CRUCIBLE DATA SHEET

Issue #5

We use this material for very corrosive & abrasive materials.

Crucible CPM® 10V Tool Steel (AISI A11)

CPM 10V is a unique tool steel made by the Crucible Particle Metallurgy process. It is designed with a tough, air hardening base analysis with added high carbon and vanadium for exceptionally good wear resistance, toughness and strength for cold and warm work tooling applications.

The exceptional wear resistance and good toughness of CPM 10V make it an excellent candidate to replace carbide and other highly wear resistant materials in cold work tooling applications, particularly where tool toughness is a problem or where cost effectiveness can be demonstrated.

The CPM process produces very homogeneous, improved quality steel which is characterized by superior dimensional stability, grindability, and toughness over conventional processes.

Carbon	**2.45%**
Manganese	**0.50%**
Silicon	**0.90%**
Chromium	**5.25%**
Vanadium	**9.75%**
Molybdenum	**1.30%**
Sulfur	**0.09% max.**

Member Steel Service Center Institute

Conventional Steel

CPM Steel

Physical Properties

Modulus of Elasticity ..... 32 psi x 10^6 ..... 221 GPa
Specific Gravity 7.41
Density ..... 0.268 lbs/in^3 ..... 7418 kg/m^3

Coefficient of Thermal Expansion

Temperature Range	in/in/°F x 10^{-6}	mm/mm/°C x 10^{-6}
70 to 200F (21 to 93C)	5.96	10.7
70 to 500F (21 to 260C)	6.18	11.1
70 to 800F (21 to 427C)	6.54	11.8
70 to 1100F (21 to 593C)	6.82	12.3

Annealed Hardness BHN 255/277

Machinability in the annealed condition is approximately 40% of W1 Tool Steel (1%C).

Typical Applications

Punches and dies for blanking, piercing, forming, cold extrusion. Knives for slitting, shearing, trimming, etc. Granulator/pelletizer blades, nozzels, screw tips, barrel liners, etc. for plastic injection molding equipment.

Powder Compaction Tooling

Woodworking Tools

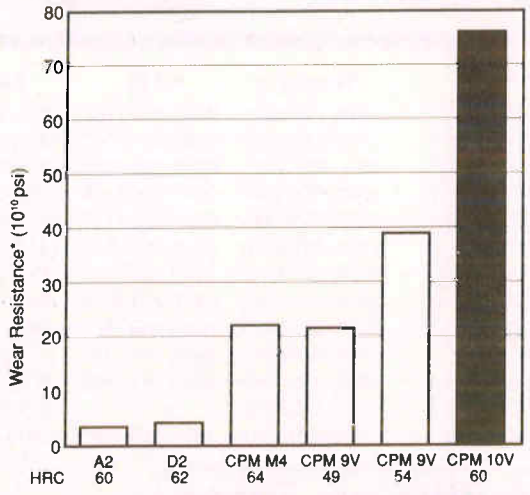
Wear Parts

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

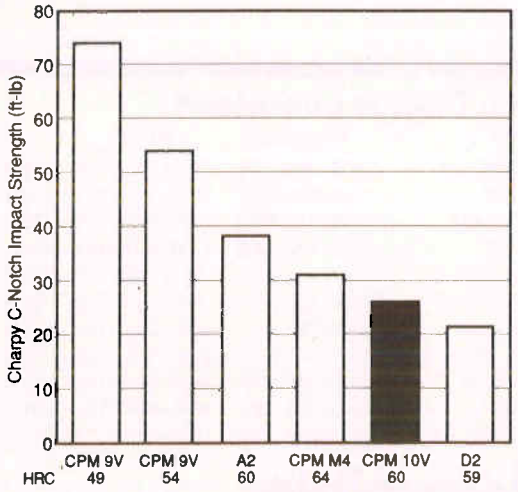
Grindability

In general, CPM 10V can be ground using the same aluminum oxide grinding wheels recommended for D2 or M2 tool steels. Intricate form grinds may require more frequent wheel dressings or slower surface speeds to prevent glazing. Borazon wheels may provide better grinding productivity,e.g. in small diameter I.D. grinding.

Wear Resistance



Toughness



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 and metallurgical engineering assistance consult your local Crucible Service Center.

Crucible Service Centers

Thermal Treatments

Critical Temperature: 1540F(840C)

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

Annealing: 1600F(870C), hold 2 hours, slow cool 30F(15C)/hr. max. to 1000F(540C), then air or furnace cool. HardnessBHN 255/277.

Stress-relieving (After machining): 1100-1300F (595-740C), hold 2 hrs., then air or furnace cool.

Straightening: Best done warm 400-800F(200-430C).

Hardening: (Salt, vacuum, or atmosphere).

Preheat: 1500-1550F(820-845C), equalize. Second preheat stage at 1850-1900F(1010-1040C) suggested for vacuum or atmosphere hardening.

High Heat: 1850-2150F(1010-1175C). Standard recommendation to achieve Rc 60-62 after tempering for a good combination of wear resistance and toughness is to use 2050 (1120C).

