Thermodur® 2367 Superclean

DESCRIPTION
Thermodur® 2367 Superclean is an electroslag remelted (ESR) hot work die steel developed for applications where high temperature properties (tensile strength & thermal conductivity) are required to resist thermal fatigue and tempering.

CHARACTERISTICS
- Excellent resistance to heat checking
- Excellent resistance to wear (erosion & abrasion)
- Excellent high-temperature strength
- Good tempering resistance
- Good toughness

APPLICATIONS
- High pressure die casting dies
- Hot forging dies
- Hot extrusion tooling
- Forming dies
- Plastic molds
- Mandrels

MECHANICAL PROPERTIES

<table>
<thead>
<tr>
<th>Hardness HRC</th>
<th>T.S (0.2%) Ksi</th>
<th>Y.S. Ksi</th>
<th>EL (%)</th>
<th>RA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>267</td>
<td>225</td>
<td>12</td>
<td>35</td>
</tr>
<tr>
<td>48</td>
<td>234</td>
<td>193</td>
<td>13</td>
<td>38</td>
</tr>
<tr>
<td>44</td>
<td>203</td>
<td>171</td>
<td>12</td>
<td>40</td>
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</tbody>
</table>

CHEMISTRY

<table>
<thead>
<tr>
<th>Typical Analysis %</th>
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<tbody>
<tr>
<td>C</td>
</tr>
<tr>
<td>Si</td>
</tr>
<tr>
<td>S</td>
</tr>
<tr>
<td>Cr</td>
</tr>
<tr>
<td>Mo</td>
</tr>
<tr>
<td>V</td>
</tr>
</tbody>
</table>

PHYSICAL PROPERTIES

(Hardened to 46 HRc)
- Density: 0.282 lbs/in³ (room temperature)
- Coefficient of Thermal Expansion:
  - 70 °F – 200 °F: 6.6 x 10⁻⁶/°F
  - 70 °F – 400 °F: 6.9 x 10⁻⁶/°F
  - 70 °F – 750 °F: 7.0 x 10⁻⁶/°F
- Thermal Conductivity:
  - 70 °F: 206 Btu/in²/ft²/hr/°F
  - 650 °F: 235 Btu/in²/ft²/hr/°F
  - 1300 °F: 245 Btu/in²/ft²/hr/°F

HEAT TREATMENT

Soft Annealing
- Temperature: 1345 °F - 1435 °F
- Cooling: Furnace 20 °F/hour to 1200 °F then air cool.
- Hardness: 235 HB Max

Stress Relieving
- Temperature: 1200 °F for 2 hours
- Cooling: Cool slowly to 920 °F in air
- Hardness: 230 HB Max

Hardening (Refer to TTT Diagram on Page 3)
- Temperature: 1875 °F - 1920 °F
- Cooling: Vacuum quench at
- Hold at temperature: 50 °F/min. to 1000 °F
- Hold for 30 minutes: Quenched then cool to below 150 °F
- Hardness: 55 HRc Max

SCHMOLZ + BICKENBACH
Providing special steel solutions
Thermodur® 2367 Superclean

**TEMPERING DIAGRAM**

<table>
<thead>
<tr>
<th>Cooling Curve Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness (HV 10)</td>
<td>690</td>
<td>673</td>
<td>665</td>
<td>627</td>
<td>620</td>
<td>620</td>
<td>634</td>
<td>606</td>
<td>606</td>
<td>554</td>
<td>548</td>
<td>525</td>
</tr>
<tr>
<td>Hardness (HRc approx.)</td>
<td>62</td>
<td>61</td>
<td>59</td>
<td>58</td>
<td>58</td>
<td>59</td>
<td>57</td>
<td>57</td>
<td>57</td>
<td>54</td>
<td>54</td>
<td>53</td>
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</tbody>
</table>

**TEMPERING (SEE DIAGRAM ON PAGE 3)**

<table>
<thead>
<tr>
<th>Temperature °F</th>
<th>Hardness HRc</th>
</tr>
</thead>
<tbody>
<tr>
<td>» 752</td>
<td>» 52</td>
</tr>
<tr>
<td>» 932</td>
<td>» 55</td>
</tr>
<tr>
<td>» 1022</td>
<td>» 55</td>
</tr>
<tr>
<td>» 1112</td>
<td>» 52</td>
</tr>
<tr>
<td>» 1202</td>
<td>» 45</td>
</tr>
<tr>
<td>» 1292</td>
<td>» 36</td>
</tr>
</tbody>
</table>

» Tempering hardness is approximate and based on two hours at temperature.
» In order to achieve faster quench rates, generous radii and machining stock should be left on during rough machining.
» Optimal heat treatment parameters should be followed to achieve maximum potential die life.
» Please contact your SCHMOLZ + BICKENBACH heat treat representative for more detailed information.

**WELDING**

Thermodur® 2367 Superclean can be welded in an annealed or hardened condition. TIG (Tungsten Inert Gas) should preferably be used. Use AISI H-13 Rod

**WELDING GUIDELINES**

<table>
<thead>
<tr>
<th>Process</th>
<th>Tig/MMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>D.C</td>
</tr>
<tr>
<td>Amperage (A)</td>
<td>100 - 150</td>
</tr>
<tr>
<td>Electrode</td>
<td>Tungsten Thorium</td>
</tr>
<tr>
<td>Electrode Diameter</td>
<td>0.10 - 0.17</td>
</tr>
<tr>
<td>Protective Gas</td>
<td>Argon</td>
</tr>
<tr>
<td>Flow (L/mm)</td>
<td>10</td>
</tr>
<tr>
<td>Filler Rod</td>
<td>AISI H-13</td>
</tr>
</tbody>
</table>

**WELDING TEMPERATURES**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Annealed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preheat Temp.</td>
<td>620 - 900 °F</td>
</tr>
<tr>
<td>Maintained Temp.</td>
<td>Above 600 °F</td>
</tr>
<tr>
<td>during welding</td>
<td></td>
</tr>
<tr>
<td>Cooled Down to:</td>
<td>150 °F</td>
</tr>
<tr>
<td>Stress Relieve</td>
<td>1050 °F for 2 hours of</td>
</tr>
<tr>
<td></td>
<td>30 - 50 °F below previous tempering temperature</td>
</tr>
</tbody>
</table>

**POLISHING**

For highly cosmetic applications, the tool should be heat treated to the highest hardness possible. Size of the tool will determine the maximum hardness. A-1 polish is achievable when proper procedures are followed. A SCHMOLZ + BICKENBACH representative should be consulted when determining the proper hardness.
Thermodur® 2367 Superclean

TECHNICAL DATASHEET

TIME-TEMPERATURE-TRANSFORMATION DIAGRAM

AUSTENITIZING TEMPERATURE 1875 °F - 1920 °F

INDUSTRY STANDARDS

Thermodur® 2367 Superclean meets or exceeds the following standards:
- NADCA #207-2006
- Ford Motor Company AMTD-DC2010

TEMPERING DIAGRAM
NORTH AMERICAN DISTRIBUTION

HEADQUARTERS + TECHNICAL SUPPORT

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Mahwah, NJ 07430

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