



# SB Specialty Metals LLC

Your *First Choice* for Specialty Metals

## PMM4 – Technical Data

### General Descriptions:

PM M4 is a high-vanadium special purpose high speed steel exhibiting better wear resistance and toughness than M2 and M3 in cold work punches, die inserts and cutting applications involving high speed and light cuts.

### Example of applications:

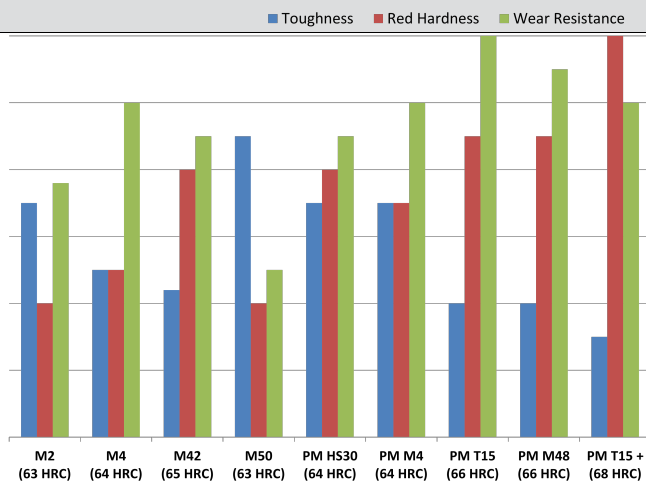
Broaches, Gear Hobs, Shaper Cutters, Shaving Cutters, Milling Cutters, Rolls, Punches, Dies.

### Chemical Composition

Carbon	Molybdenum	Vanadium	Tungsten	Chromium	Manganese	Silicon	Sulfur*
1.35%-1.50%	4.25%-5.50%	3.75%-4.50%	5.25%-6.50%	3.75%-4.75%	0.15%-0.40%	0.20%-0.45%	0.05%-0.07%

\*The addition of 0.2-0.25% sulfur in larger diameter rounds (1.640" Dia. and over) results in improved machinability and grindability with no negative effects on toughness.

### Comparison Chart



### Hardening Data

Tempering Temp °F	Heat treat response (+/- 1 HRC)					
	1875 F	1975 F	2050 F	2100 F	2150 F	2200 F
As quenched	59.5	62.5	64.5	65	65	63.5
1000	58.5	61	62.5	63.5	65	66
1025	58	60.5	62	63	64.5	65.5
1050	57.5	59.5	61	62	63.5	64.5
1100	54	56	58.5	60	61.5	62.5
1150	50	53	55	56	58	59
1200	44	48	51	52	54	55

### Size Changes During Hardening

Hardening Temp °F	Tempering Temp °F	HRC	Longitudinal Size Change %
2200	1025	65.5	+0.15

### Toughness

Hardening Temp °F	Tempering Temp °F	Hardness HRC	Charpy C-Notch Impact Value	Bend Fracture Strength
2200	1025	65.5	20 ft-lb	738(ksi)
2125	1050	63.5	28 ft-lb	744 (ksi)

### Surface Treatment

PMM4 can be nitrided, or titanium-nitride coated. If the CVD TiN treatment is used, care is required in vacuum hardening.



## PMM4 – Technical Data

### Heat Treatment

#### Forging

2000-2100 °F.  
Do not forge below 1700 °F.  
Slow cool.

#### Annealing

1600 °F, hold 2 hours, slow cool 30 °F/hr maximum to 1000 °F, then air or furnace cool.  
Achieved hardness 225 / 255 BHN.

#### Stress Relieving

(After machining): 1100-1300 °F, hold 2 hours and air or furnace cool.

#### Hardening

Salt, Vacuum or atmosphere.

#### High Heat (Austenitizing)

Preheat: 1500-1550 °F, equalize.  
A second preheat at 180-1900°F is suggested for high temperature hardening in vacuum.  
High Heat: 1875-2200 °F.  
2150-2200 °F recommended for cutting tools. 1875-2125 °F recommended for cold work applications.

#### Quench

Salt, oil or atmosphere quench to 1000-1100 °F, equalize, then air cool to below 150 °F or hand warm.  
Vacuum or atmosphere quench rate through 1850-1300 °F range is critical to achieve optimum heat treat response.

#### Tempering

1000 °F minimum recommended.  
Double tempering required and triple tempering recommended when hardening from 2100 °F or higher.  
Air cool to room temperature between tempers.

### Physical Properties

<b>Modules of Elasticity</b>	31 psi x 10 <sup>6</sup> ..... (214GPa)	<b>Density</b>	0.288 lb/in <sup>3</sup>
<b>Annealed Hardness</b>	225/255 BHN	<b>Machinability</b>	45% of O1, 25% improvement with high sulfur modification.