UNITED STATES CUTTING TOOL INSTITUTE
LEADING THE FUTURE OF THE NORTH AMERICAN CUTTING TOOL INDUSTRY

M4 High Speed Steel

M4 is an extremely versatile high-speed steel with its extremely high carbon and vanadium contents for exceptional abrasion-resistance. It is well suited for premium cutting tools of all types, particularly those used for machining abrasive alloys, castings and heat-treated materials. The high carbon content enables M4 steel to be hardened in excess of 65HRC. However, the high hardness and high vanadium carbide content make it more difficult to grind after heat treatment compared to M2 and other high-speed steels.

Other Known Names: HS 6-5-4, E M4, SKH 54, Stark.

Common Usage: Form Tools, Punches, Broach Inserts, Mills, Taps, Header Tooling.

Physical Properties

Density

0.288 lb/in^3 (7972 kg/m^3)

Specific Gravity

7.97

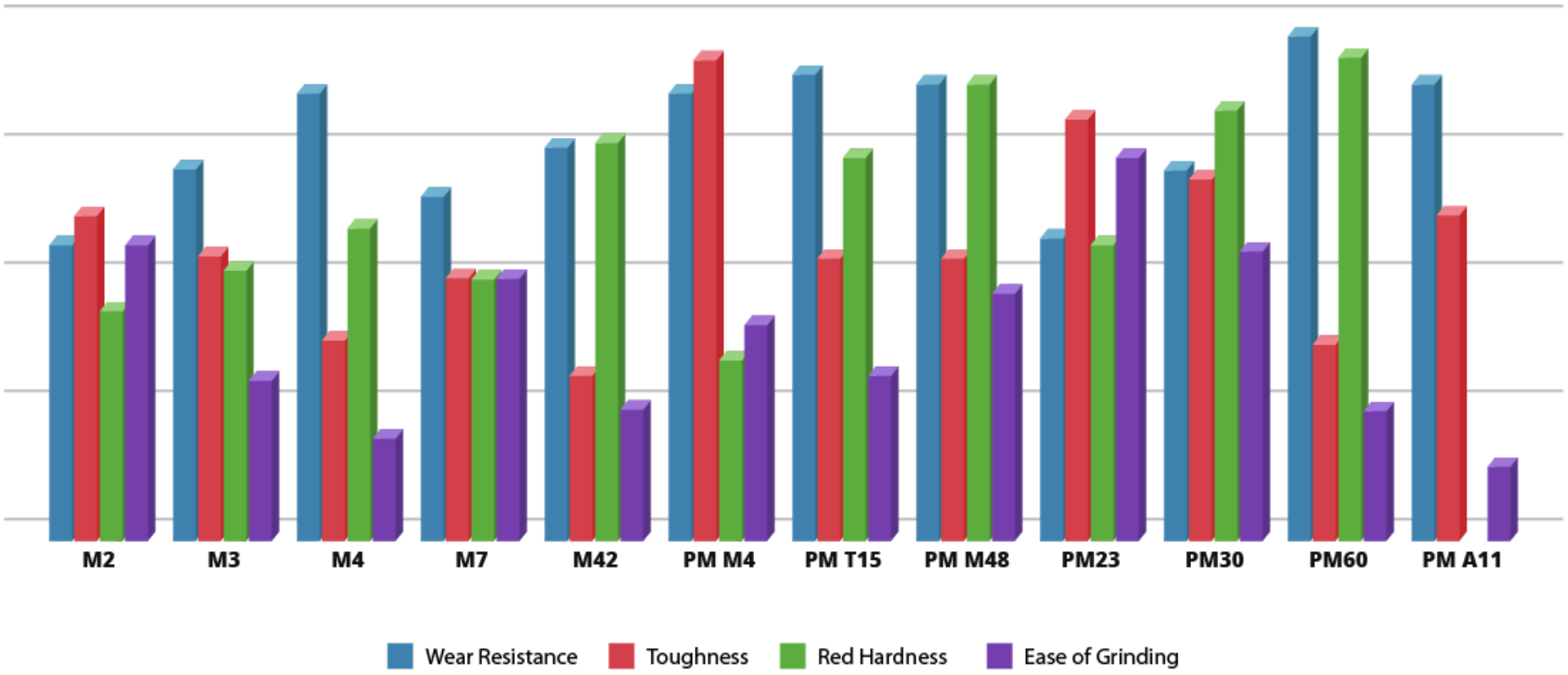
Modulus Of Elasticity 30 x

10^6 psi (207 GPa)

Machinability

35-40% of a 1% carbon steel

High Speed Steel Properties Comparison



M4 High Speed Steel Chemical Composition

						MAXIMUM	TYPICAL
Carbon	Chromium	Tungsten	Molybdenum	Vanadium	Cobalt	Annealed	Tempered
C	Cr	W	Mo	V	Co	Hb	HrC
1.3	4.25	5.85	4.75	4.1	-	255	65

M4 High Speed Steel Heat Treating

ANNEALING	PREHEAT	AUSTENITIZING	QUENCH	TEMPERING
Temp	Temp	Temp	Medium	Temp
°F	°F	°F		°F
1550/1600	1500/1550	2175/2225	Salt/Oil/Atm	1025/1050

M4 High Speed Steel Thermal Treatments

Preheating

To minimize distortion and stresses in large or complex tools use a double preheat. Heat at a rate not exceeding 400°F per hour (222°C per hour) to 1100°F (593°C) equalize, then heat to 1450-1550°F (788-843°C). For normal tools, use only the second temperature range as a single preheating treatment.

Austenitizing (High Heat)

Heat rapidly from the preheat.

- Furnace: 2200-2250°F (1204-1232°C) Salt: 2175-2225°F (1191-1218°C)
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Quenching

Pressurized gas, warm oil, or salt. For pressurized gas, a rapid 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, then cool in still air to 150-125°F (66-51°C).

Tempering

Temper immediately after quenching. Typical tempering range is 1000-1100°F (538-593°C). Hold at temperature for 2 hours, then air cool to ambient temperature. Double tempering is required. A third temper at 800-1000°F (427-538°C) after finish grinding is often beneficial.

Annealing

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 1550-1600°F (843-871°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 50°F per hour (28°C per hour) to 1000°F (538°C). Continue cooling to ambient temperature in the furnace or in air.

Information provided by Griggs Steel Company