Higher hardness after heat treatment than SKD11

A hardness of HRC 62-63 is secured after tempering at high temperatures (520-530°C). Therefore, DC53 exceeds SKD11 in strength and wear resistance.

Double the toughness of SKD11

DC53 has relatively well-performing toughness among all cold die steels. Therefore, tools and dies made of DC53 are less faced with the problems such as cracking and chipping, which often seriously affect conventional tools and dies, and enjoy greater durability.

Less residual stress after wire electro-discharge machining

Residual stress is lessened by means of high-temperature tempering. Therefore, problems such as cracking and distortion are prevented during and after wire electro-discharge machining.

Excellent machinability and grindability

DC53 is superior to SKD11 in machinability and grindability. Therefore, the use of DC53 is expected to provide relatively longer tool life and reduces the number of processes in die making.

Features

Applications

1. Precision press dies
2. Plastic forming tools for hard-to-work materials
3. Other

Stabilization Treatment

It is possible to control dimensional change with time by additional stabilization treatment (250°C–400°C) after high-temperature tempering.

The best temperature of stabilization treatment is 400°C.

Heat Treatment vs. Properties

<table>
<thead>
<tr>
<th>Heat Treatment</th>
<th>Dimensional change with time</th>
<th>Dimensional change in HT</th>
<th>Dimensional change in W-EDM</th>
<th>Hardness (HRC)</th>
<th>Toughness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>60-61</td>
<td></td>
</tr>
<tr>
<td>T : 180 - 200°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>60-61</td>
<td></td>
</tr>
<tr>
<td>T : 500°C  TWICE</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>61-63</td>
<td></td>
</tr>
<tr>
<td>T : 500 - 540°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>60-63</td>
<td></td>
</tr>
<tr>
<td>T : 500 - 540°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ 400°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Higher hardness after heat treatment than SKD11

A hardness of HRC 62-63 is secured after tempering at high temperatures (520-530°C). Therefore, DC53 exceeds SKD11 in strength and wear resistance.

Double the toughness of SKD11

DC53 has relatively well-performing toughness among all cold die steels. Therefore, tools and dies made of DC53 are less faced with the problems such as cracking and chipping, which often seriously affect conventional tools and dies, and enjoy greater durability.

Less residual stress after wire electro-discharge machining

Residual stress is lessened by means of high-temperature tempering. Therefore, problems such as cracking and distortion are prevented during and after wire electro-discharge machining.

Excellent machinability and grindability

DC53 is superior to SKD11 in machinability and grindability. Therefore, the use of DC53 is expected to provide relatively longer tool life and reduces the number of processes in die making.

Applications

1. Precision press dies
   - Wire discharge processed press dies for fine blanking, composite processing, etc.
2. Plastic forming tools for hard-to-work materials
   - Dies for cold forging, deep drawing, and thread rolling
3. Other
   - High-speed blanking punches, stainless steel sheet punches

Physical Properties

- Coefficient of expansion (× 10^-3 / °C): -150°C: 13.0, -200°C: 13.5, -300°C: 14.2
- Thermal conductivity (cal/cm·sec·°C): 100°C: 0.037, 200°C: 0.060, 300°C: 0.064, 400°C: 0.064, 500°C: 0.065
- Young's modulus (E): 21,700 (kgf/mm²)
- Modulus of rigidity (G): 8,480 (kgf/mm²)
- Poisson's ratio (v): 0.28

Stabilization Treatment

It is possible to control dimensional change with time by additional stabilization treatment (250°C–400°C) after high-temperature tempering.

The best temperature of stabilization treatment is 400°C.

