



# SB Specialty Metals LLC

Your **First Choice** for Specialty Metals

## PMA11 - Technical Data

### General Descriptions:

PMA11 is a highly alloyed tool steel made using the 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. This exceptional wear resistance and good toughness make it an excellent candidate to replace carbide in cold work tooling applications, particularly where tool toughness is necessary.

### Examples of applications:

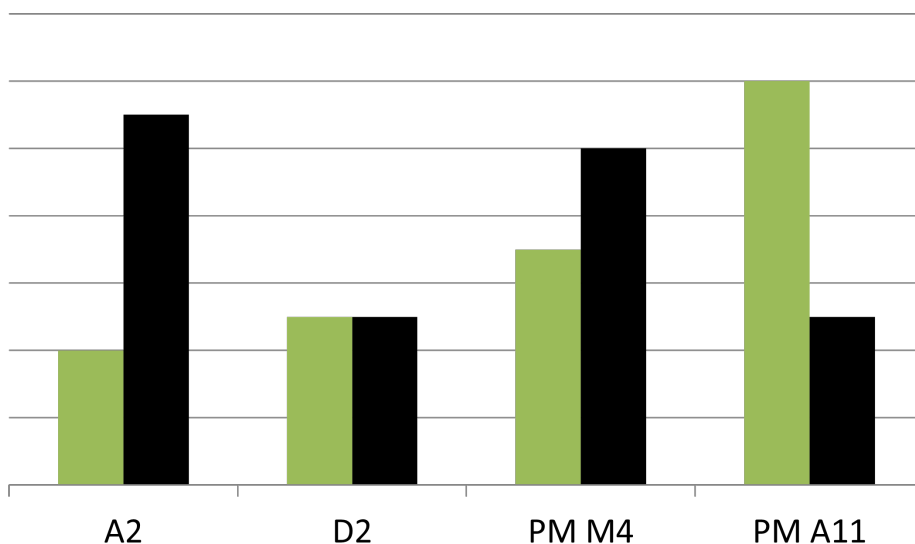
Punches & dies for blanking, piercing, forming and cold extrusion. Knives for slitting, shearing and trimming. Granulator/pelletizer blades, nozzles, screw tips and barrel liners for plastic injection molding equipment. Powder compaction tooling, woodworking tools, wear parts.

### Chemical Composition

Carbon	Manganese	Silicon	Chromium	Vanadium	Molybdenum	Sulfur
2.40-2.55%	0.40-0.60%	0.80-1.00%	5.00-5.75%	9.25-9.85%	1.10-1.50%	0.06-0.08%

### Comparison Chart

■ Wear Resistance ■ Toughness



### Typical Heat Treat Response

Tempering Temp °F	Hardness HRC (+/-1)					
	1850°F	1900°F	1950°F	2050°F	2100°F	2150°F
As Quenched	61	63	65	65	64.5	63.5
1000	56	57	60.5	62	63	64
1025	54	56	58.5	60	62	63
1050	52	54	56.5	58	60	61
1100	49	51	52	54	55	56
1150	44	45	46	48	50	51
1200	40	41	43	46	47	48

### Size Changes During Hardening

Hardening Temp °F	Tempering Temp °F	HRC	Longitudinal Size Change %
1950	1000	60.5	+0.04%
2150	1000	64	+0.04%

### Surface Treatment

PMA11 can be nitrided or titanium-nitride coated. If the CVD TiN treatment is used, care is required in vacuum hardening.



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### Heat Treatment

#### Forging

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

#### Annealing

1600°F, hold 2 hours, slow cool (30°F/Hour max) to 1000°F, then air or furnace cool.

Hardness BHN 255/277.

#### Stress Relieving

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

#### Hardening

Preheat: 1500-1550°F, equalize. Second preheat stage at 1850-1900°F, let part equalize.

#### High Heat (Austenitizing)

1850-2150°F. Standard recommendation to achieve Rc 60-62 after tempering is to use 2050°F.

#### Quench

Oil or atmosphere quench to 1000-1100°F, equalize, then air cool to below 125°F or hand warm. Vacuum or atmosphere quench rate through 1850-1300°F range is critical to achieve optimum heat treat results.

#### Tempering

1000°F minimum recommended.

Double tempering is required.

Two hours at temperature per temper, cool to room temperature between tempers.

### Physical Properties

<b>Modulus of Elasticity</b>	32 psi x 10 <sup>6</sup> (221GPa)	<b>Density</b>	0.268 lb/in <sup>3</sup>
<b>Annealed Hardness</b>	BHN 255/277	<b>Machinability</b>	65% of O1