W400 VMR®

Hot Work Tool Steel

Heat Treatment Recommendation

	Vacuum	Salt Bath / Fluidized Bed	Atmosphere Furnace Muffle Furnace / Packed
Preheating **Temperature**	1. Bring up to 1200°F, equalize 2. Heat up to 1550°F, equalize	1. 800 – 900°F, equalize 2. 1100 –1200°F, equalize 3. 1500 - 1500°F, equalize Step 1 only for big blocks (cross sections above 6")	1. Bring up to 1200°F, equalize 2. Heat up to 1550°F, equalize
Hardening **Temperature (Austenitizing)**	1810°F Holding time after the tool or part has fully heated through at the hardening temperature: 15-30 minutes, Alternatively hold 20 minutes for first 1" and then 15 minutes for each additional inch of wall thickness.		
Quenching *	**Alt. 1** Inert gas, positive pressure **Alt. 2** Back-filled pressurized gas to 750-850°F, then equalize center and surface. (Maximum holding time 30 minutes) Continue forced cooling to 150°F	**Alt. 1** Quench in Salt 950-1050°F **Alt. 2** Circulated high speed inert gas **Alt. 3** Forced air circulation	**Alt. 1** Oil in 150°F until the die is black, then air cooling **Alt. 2** Circulated inert gas **Alt. 3** Circulated air
Tempering **(minimum two times)** **Temper immediately after quenching when the complete tool reaches 150°F**	**Tempering Temperatures (°F)** / **Hardness Range** 1020 — 52-54 HRC 1050 — 50-52 HRC 1080 — 46-48 HRC 1110 — 42-44 HRC 1140 — 38-40 HRC Tempering Times: 1 hour per inch of wall thickness, or hold at temperature a minimum of 2 hours.		
Stress Temper performed on hardened tools after EDM.	Check hardness to confirm tool status. Temperature: Shall be 50°F (25°C) below the highest tempering temperature. Time: Soak 2 hours once tool comes to temperature. Cool in still air.		
Dimensional Stability	Average size change as a result of hardening and tempering may not exceed 0.005 inch per inch per maximum dimension if the tool has been stress relieved before finish machining. If stress relieving is not performed as recommended, dimensional stability may be inconsistent and cannot be guaranteed.		

* Cooling rate must be adequate to avoid any transformation products, with decreased properties as a result. However, also consider the risk of excessive distortion from very fast cooling.

W400 VMR®

The toughest hot work tool steel

- Higher working hardness – longer tool life
- Excellent Toughness and Ductility – Improved fracture toughness other hot work materials

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