

# Uddeholm Formvar<sup>®</sup>

## Hot Work Tool Steel

	Vacuum/ Atmosphere Furnace / Muffle Furnace/Packed	Salt Bath/Fluidized Bed												
	** Salt Bath heat treatment can be performed but is not recommended for details with blind holes or threaded holes that will not be rework after heat treatment.													
<b>Preheating Temperature</b>	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. 1500-1650°F, equalize Step 1 only for big blocks (cross section above 6")												
<b>Hardening Temperature (Austenitizing)</b>	1830 - 1875°F (Normally 1850°F) For dies greater than 6" in cross section 1850-1870°F is recommended. 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.													
<b>Quenching*</b>	<b>Alt. 1</b> Inert gas, positive pressure <b>Alt. 2</b> Back-filled pressurized gas to 610-840°F, then equalize center and surface (Maximum holding time 30 minutes) Continue forced cooling to 150°F	<b>Alt. 1</b> Oil 175°F until the die is black, then air cool <b>Alt. 2</b> Circulated high speed inert gas												
	<b>Alt. 1</b> Quench in oil 175°F until the die is black <b>Alt. 2</b> Martempering, salt bath or fluidized bed at 840-1020°F or 360-390°F													
	*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.													
<b>Tempering (minimum two times) Temper immediately after quenching when the complete tool reaches 150°F</b>	Hardening Temperature: 1850°F  <table border="1"> <thead> <tr> <th><u>Tempering Temperature</u></th> <th><u>Hardness</u></th> </tr> </thead> <tbody> <tr> <td>1050°F</td> <td>48-52 HRC</td> </tr> <tr> <td>1070°F</td> <td>46-50 HRC</td> </tr> <tr> <td>1090°F</td> <td>44-48 HRC</td> </tr> <tr> <td>1125°F</td> <td>42-46 HRC</td> </tr> <tr> <td>1150°F</td> <td>40-44 HRC</td> </tr> </tbody> </table> Tempering Times: 1 hour per inch of wall thickness, or hold at temperature a minimum of 2 hours.		<u>Tempering Temperature</u>	<u>Hardness</u>	1050°F	48-52 HRC	1070°F	46-50 HRC	1090°F	44-48 HRC	1125°F	42-46 HRC	1150°F	40-44 HRC
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<b>Stress temper performed on hardened tools after EDM; welding with QRO 90 or DIEVAR TIG Rods, or during preventative maintenance.</b>	Check hardness to confirm tool status. <b>Temperature:</b> Shall be 50°F below the lowest tempering temperature. <b>Time:</b> Soak 30 minutes per inch of maximum section with a minimum of 2 hours once tool comes to temperature. Cool in still air for simple shapes. For complex shapes, furnace cool to 800°F, then air cool.  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.													
<b>Dimensional Stability</b>	Average size change as a result of hardening and tempering may not exceed 0.005 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.													

### Characteristics

- Very good temper resistance
- Good response to nitriding
- Good weldability

This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as a warranty of specific properties of the products described or a warranty for fitness for a particular purpose. It is your responsibility to confirm you have the latest revision of this document (verify on our website) and that you forward to your Heat Treatment service provider. Failure to do so may result in inferior material properties. Revision Date: August 19, 2024