CRUCIBLE

DATA SHEET

CRUCIBLE CPM® Rex® T15(HS) High Speed Steel (AISI T15)

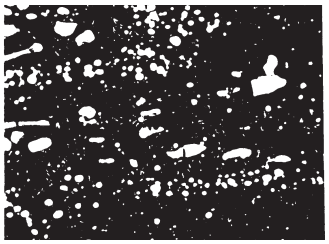
Issue #1

CPM Rex T15 is a super high speed steel made by the Crucible Particle Metallurgy (CPM) process. It is a tungsten type high speed containing high vanadium for excellent abrasion resistance, and cobalt for good red hardness. CPM Rex T15 is ideal for cutting difficult to machine materials where high frictional heating is encountered.

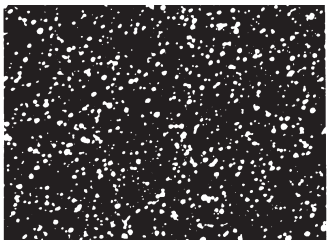
The CPM process results in a homogeneous microstructure with a finer, more uniform carbide distribution imparting superior dimensional stability, grindability and toughness when compared to steels produced by conventional processes. The CPM process also allows the design of more highly alloyed grades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

Carbon	**1.6%**
Chromium	**4.0%**
Vanadium	**4.9%**
Tungsten	**12.0%**
Cobalt	**5.0%**
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.*

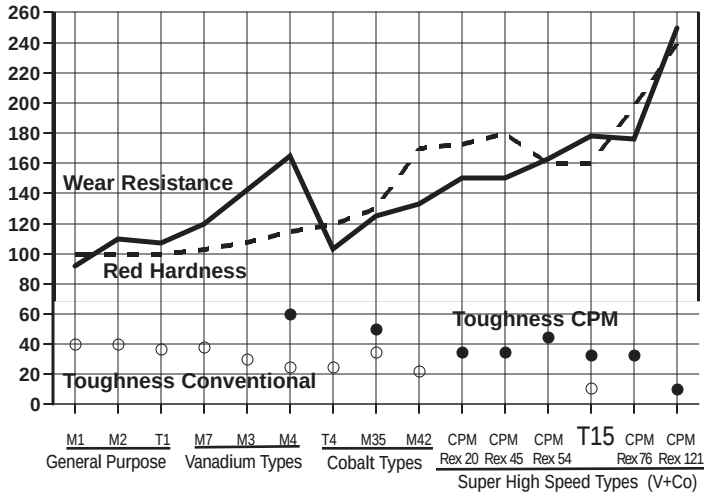


Conventional High Speed Steel



CPM High Speed Steel

High Speed Steel Comparagraph



High Speed Steel Classification

Physical Properties

Elastic Modulus	31X10^6 psi	214 GPa
Specific Gravity	8.19	
Density	0.296 lbs/in^3	8.193 g/cm^3

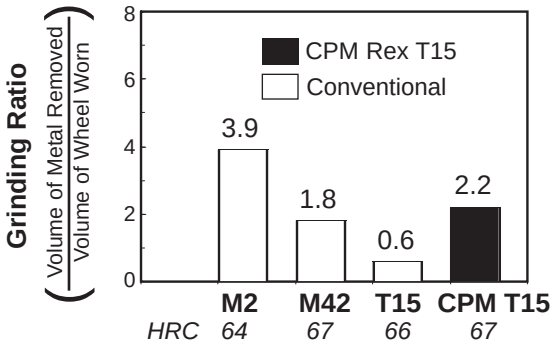
Coefficient of Thermal Expansion

°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

Machinability in the annealed condition is approximately 20% of W1 Tool Steel (1% C).

Grindability of CPM Rex T15 compares favorably with regular high speed steels because of the fine, uniformly distributed carbides. Conventional grinding wheels designed for high speed steels can be used. In special cases, the advice of a grinding wheel manufacturer should be sought.



Typical Applications

Broaches	**Milling Cutters**
End Mills	**Spade Drills**
Form Tools	**Shaper Cutters**
Gear Hobs	**Taps**

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

Crucible Industries LLC

Thermal Treatments

Critical Temperature: 1550°F (845°C)
Forging: 2000-2100°F (1095-1150°C). Do not forge below 1700°F (925°C). Slow cool after forging.

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 1100-1300° F (595-705°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: 2125-2250° F (1165-1235° C). To achieve HRC 66-68, 2225-2250°F (1220-1235°C) is recommended.

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. A fast quench rate from hardening temperature to below 1100°F (595°C) is critical to achieve optimum heat treat response. 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.

Size Change During Hardening (Longitudinal):

Hardening Temp.	Tempering Temp.	HRC	Long. Size Change
2200°F (1205°C)	1025°F (550°C)	66	+0.0020 in./in. (+0.051 mm/mm)

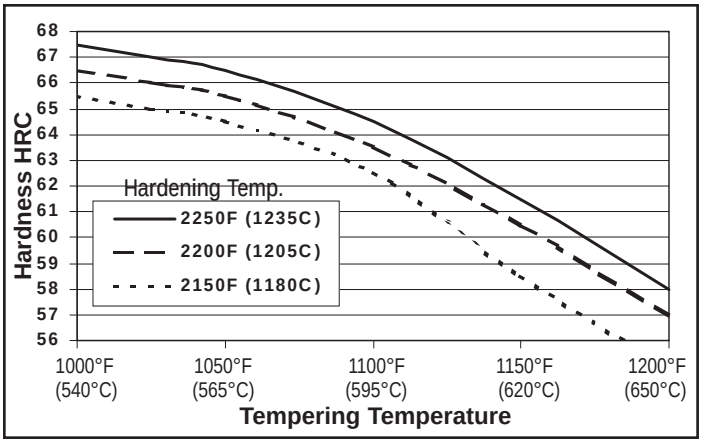
Note: Properties shown throughout this data sheet are typical values. Normal variations in chemistry, size and heat treat conditions may cause deviations from these values.

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

Tempering Temperature °F	(°C)	2125°F (1165°C)	2150°F (1180°C)	2175°F (1190°C)	2200°F (1205°C)	2225°F (1220°C)	2250°F (1235°C)
As-Quenched		67	66.5	66	65.5	64.5	64
1000	(540)	65	65.5	66	66.5	67	67.5
Optimum For Maximum Toughness and Effective Stress Relieving							
1025	(550)	64.5	65	65.5	66	66.5	67
1050	(565)	64	64.5	65	65.5	66	66.5
1100	(595)	62	62.5	63	63.5	64	64.5
1150	(620)	57	58.5	59.5	60.5	61	61.5
1200	(650)	54	55	56	57	57.5	58

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	10	5	5	5
Minimum number of tempers	3	3	3	3	3	3



Toughness: Lowering the hardening temperature (under-hardening) reduces the grain size and increases toughness.

Hardening Temp. °F	(°C)	Tempering Temp. °F	(°C)	Hardness HRC	Charpy Impact C-Notch ft.lb.	(J)	Bend Fracture Strength ksi	(MPa)
2250	(1235)	1000	(540)	68	12	16	581	4005
2250	(1235)	1025	(550)	67	14	19	678	4675
2150	(1175)	1025	(550)	65	21	28	706	4865
2150	(1175)	1050	(565)	64.5	22	29	740	5102

Surface Treatments

CPM Rex T15 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
575 State Fair Blvd., Solvay, NY 13209
www.crucible.com
800-365-1180 315-487-4111

DS 298 CPM Rex T15 2/10

Printed in U.S.A.