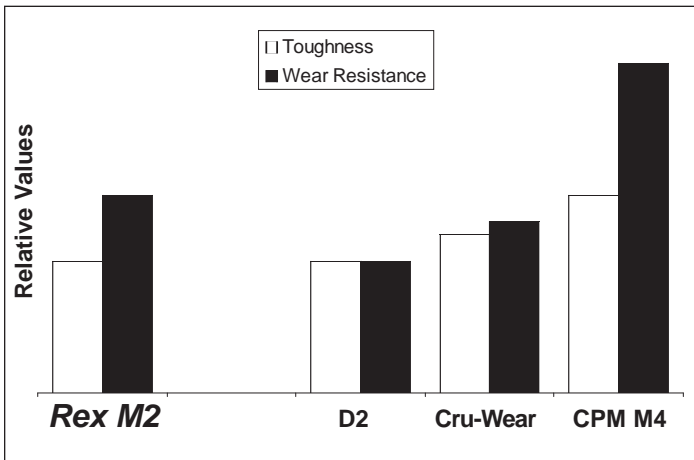


# CRUCIBLE

Rex M2 is a tungsten-molybdenum general purpose high speed steel. It is suitable for a wide variety of cutting tools and is often used for metalforming tools such as punches and dies. Rex M2 is a good choice for cutting tools which require moderate feeds and speeds. It provides sufficient red hardness along with outstanding toughness for a high speed steel. For cold work applications, Rex M2 offers higher hardness and wear resistance than D2. Its high attainable hardness provides superior compressive strength for deformation resistance, reducing susceptibility to such problems as peening, denting and edge rollover. Its high tempering temperature and red hardness make it an excellent substrate for most surface treatments.

## Tool Steel Comparagraph



## Typical Applications

Punches  
Dies  
Broaches  
Milling Cutters

Thread Roll Dies  
Form Tools  
Lathe Tools

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

## Crucible Industries LLC

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## DATA SHEET

### CRUCIBLE REX M2

Issue #1

<b>Carbon</b>	<b>0.85%</b>
<b>Chromium</b>	<b>4.15%</b>
<b>Vanadium</b>	<b>1.95%</b>
<b>Tungsten</b>	<b>6.40%</b>
<b>Molybdenum</b>	<b>5.00%</b>

### Physical Properties

<b>Elastic Modulus</b>	30 X 10 <sup>6</sup> psi	(207 GPa)
<b>Density</b>	0.294 lbs./in <sup>3</sup>	(8.14 g/cm <sup>3</sup> )
<b>Coefficient of Thermal Expansion</b>		
	in/in/°F	mm/mm/°C
100-500°F (40-260°C)	6.28X10 <sup>-6</sup>	(11.3X10 <sup>-6</sup> )
100-800°F (40-425°C)	6.67X10 <sup>-6</sup>	(12.0X10 <sup>-6</sup> )
100-1000°F (40-540°C)	6.97X10 <sup>-6</sup>	(12.5X10 <sup>-6</sup> )

### Mechanical Properties

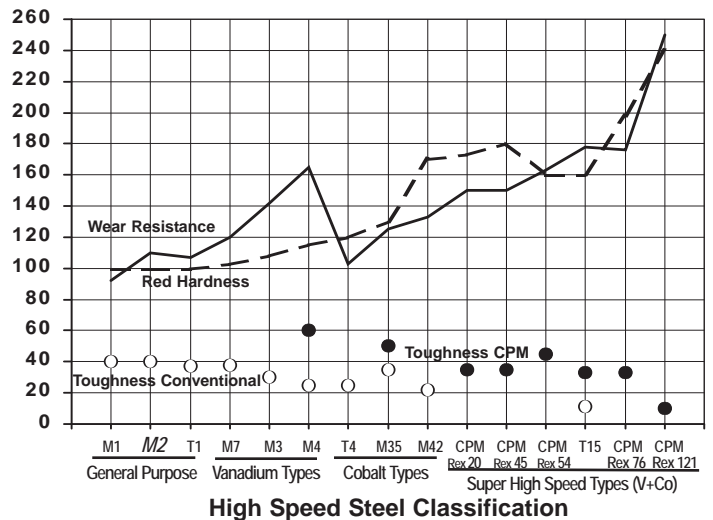
#### Impact Toughness

Heat Treatment <sup>(1)</sup>		HRC	Impact Toughness <sup>(2)</sup>	
Austenitizing Temperature	Tempering Temperature		ft.-lb. (J)	
2175°F (1190°C)	1025°F (550°C)	64	17 (23)	
2150°F (1175°C)	1050°F (565°C)	63	19 (26)	
2100°F (1150°C)	1075°F (580°C)	61	21 (28)	

