



SB Specialty Metals LLC

Your **First Choice** for Specialty Metals

M2 ESR – Technical Data

General Descriptions:

M2 ESR is a premium version of conventional M2 high speed steel. The ESR process provides a cleaner steel with a more homogeneous structure. The more homogeneous structure provides better mechanical properties, including better toughness. This grade has a good balance of wear resistance and toughness which makes it a good cold work material for a variety of applications in addition to high speed applications.

Example of applications:

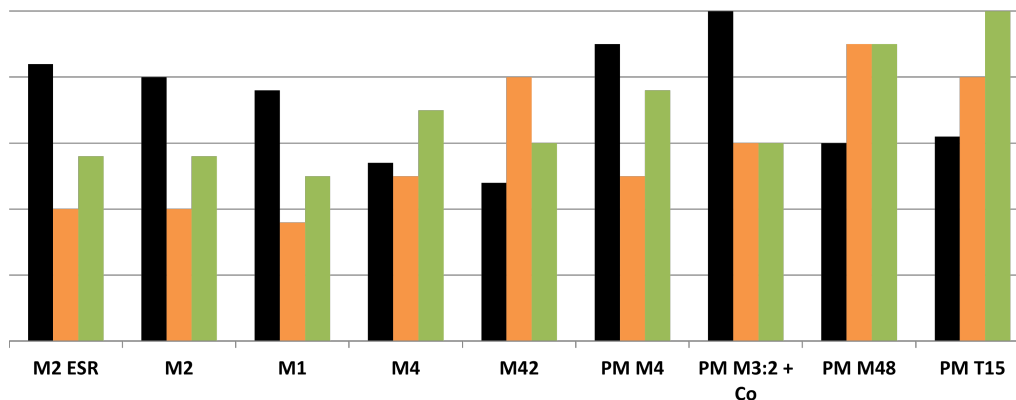
Drills, end mills, tool bits, broaches, milling cutters, form tools, taps and punches. M2 can also be used in numerous cold work applications as well as certain hot work applications.

Chemical Composition

Carbon	Molybdenum	Tungsten	Vanadium	Chromium	Silicon	Manganese
0.78%-0.88%	4.50% - 5.50%	5.50%-6.75%	1.75% - 2.20%	3.75% - 4.50%	0.20%-0.45%	0.15%-0.40%

Comparison Chart

■ Toughness ■ Red Hardness ■ Wear Resistance



Typical Heat Treat Response

Tempering Temp °F	Hardness (HRC)		
	2100°F	2150°F	2250°F
975	64	65	66
1000	64	65.2	66.8
1025	63.5	65.1	66.8
1050	62.6	64.8	66
1075	61.3	64	65
1100	60	62.5	64
1125	58.4	60.5	62.4
1150	57	58	60.9
1175	---	---	59
1200	---	---	57

Size Changes During Hardening

Hardening Temp °F	Tempering Temp	HRC	Longitudinal Size Change %
2200	1025	65	+0.22

Surface Treatment

M2 ESR can be nitrided, or titanium-nitride coated. If it is titanium-nitride coated, care is required in vacuum hardening.



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Heat Treatment

Forging

Critical temperature - 1530 °F.
Forging temperature - 2075 °F. Slow cool after forging. Do not forge below 1700 °F.

Annealing

Heat to 1600 °F and hold for two hours at temperature.
Slow cool 25 °F per hour to 1000 °F, then air or furnace cool to room temperature.
Resulting hardness - Brinell 217/255.

Stress Relieving

Performed after rough machining to minimize distortion in heat treatment.
1200 °F, hold for two hours at temperature, then air cool to room temperature.

Hardening

Salt bath or vacuum furnace preferred.

High Heat (Austenitizing)

Preheat-1500/1550 °F - let parts equalize. 2100/2225 °F - soak for 5-10 minutes. For vacuum hardening, use the high side of the austenitizing range and use longer soak time.

Quench

Salt bath quench to 1000/1100 °F, equalize, then air cool to 150 °F. Temper immediately following the quench.
Vacuum quench at a minimum of 50 °F per minute down to below 1000 °F, then cool to room temperature.

Tempering

Minimum of 1000 °F tempering temperature required.
Double tempering is required, triple tempering is recommended.
Air cool to room temperature between tempers.

Physical Properties

Modulus of Elasticity	30 psi x 10 ⁶ ... (207 GPa)	Density	0.294 lb/in ³
Annealed Hardness	215-255 Brinell hardness (BHN)	Machinability	Similar to D2.