

M-2 HIGH SPEED STEEL

M-2 is the tungsten-molybdenum high speed steel that has become the favorite for all general purpose applications. It has a wider heat treating range than most of the molybdenum high speed steels, and has the resistance to decarburization that is characteristic of the tungsten types. It offers an excellent combination of good red hardness, toughness, and wear resistance.

TYPICAL APPLICATIONS

Drills, taps, end mills, reamers, milling cutters, hobs, form tools, saws, lathe and planer tools, chasers, broaches and boring tools.

PHYSICAL PROPERTIES

Critical temperature-(on heating) 1540°F

Specific Gravity - 8.15

Coefficient of Thermal Expansion

100 - 500°F	5.16 x 10-6 in/in/°F
100 - 800°F	6.16
100-1000°F	6.59
100-1200°F	6.78
100-1500°F	6.88

THERMAL PRACTICE

FORGING - Heating for forging must be done slowly and uniformly, with care being taken not to put cold steel into a hot furnace. Soak through at 1700-1800°F and then heat to 1900-2050°F for initial forging. Do not forge below 1600-1700°F, and when forging is completed, cool slowly in lime, mica, dry ashes or furnace.

ANNEALING - Heat slowly to 1500-1550°F, hold until the entire mass is heated through, and cool slowly in the furnace (30°F per hour) to about 1000°F, after which the cooling rate may be increased. Suitable precautions must be taken to prevent excessive carburization or decarburization.

STRAIN RELIEVING - When desirable to relieve the strains of machining, heat slowly to 1150-1250°F, allow to equalize, and then cool in still air.

PREHEAT FOR HARDENING - Warm slightly before charging into preheat furnace, which should be operating at 1350-1550°F.

HARDENING - After thorough preheating, transfer to the hardening furnace, operating at 2150-2225°F, depending upon the degree of hardening required for the application, and the size of the tool.

QUENCHING - Cool in air, oil, or a molten salt bath operating at 1000-1100°F. In the case of oil quenching, it is usually good practice to interrupt the quench by removing the tool after it has reached about 1000°F, and allow the cooling to continue in still air. Where a salt bath is used, the tool should be held only long enough to equalize at the bath temperature, and then should be removed and cooled in air. Any necessary straightening should be done while cooling in the range of 850-450°F. Tools should be allowed to cool to 150°F, or to where the can be held in the bare hand, and then tempered immediately.

TEMPERING - The tempering temperature may be varied according to the desired hardness, but is usually in the range of 1000-1100°F. Double tempering is always recommended. The response to tempering is shown in the following chart.

**Hardening 2150°F 2200°F 2225°F
Temperature**

Double Temp.

800°F	61.0RC	61.5RC	62.0RC
850°F	61.5	62.0	62.5
900°F	62.5	63.0	63.5
950°F	63.0	64.0	65.0
1000°F	64.0	65.0	65.5
1025°F	63.5	65.0	65.5
1050°F	63.0	64.5	65.0
1100°F	61.5	62.5	63.5
1150°F	57.5	59.0	60.0
1200°F	51.0	54.0	55.0

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