

# TECHNICAL BULLETIN

## AISI M-2 High Speed Tool Steel Annealed

Typical Analysis:	Carbon	Tungsten	Moly.	Chromium	Vanadium
	0.83	6.35	5.00	4.15	1.90

Color Code: Gold

### HEAT TREATMENT

<b>Forging</b>	2050 to 2100°F, stop at 1800°F. Cool slowly
<b>Annealing</b>	1600°F, cool slowly, Brinell 241 max
<b>Preheating</b>	1550°F, soak before hardening
<b>Hardening</b>	2250 to 2275°F, oil quench
<b>Tempering</b>	1000 to 1050°F, Rockwell C 65/66

### CHARACTERISTICS

**Machinability** — Like all highly alloyed steels, M-2 machines with somewhat more difficulty than the lower alloyed steels. It is rated at 65 as compared to a 1% carbon tool steel, which is rated at 100.

### INSTRUCTIONS FOR WORKING

**Hardening** — Harden M-2 by preheating slowly to 1550°F and holding until thoroughly soaked. Heat rapidly to 2250 to 2275°F. Generally, total heating time in the furnace varies from a few minutes to a maximum of 15 minutes, depending on the size of the tool. Oil quenching from the hardening temperature is preferred for developing full hardness, although air quenching or quenching in hot salt or lead may be done.

When the tools have reached a temperature of 150 to 200°F in the quench, temper immediately. Precautions should be taken to prevent decarburization on tools which cannot be ground after hardening.

**Tempering** — The best temperature range for M-2 is 1000 to 1050°F. This results in the best combination of cutting ability, hardness, strength, and toughness. Tools are tempered by heating to the above temperature and holding for two hours per inch of greatest thickness, then cooling all the way to room temperature. It is customary to use a double-tempering operation on high-speed tool steels. This is carried out by a second heating to a temperature 25 to 50 degrees below the first tempering operation. Tempering at higher temperatures will increase the toughness of tools at the expense of hardness. Therefore, hot-work and shock-resisting tools are usually tempered with a range of 1100 to 1200°F.

Test specimens 1 in. round x 2<sup>1</sup>/<sub>2</sub> in. long of M-2 steels were hardened in oil and still air at a temperature of 2250°F. After hardening, specimens were tempered for two hours at temperatures ranging from 300 to 1400°F. Specimens were then tested for Rockwell hardness. Treatment given the specimens and the hardnesses obtained are shown below.

These results on 1-in. round specimens may be used as a guide in tempering tools to desired hardness. However, tools of heavy section or mass may be several points lower in Rockwell hardness for a given treatment.

Tempering Temperature-°F	Rockwell C	
	Air-Quench	Oil-Quench
300	65	65
400	64	63
500	63	62.5
600	62.5	62.5
700	63	62.5
800	63.5	63.5
850	63.5	63.5
900	65	64
950	66	65
1000	66	65.5
1050	66	63.5
1100	64.5	61.5
1150	62	60
1200	53.5	53
1300	43	39.5
1400	33.5	34



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