Uddeholm Stavax® ESR
Premium Stainless Mold Steel

	Vacuum (See reverse for more specific guidelines)	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 – 1600°F, equalize Step 1 only for big blocks (cross section above 6")	1. Bring up to 1200°F, equalize 2. Heat up to 1550°F, equalize
Hardening Temperature (Austenitizing)	1870 – 1920°F (Normally 1885°F) Holding time after the tool or part has fully heated through at the hardening temperature: minimum 30 minutes, maximum 1 hour. 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; direct quench **Alt. 2** Inert gas, positive pressure; interrupted quench (see reverse for specific guidelines).	**Alt. 1** Quench in fluidized bed at 700°F then cool in circulated air. **Alt. 2** Quench in oil 150°F until the part is black. **Alt. 3** Quench in Circulated air.	**Alt. 1** Oil 150°F until the part is black, then air cooling. **Alt. 2** Circulated inert gas. **Alt. 3** Circulated air.
	* Temper immediately after quenching when the tool or part reaches 150°F.		
Tempering (minimum two times) Avoid high hardening temperature (>1885°F) in combination with low (<480°F) tempering temperature. Tempering at high temperatures (>1020°F) may be necessary to relieve residual stresses for large/complex tools.	Hardening Temperature: 1885°F **Tempering Temperatures (°F)** / **Hardness** 480°F – 50-52 HRC 570°F – 49-51 HRC 1020°F – 40-42 HRC 1150°F – 34-36 HRC 1200°F – 30-32 HRC Tempering Times: 1 hour per inch of wall thickness, or hold at temperature a minimum of 2 hours. Check hardness in between tempers.		
Stress Temper performed on hardened tools after EDM, welding or during preventative maintenance	Check hardness to confirm tool status. **Temperature:** Shall be 50°F below the lowest tempering temperature. **Time:** Soak 30 minutes per inch of maximum section with a minimum of 2 hours once tool comes to temperature. Cool in still air. Caution: Stress tempering in an unprotected atmosphere will oxidize the tool. For hot work applications, this can prove beneficial to protect the tooling surface during operation. However, in other applications where surface finish condition is a concern, consult your heat treater on options for protective atmospheres or finish the surface after stress tempering.		
Dimensional Stability	Average size change as a result of hardening and tempering may not exceed 0.003 inch/inch/ 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.		

Additional Information: Soft annealing should be done prior to re-hardening. Protect the steel and heat through to 1630°F. Then cool in the furnace at 40°F per hour to 1560°F, then at 20°F per hour to 1290°F, then freely in air.

Characteristics

- Special re-melting techniques – excellent polishability
- Isotropic mechanical properties – greater reliability in production
- Unique cleanliness – excellent corrosion resistance

UDDEHOLM
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Vacuum Heat Treatment Guidelines for Optimal Tool Properties

Max Wall Thickness	Shape	Furnace Type	Pre-Heat Temperature	Hardening Temperature	Holding Time once soaked through	Quenching Process	Target Quench Rate 1885-1000°F, °F/min.	Temper	Hardness HRC
≤ 2”	Simple	Vacuum	1200°F, equalize 1550°F, equalize	1885°F	30 minutes	4-5 bar; cool to 150°F	70-90	Twice at 480°F	50-52
≤ 2”	Complex	Vacuum	1200°F, equalize 1550°F, equalize	1885°F	30 minutes	2-3 bar: cool to 150°F – or - 4-5 bar; step quench between 1000-700°F (Δ T=200°F min.); continue forced quenching. Temper immediately when tool core reaches 150°F.	70-90	Twice at 480°F	50-52
2” – 4”	All	Vacuum	1200°F, equalize 1550°F, equalize	1885°F	30 minutes	4-5 bar; step quench between 1000-700°F (Δ T=200°F min.); continue forced quenching. Temper immediately when tool core reaches 150°F.	70-90	Twice at 480°F	49-51
4” – 6”	All	Vacuum	1200°F, equalize 1550°F, equalize	1885°F	30 minutes	4-5 bar; step quench between 1000-700°F (Δ T=200°F min.); continue forced quenching. Temper immediately when tool core reaches 150°F.	70-90	Twice at 480°F	47-49
>6”	All	Vacuum	1200°F, equalize 1550°F, equalize	1885°F	30 minutes	4-5 bar; step quench between 1000-700°F (Δ T=200°F min.); continue forced quenching. Temper immediately when tool core reaches 150°F.	Recommendations on case-by-case basis	Recommendations on case-by-case basis*	36-46

*Double temper at 980°F or higher may be necessary to relieve residual stress.

NOTE:

1. Exact heat treatment parameters will change slightly from chemistry to chemistry. Contact the mold material supplier for specific guidelines.
2. These are general guidelines. Heat treatment must be tailored to the actual design of the mold and specified in writing to the heat treater.
3. The required properties for an AISI 420 mold depend upon each specific application.

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