DATA SHEET

LATROBE SPECIALTY STEEL COMPANY

Latrobe, PA 15650-0031 USA

Issue 1

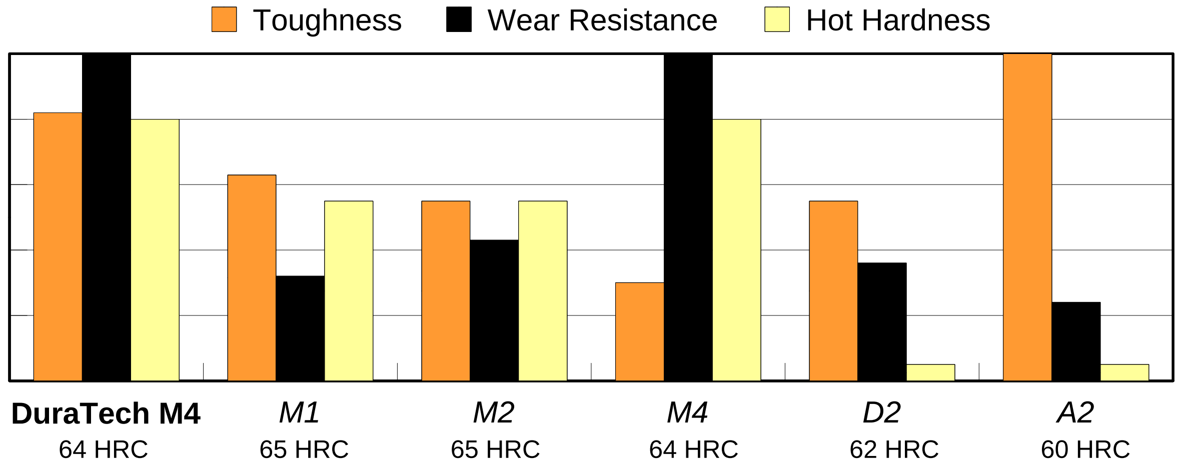
DuraTech™ M4 Powder Metal High Speed Steel
ASTM M4 (High Carbon)

Typical Composition

C	Mn	Si	Cr	W	Mo	V
1.45	0.25	0.25	4.50	5.50	5.20	3.85

DuraTech M4 high speed steel is an extremely versatile high speed steel that provides a unique combination of high wear resistance with high impact toughness and transverse bend strength. A large volume of vanadium carbides provides the high wear resistance. The high impact toughness and high transverse bend strength are results of the fine grain size, small carbides, and superior cleanliness of the powder metallurgy (PM) microstructure. DuraTech M4 offers improved cutting tool life compared to conventionally-wrought M1, M2, M7, and other lower-alloyed high speed steels. DuraTech M4 also excels in cold work tooling applications, where it provides better toughness and wear resistance than high-carbon, high-chromium die steels such as D2 and D3.

Relative Properties



Physical Properties

Density: 0.286 lb/in^3 (7916 kg/m^3)
Specific Gravity: 7.92
Modulus of Elasticity: 31x10^6 psi (214 GPa)

Machinability: 40-45% of a 1% carbon steel

Coefficient of Thermal Expansion:

Temperature °F	in/in/ °F x 10^{-6}	Temperature °C	mm/mm/ °C x 10^{-6}
100 - 500	5.30	38 - 260	9.53
100 - 800	6.31	38 - 427	11.34
100 - 1000	6.65	38 - 538	11.95
100 - 1200	6.81	38 - 649	12.24
100 - 1500	7.00	38 - 816	12.58

DuraTech™ M4
HEAT TREATING INSTRUCTIONS

(See Tech-Topics Bulletin 102 for a more thorough explanation of heat treating.)

CRITICAL TEMPERATURE

Ac1: 1545°F (840°C)

HARDENING:

Preheating: 1500-1550°F (816-845°C), equalize.
A second preheat at 1850-1900°F (1010-1040°C) is recommended for vacuum hardening.

Austenitizing (High Heat): Heat rapidly from the preheat.

For Cutting Tools:
Soak for 5 to 15 minutes.
Furnace: 2150-2200°F (1177-1204°C)
Salt Bath: 2125-2175°F (1163-1191°C)

For Cold Work Tooling:
Soak for 20 to 45 minutes.
Furnace: 1875-2125°F (1023-1163°C)
Salt Bath: 1850-2100°F (1010-1149°C)

Quenching: Pressurized gas, warm oil, or salt.
For pressurized gas, the furnace should have a minimum quench pressure of 4 bars. *A quench rate of approximately 400 °F (222°C) per minute 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).

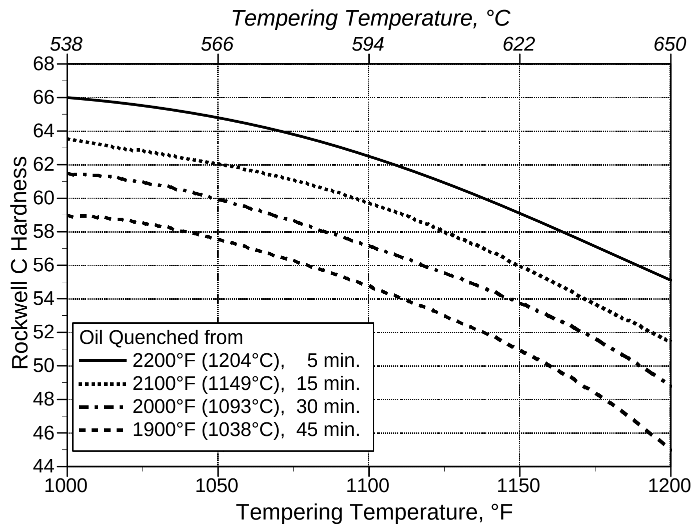
Tempering: *Temper immediately after quenching*. Typical temperature range is 1000-1100°F (538-593°C). Do not temper below 1000°F (538°C). Hold at temperature for 2 hours then air cool to ambient temperature. Double tempering is required. Triple tempering is required when austenitized at 2100°F (1149°C)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

ANNEALING: Annealing must be performed after hot working and before rehardening.

Heat at a rate not exceeding 400°F per hour (222°C per hour) to 1575-1600°F (857-871°C), and hold at temperature for 1 hour per inch of maximum 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. The resultant hardness should be a maximum of 255 HBW.

HEAT TREATMENT RESPONSE

As Oil Quenched from	HRC
1900°F (1038°C), 45 minutes	60
2000°F (1093°C), 20 minutes	63
2100°F (1149°C), 15 minutes	65
2200°F (1204°C), 5 minutes	63.5



HOT HARDNESS

Oil Quenched from 2200°F (1204°C) and triple tempered at 1025°F (552°C)	
Test Temperature	HRC
72°F (22°C)	65.5
600°F (316°C)	62
800°F (427°C)	60
1000°F (538°C)	57
1100°F (593°C)	54
1200°F (649°C)	44
1300°F (704°C)	20

Latrobe, PA Phone: 724-537-7711
FAX: 724-532-6316
WEB: www.latrobesteel.com

Vienna, OH Phone: 800-321-6446
FAX: 330-609-2054

Marlborough, MA Phone: 800-444-4447
FAX: 508-481-6581