

# UDDEHOLM MIRRAX™ ESR

## Premium Mold Steel Enhanced 400 Series Stainless

### General Heat Treatment Recommendations

<p><b>Tooling Preparation</b></p>	<p>Review tool for sharp corners, strong angularity of the tooling, thin to thick transition areas and other aspects of the tool preparation which could affect heat treatment performance. Inspect for welding marks, braze joints, grinding burns, or Electro Discharge Machining indications. If steel has been welded, reanneal the steel per the MIRRAX ESR Data Sheet Guidelines.</p> <p>A minimum 3/16 inch (.1875 inch) radii should be considered on internal radii prior to heat treatment, to permit the best quench rate for the process.</p>	
<p><b>Heat Treatment</b></p>	<p><b>Vacuum: min 4-5 bar overpressure is recommended or similar cooling rate</b></p>	<p><b>High Speed Gas/Circulating Atmosphere</b></p>
<p><b>Preheating Temperature</b></p>	<p><b>Blocks &lt; 12 inches thick</b> 1. Bring up to 1200°F, equalize 2. Heat up to 1550°F, equalize</p>	<p>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")</p>
<p><b>Hardening Temperature Austenitizing</b></p>	<p>1830–1880°F (Normally 1870°F) For tooling greater than 8" in cross section 1830°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.</p>	
<p><b>Quenching</b></p>	<p><b>Alt. 1</b> Inert gas, positive pressure; direct quench <b>Alt. 2</b> Inert gas, positive pressure; interrupted quench.</p>	<p><b>Alt. 1</b> Oil 150°F until the die is black, then air cooling. <b>Alt. 2</b> Circulated inert gas. <b>Alt. 3</b> Circulated air.</p> <ul style="list-style-type: none"> <li>▪ Temper immediately after quenching when the tool or part reaches 150°F.</li> <li>▪ For maximum dimensional stability sub-zero treatment can be applied immediately after quench. Avoid intricate shapes due to the risk of cracking.</li> </ul>
<p><b>Tempering (minimum two times)</b> Avoid high hardening temperature (1880°F) in combination with low (&lt;480°F) tempering temperature. Tempering at high temperatures (&gt;1020°F) may be necessary to relieve residual stresses for large/complex tools.</p>	<p style="text-align: center;"><b>Temperature</b></p> <p style="text-align: center;">970°F 1020°F 1150°F 1200°F</p> <p><b>Time:</b> 1 hour per inch of wall thickness, or hold at temperature a minimum of two hours.</p> <ul style="list-style-type: none"> <li>▪ Tempering at 480-570°F (250-300°C) results in the best combination of toughness, hardness and corrosion resistance. However for very large molds, complicated designs, or for minimum size change a high tempering temperature is recommended. Consult Bohler-Uddeholm before using.</li> </ul>	<p style="text-align: center;"><b>Hardness</b></p> <p style="text-align: center;">49-51 HRC 42-44 HRC 36-38 HRC 33-35 HRC</p>
<p><b>Stress Temper performed on hardened tools after EDM; welding or during preventative maintenance.</b></p>	<p>Check hardness to confirm tool status. <b>Temperature:</b> Shall be 50°F (28°C) below the highest 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.</p>	
<div style="border: 2px solid blue; padding: 5px; width: fit-content;"> <p><b>IMPORTANT: ALLOW FOR SIZE CHANGE</b></p> </div>	<p>Expect shrinkage of the dimensions when performing low temperature tempers (when tempered below 950°F). When tempering above 950°F, expect growth. Manufacture with enough machining allowance to compensate for dimensional changes. Use 0.003 inch/inch/maximum dimension overall as a guideline provided that a stress relief; is performed between rough and semi-finished machining. Please see the MIRRAX ESR Data Sheet for further details.</p>	

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.