CRUCIBLE

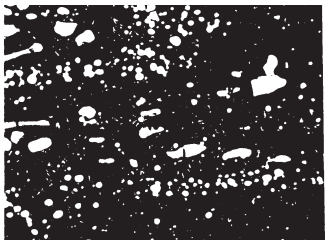
DATA SHEET

CRUCIBLE CPM® Rex® 66 (HS) High Speed Steel

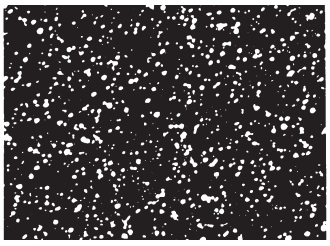
Issue #1

CPM Rex 66 is a super high speed steel made by the Crucible Particle Metallurgy (CPM) process. It is a tungsten type high speed with a high vanadium content for excellent abrasion resistance, similar to that of CPM Rex T15, and 8% cobalt for a higher red hardness than CPM Rex T15. It also offers high compressive strength due to its high attainable hardness. It is best suited for applications requiring both a high red hardness and high wear resistance.

The CPM process results in a homogeneous microstructure with a finer, more uniform carbide distribution imparting superior dimensional stability, grindability and toughness when compared to steels produced by conventional processes. The CPM process also allows the design of more highly alloyed grades which cannot be produced by conventional steelmaking.



Conventional High Speed Steel

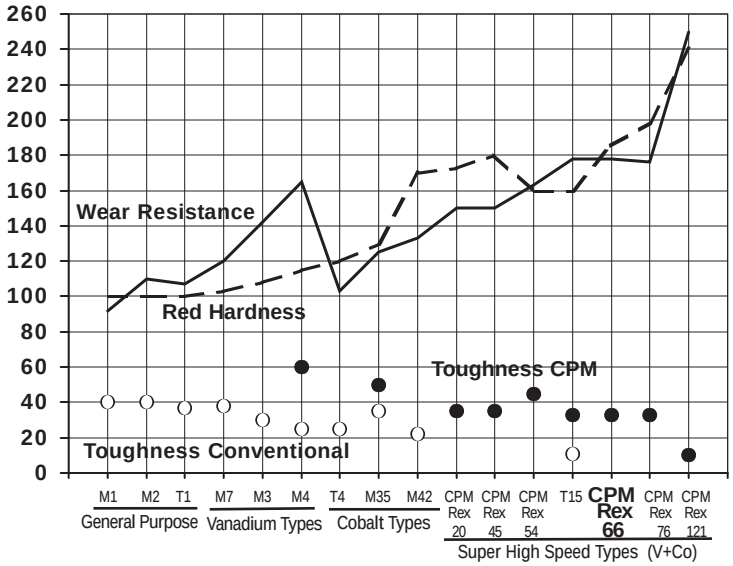


CPM High Speed Steel

Carbon	**1.67%**
Chromium	**4.75%**
Vanadium	**4.80%**
Tungsten	**9.50%**
Molybdenum	**2.00%**
Cobalt	**8.0%**
Sulfur	**0.06% (0.22%)***

**Because of the extremely fine and uniform microstructure produced by the CPM (Crucible Particle Metallurgy) process, sulfur may be added if desired to improve the machinability. The higher sulfur content benefits the tool-maker by allowing ease of manufacture, and the tool user by allowing easier resharpening. The CPM process ensures that the additional sulfur will not detrimentally affect the tool's toughness.*

High Speed Steel Comparagraph



High Speed Steel Classification

Typical Applications

Spade Drills	**Form Tools**	**End Mills**
Reamers	**Broaches**	**Hobs**
Shaper Cutters	**Milling Cutters**	**Tool Bits**

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

Physical Properties

Elastic Modulus	$31X10^6$ psi	214 GPa
Specific Gravity	8.25	
Density	0.298 lbs/in^3	8.249 g/cm^3

Coefficient of Thermal Expansion

°F	°C	in/in/°F	mm/mm/°C
70-500	20-260	5.5 X 10^{-6}	9.9 X 10^{-6}
70-800	20-425	6.1 X10^{-6}	11.0 X 10^{-6}
70-1000	20-540	6.4 X10^{-6}	12.5 X 10^{-6}

Machinability and Grindability

The machinability and grindability of CPM Rex 66 compares favorably to CPM T15 and other high speed steels because of the very fine, uniformly distributed carbides. The high sulfur (HS) modification provides enhanced machinability without detrimentally affecting the tool's toughness.

