments. It will retain its hardness after such processes, making it a more suitable substrate than D2. NOTE: CVD coating processes are generally performed at temperatures which exceed the critical temperature and may result in non-predictable dimensional distortion.

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DS450 08/15 CPM Cru-Wear Crucible Industries Printed in U.S.A.