



Technical Information: PM M4

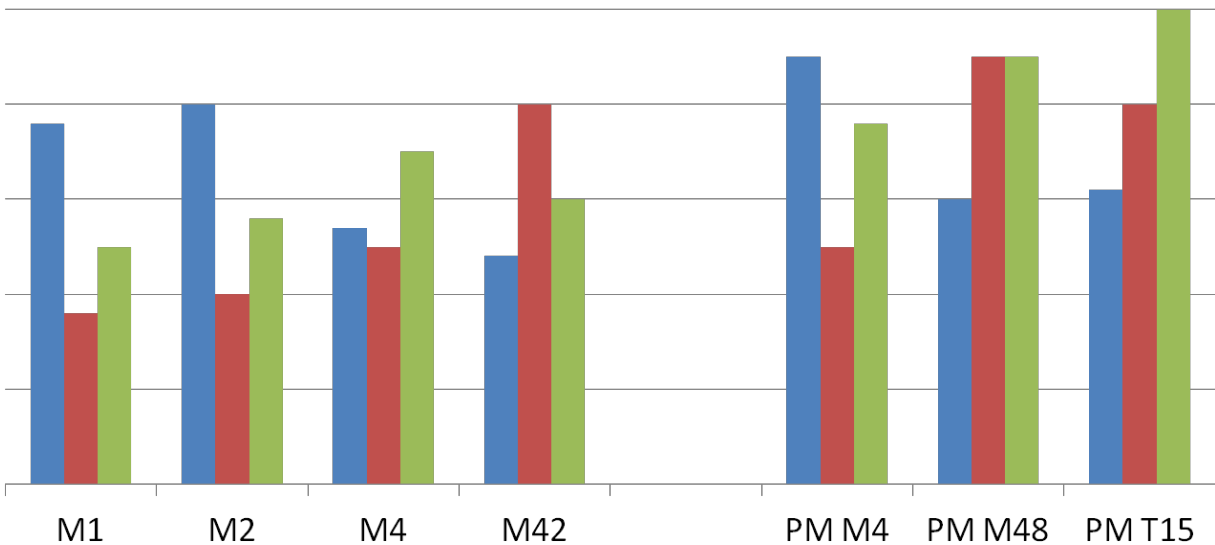
PM M4 IS A MOLYBDENUM/TUNGSTEN HIGH SPEED STEEL PRODUCED USING THE PM (POWDERED METAL) STEEL MAKING PROCESS. THE GRADE HAS AN EXCELLENT BALANCE OF TOUGHNESS AND WEAR RESISTANCE MAKING IT IDEAL FOR CUTTING TOOLS AND FOR COLD WORK TOOLING. PM STEELS HAVE EXCELLENT GRINDABILITY VS CONVENTIONAL STEELS.

TYPICAL CHEMICAL COMPOSITION

CARBON	1.45%	CHROMIUM	4.50%
MOLYBDENUM	4.50%	SILICON	0.40%
VANADIUM	4.00%	MANGANESE	0.40%
SULFUR	0.03/0.10	TUNGSTEN	5.50%

HIGH SPEED STEEL PROPERTIES COMPARISON

■ Toughness ■ Red Hardness ■ Wear Resistance



PHYSICAL PROPERTIES

MODULUS OF ELASTICITY.....31 PSI X 10⁶(207 GPa)
DENSITY..... 0.286 LB/IN³
ANNEALED HARDNESS.....205-250 BRINELL HARDNESS (BHN)
MACHINABILITY.....SIMILAR TO M2 TOOL STEEL

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HEAT TREATMENT

ANNEALING

HEAT TO 1600°F, HOLD TWO HOURS
SLOW COOL 20°F/HOUR TO 600°F
THEN AIR OR FURNACE COOL TO ROOM TEMPERATURE

STRESS RELIEVING

PERFORMED PRIOR OR AFTER MACHINING TO MINIMIZE DISTORTION IN HEAT TREATING
1100/1200°F, HOLD TWO HOURS
THEN AIR COOL TO ROOM TEMPERATURE

HARDENING

SALT BATH, PROTECTIVE ATMOSPHERE, OR VACUUM FURNACE EQUIPMENT PREFERRED.

HIGH HEAT (AUSTENITIZING)

1950/2200°F FOR 5 TO 30 MINUTES AT HEAT.
HIGHER AUSTENITIZING TEMPERATURES REQUIRE LESS TIME AT HEAT

QUENCH

SALT BATH QUENCH TO 1000-1100°F, EQUALIZE, THEN AIR COOL TO 150°F.
VACUUM OR ATMOSPHERE QUENCH RATE OF A MINIMUM 50 DEGREES F PER MINUTE DOWN TO 1200F IS
CRITICAL TO ACHIEVE BEST HEAT TREAT RESPONSE.
TEMPER IMMEDIATELY FOLLOWING QUENCH

TEMPERING

MINIMUM 1000°F TEMPERING TEMPERATURE REQUIRED.
DOUBLE TEMPERING IS REQUIRED, TRIPLE TEMPERING RECOMMENDED.
AIR COOL TO ROOM TEMPERATURE BETWEEN TEMPERS.

TYPICAL HEAT TREAT RESPONSE

TEMPERING TEMP °F	HARDENING TEMP 1950°F	HARDENING TEMP 2200°F
As QUENCHED	64	63.5
1000	64	66
1025	62	66
1050	62	65
1075	61	64
1100	60	63

LONGITUDINAL SIZE CHANGE

APPROXIMATELY: PLUS 0.15%