



## PM A11 High Speed Steel

PM A11 high-speed tool steel is a versatile tool and die steel which provides extremely high wear-resistance in combination with relatively high impact toughness. A large volume of hard vanadium carbides provides the high wear-resistance. PM A11 offers substantially better wear-resistance than the high-carbon, high-chromium die steels such as D2 and D7. Many advantages we see when using this steel in cold work tooling applications are ease of grinding, improved response to heat treatments and cost effectiveness.

Other Known Names: CPM<sup>®</sup> 10V<sup>®</sup>, AISI A11

Common Usage: Punches, Extrusion Tooling, Slitter Knives, Cold Work Tooling.

### Physical Properties

Density

0.298 lb/in<sup>3</sup> (8256 kg/m<sup>3</sup>) Specific

Gravity

8.26

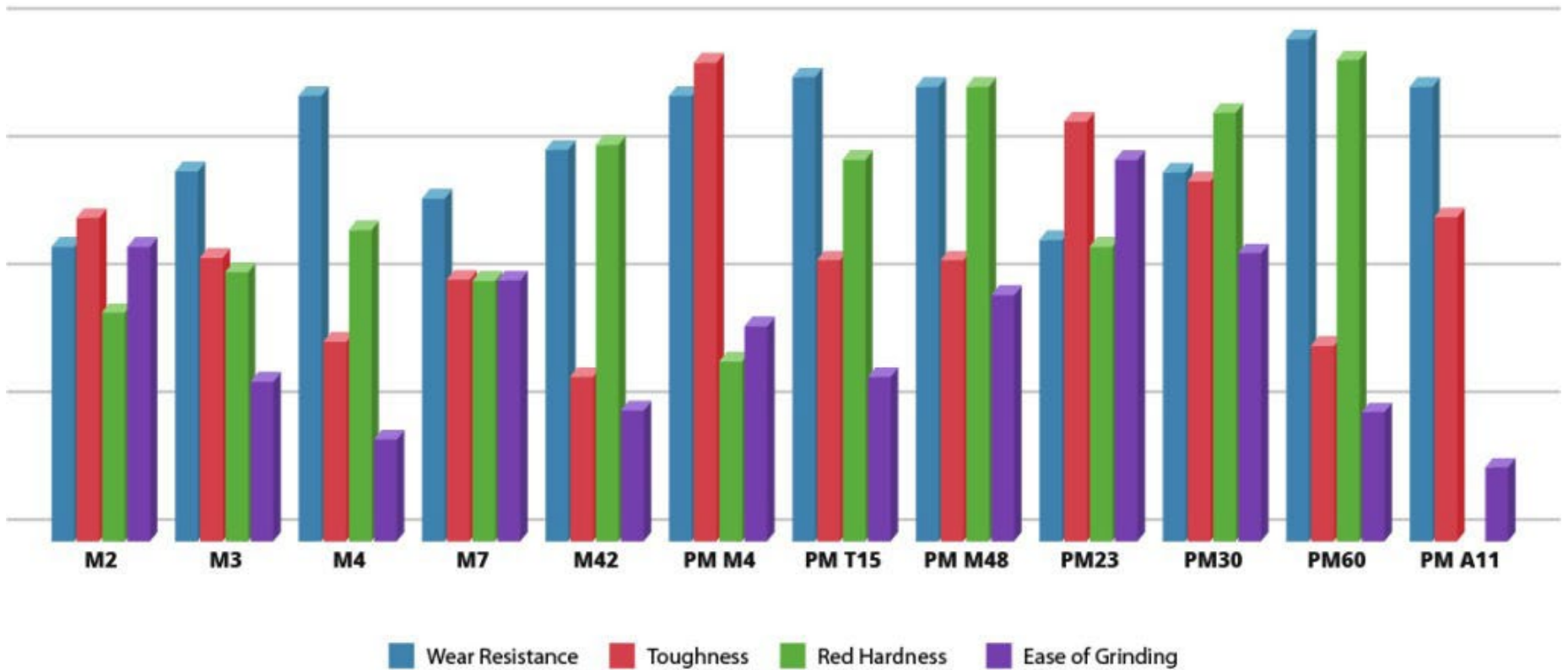
Modulus Of Elasticity 31 x 10<sup>6</sup>

psi (214 GPa)

Machinability

10-15% of a 1% carbon steel

# High Speed Steel Properties Comparison



# PM A11 High Speed Steel Chemical Composition

						<b>MAXIMUM</b>	<b>TYPICAL</b>
Carbon	Chromium	Tungsten	Molybdenum	Vanadium	Cobalt	Annealed	Tempered
C	Cr	W	Mo	V	Co	Hb	HrC
2.45	5.25	.5 max	1.3	9.75	.5 max	255	63

# PM A11 High Speed Steel Heat Treating

<b>ANNEALING</b>	<b>PREHEAT</b>	<b>AUSTENITIZING</b>	<b>QUENCH</b>	<b>TEMPERING</b>
Temp	Temp	Temp	Medium	Temp
°F	°F	°F		°F
1600	1500/1550	1850/2150	Salt/Oil/Atm	1040

# PM A11 High Speed Steel Thermal Treatments

Preheating

1500-1550°F (816-845°C), equalize.

Austenitizing (High Heat)

Heat rapidly from the preheat, typically by transferring to a second furnace. For Optimum Wear Resistance

- ◆ Soak for 5 to 15 minutes.
- ◆ Furnace or Salt Bath: 2150°F (1177°C)

For Balance of Wear Resistance and Toughness

- ◆ Soak for 15 to 30 minutes.
- ◆ Furnace or Salt Bath: 2050°F (1121°C)

For Maximum Toughness and minimum distortion in cooling

Soak for 30 to 60 minutes.



Furnace: 1975°F (1080°C)

Salt Bath: 1950°F (1066°C)



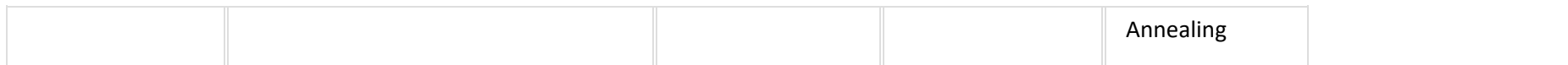
Air, pressurized gas, warm oil, or salt. Sections less than 3" thick may be air cooled to maximum hardness. Sections 3" thick or more must be quenched at a faster rate, using one of the methods below, to attain maximum hardness. For pressurized gas, the furnace should have a minimum quench pressure of 4 bars. The quench rate to below 1000°F (538°C) is critical to obtain the desired properties.

For oil, quench until black, about 900°F (482°C), then cool in still air to 150-125°F (66-51°C). For salt maintained at 1000-1100°F (538-593°C), equalize in the salt, then cool in still air to 150-125°F (66-51°C).



Temper immediately after quenching.

Typical temperature range is 1000-1100°F (538-593°C). Do not temper below 1000°F (538°C). Hold at temperature for 2 hours then air cool to ambient temperature. Triple tempering is required is required when austenitized at 2100°F (1149°C) or higher.



Annealing must be performed after hot working and before re-hardening

Heat at a rate not exceeding 400°F per hour (222°C per hour) to 1600°F (871°C), and hold at temperature for 1 hour per inch (25.4 mm) of thickness, 2 hours minimum. Then cool slowly with the furnace at a rate not exceeding 30°F per hour (17°C per hour) to 1000°F (538°C). Continue cooling to ambient temperature in the furnace or in air.