Surface Treatments

CPM Rex 66 can be nitrided or PVD coated if desired. If a CVD treatment is used, subsequent hardening is required and may result in undesirable distortion.

Crucible Industries LLC

Thermal Treatments

Annealing

Heat to 1600° F (870°C), hold 2 hours, slow cool no faster than 25°F (15° C) per hour to 1000° F (540°C), then furnace cool or cool in still air to room temperature.
Annealed Hardness: Approx. BHN 245/275

Stress Relieving

Annealed parts: Heat to 1300° F (705°C), hold 2 hours, then air cool or furnace cool.
Hardened parts: Heat to 25°F (15°C) below original tempering temperature, or 1000°F (540°C) minimum, hold 2 hours, then air cool or furnace cool.

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

Hardening (Salt Bath or Vacuum Furnace preferred.)

Pre-heat: 1500-1550°F (815-845°C), hold long enough to soak through. A second pre-heat at 1850-1900°F (1010-1040°C) is recommended when vacuum hardening.

Austenitize: 2050-2200° F (1120-1205° C). Hold part at temperature 5-10 minutes. Soak time will vary depending on part size. Smaller part size, use the shorter soak time, whereas larger parts should be soaked longer.

Quench: Salt, oil or atmosphere quench to below 1100°F (595° C), equalize then air cool to hand warm, below 125°F (50°C). Vacuum or atmosphere quenching may result in slightly lower hardness for larger tools. The quench rate through 1850-1300° F (1010-705°C) is critical to achieve optimum results. A slower cooling rate below 1000°F (540°C) may be used to minimize distortion.

Temper: Triple temper at 1000°F (540°C) or higher. Hold at least 2 hours at temperature for each temper. Air cool to room temperature between tempers. Typical tempering range is 1025-1050°F (550-565°C).

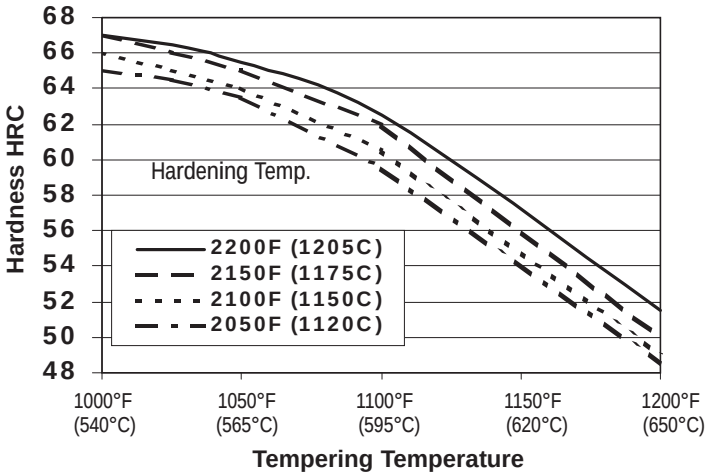
Note: Properties shown throughout this data sheet are typical values. Normal variations in chemistry, size and heat treat conditions may cause deviations from these values.

Heat Treat Response (HRC) - Oil or Salt Quench (Note A)

Tempering Temperature °F	(°C)	2050°F (1120°C)	2100°F (1150°C)	2150°F (1175°C)	2200°F (1205°C)
As-Quenched		66	65.5	64.5	64
1000	(540)	65	66	67	67
Optimum For Maximum Toughness and Effective Stress Relieving					
1025	(550)	64.5	65	66	66.5
1050	(565)	63.5	64	65	65
1100	(595)	59.5	60.5	62	62.5
1200	(650)	48.5	49	50	51.5

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 ≅1 POINT HRC LOWER.

Minimum time at Aust. temp. (mins)	10	10	5	5
Minimum number of tempers	3	3	3	3



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