# M7 ESR - Technical Data

## General Descriptions:

M7 is made using the ESR melting practice.
It is a molybdenum type high speed steel designed with higher carbon and vanadium to provide higher hardness after heat treatment and improved wear resistance compared to M1 steel.

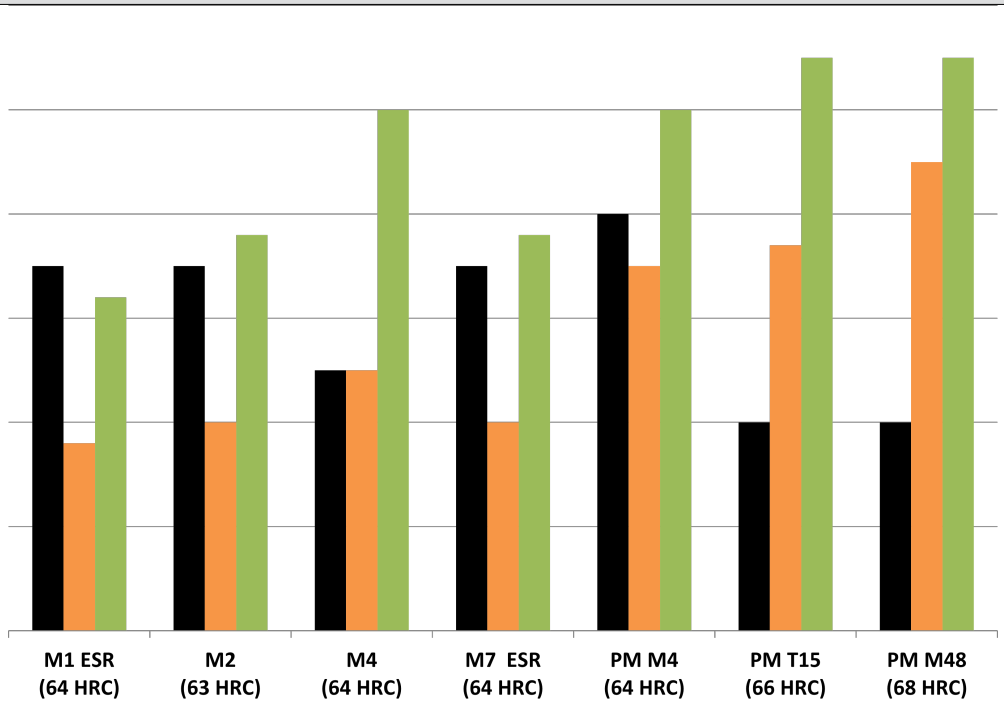
## Examples of applications:

Chasers, reamers, drills, taps, end mills, counterbores, form tools and countersinks.

## Chemical Composition

| Carbon | Manganese | Silicon | Chromium | Vanadium | Tungsten | Molybdenum |
|---|---|---|---|---|---|---|
| 0.97-1.05% | 0.15-0.40% | 0.20-0.55% | 3.50-4.00% | 1.75-2.25% | 1.40-2.10% | 8.20-9.20% |

## Comparison Chart




## Typical Heat Treat Response

| Tempering Temp °F | Hardness HRC 2150 °F | 2200 °F |
|---|---|---|
| 1000 | 65.1 | 66.0 |
| 1025 | 64.9 | 66.0 |
| 1050 | 64.0 | 65.2 |
| 1075 | 61.2 | 64.0 |
| 1100 | 57.7 | 62.0 |
| 1125 | ---- | 60.0 |
| 1150 | ---- | 57.0 |

## Size Changes During Hardening

| Hardening Temp °F | Tempering Temp | HRC | Longitudinal Size Change % |
|---|---|---|---|
| 2200 °F | 1025 °F | 66 | +0.22 |

## Surface Treatment

M7 can be nitrided or titanium-nitride coated.
If the CVD TiN treatment is used,
care is required in vacuum hardening.

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### Forging

2000 °F, do not forge below 1700 °F.
Slow cool after forging.

### Annealing

1600 °F, hold 2 hours, slow cool 25 °F/hr max. to 1000 °F, then air or furnace cool.
Hardness BHN 229/248.

### Stress Relieving

1100-1300 °F, hold 2 hours and air or furnace cool.

### Hardening

Salt Bath or Vacuum Furnace preferred.

### High Heat (Austenitizing)

Preheat to 1500-1550 °F - let parts equalize.
2150-2200 °F, soak 2 to 5 minutes.
For vacuum hardening, use the high side of the high heat range and soak times.

### Quench

Salt or vacuum quench to 1000-1100°F, equalize then air cool to 150 °F.
Temper immediately.The vacuum quench rate to below 1000 °F is critical to achieve proper results.

### Tempering

Tempering at 1000 °F or higher is recommended.
Temper at least two times at recommended temperatures.
2 hours per temper, cool to room temperature between tempers.

## Physical Properties

| | | | |
|---|---|---|---|
| **Modulus of Elasticity** | 30 x $10^6$ psi (207 GPa) | **Density** | 0.287 lb/$in^3$ |
| **Annealed Hardness** | BHN 229/248 | **Machinability** | 65% of O1 |