Daido’s Hot Work Die Steel Series

**DHA-HS1**

**Features**

- **High thermal conductivity**: With high thermal conductivity of approx. 36(W/m·K) at room temperature, DHA-HS1 helps reducing cooling time of dies and steel sheets.
- **High hardness**: Practical hardness of up to 54 HRC can be obtained at a wide range of tempering temperatures. Surface treatment can also be applied.
- **High softening resistance**: DHA-HS1 retains high hardness at elevated temperatures when in contact with hot steel sheets.

**Physical properties**

- **Thermal expansion rate**
  - **W/m·K**: 36.3
  - Accuracy of repeated measurements is about ±1.8%

- **Specific heat**
  - **W/kg·K**: 49.5
  - **W/kg·K**: 56.1
  - **W/kg·K**: 59.9
  - **W/kg·K**: 62.6
  - **W/kg·K**: 69.2
  - **W/kg·K**: 75.7
  - **W/kg·K**: 85.4
  - **W/kg·K**: 107.2

- **Young’s modulus, Rigidity modulus, Poisson’s ratio**
  - **Young’s modulus**: 208 GPa
  - **Rigidity modulus**: 82 GPa
  - **Poisson’s ratio**: 0.27

**Heat treatment**

<table>
<thead>
<tr>
<th>Re-forging Temperature (°C)</th>
<th>Heat treatment (°C)</th>
<th>Heat treatment (°C)</th>
<th>Hardness</th>
<th>Transformation Temp. (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900 ~ 1200</td>
<td>Annealing</td>
<td>Quenching</td>
<td>Tempering</td>
<td>Annealed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Quenched &amp; tempered</td>
</tr>
<tr>
<td></td>
<td>820 ~ 870</td>
<td>650 ~ 700</td>
<td>550 ~ 670</td>
<td>Ac</td>
</tr>
<tr>
<td></td>
<td>Slow cooling +</td>
<td>Air cooling</td>
<td></td>
<td>45 ~ 54 HRC</td>
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<tr>
<td></td>
<td>650 ~ 700</td>
<td></td>
<td></td>
<td>725 ~ 790</td>
</tr>
<tr>
<td></td>
<td>Air cooling</td>
<td></td>
<td></td>
<td>230 (Austenitized at</td>
</tr>
<tr>
<td></td>
<td>(≥ 6bar)</td>
<td></td>
<td></td>
<td>1030°C)</td>
</tr>
</tbody>
</table>

**Notice**

- Please be careful of quenching crack on the cooling.
- Please ask for our advise when you heat-treat for the first time in order to avoid unexpected trouble.

**Notes**

- DHA is a registered trademark or trademark of Daido Steel Co., Ltd.
- **Material**: The steels included in this brochure are the representative values based on the result of our measurements, and do not guarantee the performance in use of the products.
- **Condition**: The material and information to be used in our department is a range as the information of this brochure is updated without previous notice.
Properties

**Tempering hardness curves**
- Specimen: 10x15x15mm, Quenching: 1800°C, Gas cooling

**Softening resistance**
- Specimen: 10x15x15mm, Quenching: 1800°C, Gas cooling

**Thermal conductivity and Hot stamping test results**
- Specimen: 10x15mm, Quenching: 1800°C, Gas cooling

**Test die and Hot stamping test method**
- Press conditions: Cycle time 3.09pm
- Holding time at the bottom dead center: 6.0sec
- Steal sheet temperature at the start of pressing: approx. 850°C
- Cooling condition: Coolant temperature: approx. 18°C
- Location of water line: approx. 10mm from the die surface
- Evaluation: Thermocouple position: Lower die: approx. 5mm from the die surface

**CCT diagram**
- Austenizing temp.: 1800°C ± 15mm

**Relation between Quenching cooling rate and Hardness after tempering**
- Specimen: 10x15x15mm, Quenching: 1800°C, Gas cooling

**Sheet surface temperature immediately after opening die**
- A steel sheet cooling rates increase in quenching.

**Die temperature during pressing**
- A die temperature in consecutively forming falls quickly.

**Hardness distribution**
- Hardness can be secured up to the center.

**Dimensional change**
- Specimen: 10x15x15mm, Quenching: 1800°C, Gas cooling

**Mechanical properties at R.T.**
- Hardness (HRC) 53
- Tensile strength (MPa) 1,973
- 0.2% Yield strength (MPa) 1,787
- Charpy Impact values (J/cm²) 17
- Fracture toughness (MPa·m²) 35

**Fatigue properties**
- Applied stress (MPa)