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

(2) Charpy C-Notch Impact Test

### High Speed Steel Comparagraph



## Thermal Treatments

**Critical Temperature:** 1530°F (830°C)

**Annealing:** Heat to 1600°F (870°C), hold 2 hours, slow cool no faster than 25°F (15°C) per hour to 1000°F (535°C), then furnace cool or cool in still air to room temperature.

**Annealed Hardness:** About BHN 217/255

### 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 25-50°F (15-30°C) below original tempering temperature, hold 2 hours, then furnace cool or cool in still air.

### Hardening

**Preheat:** Heat to 1450-1500°F (790-815°C) Equalize.

**Second Preheat:** Suggested for vacuum hardening. Heat to 1850-1900°F (1010-1040°C)

**Austenitize:** 1975-2225°F (1150-1220°C), hold time at temperature 5-30 minutes (see chart).

**Quench:** Air or positive pressure quench (2 bar minimum) 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 treatment, if practical, will ensure the maximum attainable toughness for a given hardening treatment. Temper immediately.

**Temper:** Two to three times at 1000°F (540°C) or higher. 2 hours minimum each time. Triple tempering is recommended when hardening from 2100°F (1150°C) or higher. Air cool to room temperature in between tempers.

**Size Change:** +0.0015 to +0.0022 in/in.

### Recommended Heat Treatment:

Cutting tools: Austenitize at 2125-2225°F (1165-1220°C)

Cold work tools: Austenitize at 1975-2125°F (1080-1165°C) (See chart.)

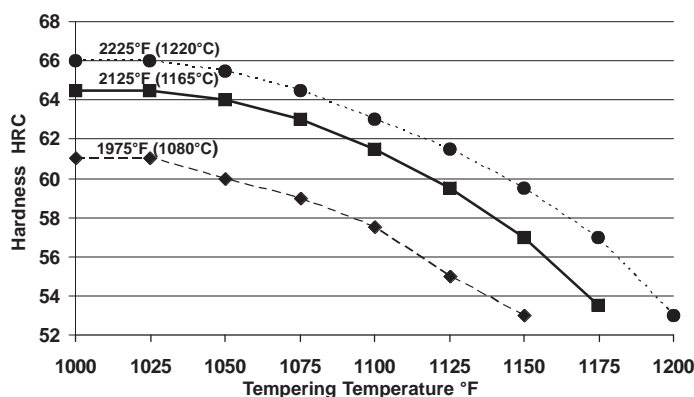
*Note: Properties shown throughout this data sheet are typical values. Normal variations in chemistry, size and heat treat conditions may cause deviations from these values.*

## Heat Treat Response

### Hardness HRC

Tempering Temperature	Austenitizing Temperature		
	1975°F (1080°C)	2125°F (1165°C)	2225°F (1220°C)
Minimum time at Austenitizing Temp.	30 min.	15 min.	5 min.
<b>Oil Quenched</b>			
1000°F (540°C)	61	64.5	66
Optimum for Maximum Toughness and Effective Stress Relieving			
1025°F (550°C)	61	64.5	66
1050°F (565°C)	60	64	65.5
1075°F (580°C)	59	63	64.5
1100°F (595°C)	57.5	61.5	63
1125°F (605°C)	55	59.5	61.5
1150°F (620°C)	53	57	59.5
1175°F (635°C)	—	53.5	57
1200°F (650°C)	—	—	53
Minimum number of Tempers	2	3	3

*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 (>1000°F) Rex M2 is suitable for nitriding, PVD coating or similar surface treatments. CVD coating processes may result in non-predictable dimensional changes.



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