Quench: Salt, oil or atmosphere quench to 1000-1100F(540-595C), equalize, then air cool to below 125F(50C) or hand warm. Vacuum or atmosphere quench rate through 1850-1300F(1010-705C) range is critical to achieve optimum heat treat response.

Temper: 1000F(540C) minimum recommended. Double tempering required. (See table).

Stress-relieving (Hardened parts): Temper 30F(15C) below original tempering temperature.

Size Change During Hardening

Hardening Temp.	Tempering Temp.	HRC	Longitudinal Size Change
1950F(1065C)	1000F(540C)	60	+.0004 in./in. (.010 mm/mm)
2150F(1175C)	1000F(540C)	64	+.0004 in./in. (.010 mm/mm)

Surface Treatments

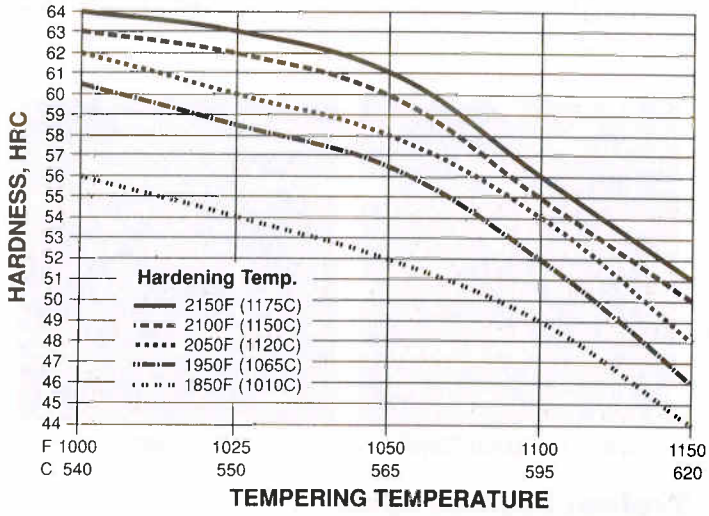
CPM 10V can be nitrided, steam tempered or titanium-nitride coated if desired. If the CVD TiN treatment is used, care is required in vacuum hardening.

Hardening Data

TEMPERING TEMPERATURE C	F	HEAT TREAT RESPONSE ± 1 HRC (NOTE A) 1850 F (1010C)	1900 F (1040 C)	1950 F (1065 C)	2050 F (1120 C)	2100 F (1150 C)	2150 F (1175C)
AS QUENCHED		61	63	65	65	64.5	63.5
540	1000	56	57	60.5	62	63	64
OPTIMUM FOR MAXIMUM TOUGHNESS AND EFFECTIVE STRESS-RELIEVING.							
550	1025	54	56	58.5	60	62	63
565	1050	52	54	56.5	58	60	61
595	1100	49	51	52	54	55	56
620	1150	44	45	46	48	50	51
650	1200	40	41	43	46	47	48

NOTE A 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.

MINIMUM TIME AT AUST TEMP (MINS)	60	45	30	20	15	10
MINIMUM NUMBER OF TEMPERS (2 HRS)	2	2	2	2	3	3



Toughness

Depending upon the application requirement for hardness, lowering the hardening temperature (underhardening) increases toughness.

Hardening Temp. F	(C)	Tempering Temp. F	(C)	Hardness HRC	Charpy C-Notch Impact Value ft-lb	(J)	Bend Fracture Strength ksi	(MPa)
2150	1175	1000	540	64	15	20	627	4322
2100	1150	1000	540	63	16	22	615	4239
2050	1120	1025	550	61	23	30	635	4377
1950	1065	1025	550	59	26	35	-	-

Service Center Locations

Location	Telephone	WATS	FAX
ATLANTA, GA	(404) 969-9325	(800) 365-1158	(404) 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
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JACKSONVILLE, FL	(904) 262-8447	(800) 365-1159	(904) 262-3995
KENILWORTH, NJ	(908) 964-0440	(800) 365-1116	(908) 964-8155
LOS ANGELES, CA	(310) 775-7344	(800) 365-1179	(310) 830-9784
MILWAUKEE, WI	(414) 781-6710	(800) 242-0948	(414) 781-6743
MINNEAPOLIS, MN	(612) 331-6320	(800) 365-1153	(612) 331-4137
MONTREAL, QUE.	(514) 365-4060	(800) 363-8756	(514) 365-9350
NASHVILLE, TN	(615) 361-6699	(800) 365-1162	(615) 360-3742
ROCHESTER, NY	(716) 924-8570	(800) 365-1128	(716) 924-8576
TORONTO, ONT.	(905) 856-2442	(800) 263-2367	(905) 856-2119
VANCOUVER, BC	(604) 525-0544		(604) 520-3596
DIVISION OFFICES	(315) 487-4111	(800) 365-1185	(315) 487-4028

Crucible Service Centers
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Quality on Time