HOT WORK TOOL STEELS

Available Product Shapes

- Long Products
- Open Die Forgings
- Plates

Product Description

Heavy duty hot work tools and dies, mainly for light alloy processing: mandrels, dies, and containers for metal tube and rod extrusion; hot extrusion equipment; tools and dies for the manufacture of hollow bodies, screws, rivets, nuts and bolts. Die casting equipment, forming dies, die inserts, hot shear blades, and plastic moulding dies.

Properties

- Good toughness & ductility
- High wear resistance
- Very good machinability
- High hot hardness
- Good polishability
- Good thermal conductivity
- Good micro-cleanliness
- Coatable
- Can be nitrated

Applications

- Blow Molding
- General Components for Mechanical Engineering
- Injection Molding
- Press Hardening / Hot Stamping
- Mechanical Engineering / Machine Building General

- Extrusion
- Gravity / Low Pressure Die-Casting
- Machine knife (for producers)
- Progressive Forging (Hatebur)
- Forging (Hot / Semi-hot)
- High Pressure Die-Casting
- Oth. Automotive components (Turbochargers, Piston Rings, Sensors, etc.)
- Tool Holders (milling, drilling, turning & chucks)

Material designation

<table>
<thead>
<tr>
<th>Material designation</th>
<th>Standards</th>
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<tbody>
<tr>
<td>1.2344 SEL</td>
<td>4957 EN ISO</td>
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<tr>
<td>T20813 UNS</td>
<td>G4404 JIS</td>
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<td>X40CrMoV5-1 EN</td>
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<td>H13 AISI</td>
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<tr>
<td>SKD61 JIS</td>
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Chemical composition

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<tr>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>Cr</th>
<th>Mo</th>
<th>V</th>
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<tr>
<td>0.39</td>
<td>1.10</td>
<td>0.40</td>
<td>5.20</td>
<td>1.30</td>
<td>0.95</td>
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Material characteristics

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<tr>
<th></th>
<th>High temperature strength</th>
<th>High temperature toughness</th>
<th>High temperature wear resistance</th>
<th>Machinability</th>
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<tr>
<td><strong>BÖHLER W302</strong></td>
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<td><strong>BÖHLER W300</strong></td>
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<td><strong>BÖHLER W360</strong></td>
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<td><strong>VMR</strong></td>
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Delivery condition

**Annealed**
- Hardness: max. 205 HB

**Hardened and Tempered**
- Hardness: 40 - 55 HRC | bars hardened and tempered (BHT)

Heat treatment

**Annealing**
- Temperature (°C / °F): 750 / 1382 - 800 / 1472
  - Slow controlled cooling in furnace at a rate of 50 to 68 °F/hr (10 to 20 °C/hr) down to approx. 1112°F (600 °C), further cooling in air.

**Stress relieving**
- Temperature (°C / °F): 600 / 1112 - 650 / 1202
  - Slow cooling in furnace. Intended to relieve stresses set up by extensive machining, or in complex shapes. After through heating, hold in neutral atmosphere for 1 - 2 hours.

**Hardening and Tempering**
- Temperature (°C / °F): 1020 / 1868 - 1080 / 1976
  - Oil, salt bath 932-1022°F (500 - 550 °C), air, vacuum. Holding time after temperature equalization: 15 to 30 minutes. After hardening, tempering to the desired working hardness, see tempering chart.
Heat treatment sequence

Continuous cooling CCT curves

Austenitising temperature: 1020°C (1868°F)
Holding time: 15 minutes

Vickers hardness
1...35 phase percentages
0.4...18 cooling parameter, i.e. duration of cooling from 800 - 500°C (1472-932°F) in s x 10⁻²
5...1 K/min cooling rate in K/min in the 800 - 500°C (1472-932°F) range
Quantitative phase diagram

Tempering chart

Tempering:

Slow heating to tempering temperature immediately after hardening / time in furnace 1 hour for each 0.787 inch (20 mm) of workpiece thickness but at least 2 hours / cooling in air. It is recommended to temper at least twice. A third tempering cycle for the purpose of stress relieving may be advantageous.

1st tempering approx. 86°F (30°C) above maximum secondary hardness.

2nd tempering to desired working hardness. The tempering chart shows average tempered hardness values.

3rd for stress relieving at a temperature 86 to 122 °F (30 to 50°C) below highest tempering temperature.

Hardening temperature: 1050°C (1922°F)
Specimen size: square 50 mm
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Physical Properties at 20°C / 68°F

<table>
<thead>
<tr>
<th>Property</th>
<th>Density</th>
<th>Specific heat</th>
<th>Spec. electrical resistance</th>
<th>Modulus of elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.8 / 0.28</td>
<td>460 / 109.87</td>
<td>0.52 / &lt;0.001</td>
<td>215 / 31.18</td>
</tr>
<tr>
<td></td>
<td>[kg/dm³ / lb/in³]</td>
<td>[J/(kg.K) / BTU (IT) lb/F]</td>
<td>[Ohm.mm²/m / Ohm.inch²/ft]</td>
<td>[10⁴N/mm² / 10⁴ksi]</td>
</tr>
</tbody>
</table>

Thermal Expansions

<table>
<thead>
<tr>
<th>Temperature (°C / °F)</th>
<th>100 / 212</th>
<th>200 / 392</th>
<th>300 / 572</th>
<th>400 / 752</th>
<th>500 / 932</th>
<th>600 / 1112</th>
<th>700 / 1292</th>
</tr>
</thead>
</table>

For more information see www.voestalpine.com/bohler-edelstahl