Heat Treatment vs. Properties

<table>
<thead>
<tr>
<th>Heat Treatment</th>
<th>Dimensional change with time</th>
<th>Dimensional change in HT</th>
<th>Dimensional change in W-EDM</th>
<th>Hardness (HRC)</th>
<th>Toughness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>60-61</td>
<td></td>
</tr>
<tr>
<td>T : 180 - 200°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>60-61</td>
<td></td>
</tr>
<tr>
<td>T : 500°C  TWICE</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>61-63</td>
<td></td>
</tr>
<tr>
<td>T : 500 - 540°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>60-63</td>
<td></td>
</tr>
<tr>
<td>T : 500 - 540°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ 400°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Higher hardness after heat treatment than SKD11

A hardness of HRC 62-63 is secured after tempering at high temperatures (520-530°C). Therefore, DC53 exceeds SKD11 in strength and wear resistance.

Double the toughness of SKD11

DC53 has relatively well-performing toughness among all cold die steels. Therefore, tools and dies made of DC53 are less faced with the problems such as cracking and chipping, which often seriously affect conventional tools and dies, and enjoy greater durability.

Less residual stress after wire electro-discharge machining

Residual stress is lessened by means of high-temperature tempering. Therefore, problems such as cracking and distortion are prevented during and after wire electro-discharge machining.

Excellent machinability and grindability

DC53 is superior to SKD11 in machinability and grindability. Therefore, the use of DC53 is expected to provide relatively longer tool life and reduces the number of processes in die making.

Applications

1. Precision press dies
   - Wire discharge processed press dies for fine blanking, composite processing, etc.
2. Plastic forming tools for hard-to-work materials
   - Dies for cold forging, deep drawing, and thread rolling
3. Other
   - High-speed blanking punches, stainless steel sheet punches

Physical Properties

- Specific gravity (g/cm³): 7.87
- Coefficient of expansion (× 10^-3 / °C): -150°C: 13.0, -200°C: 13.5, -300°C: 14.2
- Thermal conductivity (cal/cm·sec·°C): 100°C: 0.037, 200°C: 0.060, 300°C: 0.064, 400°C: 0.064, 500°C: 0.065
- Young's modulus (E): 21,700 (kgf/mm²)
- Modulus of rigidity (G): 8,480 (kgf/mm²)
- Poisson's ratio (v): 0.28

Stabilization Treatment

It is possible to control dimensional change with time by additional stabilization treatment (250°C–400°C) after high-temperature tempering.

The best temperature of stabilization treatment is 400°C.

Heat Treatment vs. Properties

<table>
<thead>
<tr>
<th>Heat Treatment</th>
<th>Dimensional change with time</th>
<th>Dimensional change in HT</th>
<th>Dimensional change in W-EDM</th>
<th>Hardness (HRC)</th>
<th>Toughness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>60-61</td>
<td></td>
</tr>
<tr>
<td>T : 180 - 200°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>60-61</td>
<td></td>
</tr>
<tr>
<td>T : 500°C  TWICE</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>61-63</td>
<td></td>
</tr>
<tr>
<td>T : 500 - 540°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 H : 1030°C</td>
<td></td>
<td>△</td>
<td></td>
<td>60-63</td>
<td></td>
</tr>
<tr>
<td>T : 500 - 540°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ 400°C</td>
<td></td>
<td>▲</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Our newly developed cold die steel, DC53, is an improvement over the alloy tool steel SKD11 specified in Japanese Industrial Standard (JIS) G4404. It eliminates the disadvantage of insufficient hardness and toughness, resulting from high-temperature tempering found with SKD11, and is intended to replace SKD11 in use for general purposes and precision dies.

### Heat Treatment

**Quenching hardness curve**

![Quenching hardness curve](image)

**Quenching & tempering hardness curve**

![Quenching & tempering hardness curve](image)

#### [Standard Heat Treatment Conditions]

**Usual quenching**

- **Quenching**
  - 1020~1040°C
  - 800~850°C
  - 500°C hot bath
  - Air or oil-cooling
  - Holding time: 1hr.
  - As quenched
  - Standard heating time (salt bath)
    - Dia. thickness (mm)
    - Thickness below 100mm
      - 5
      - 10
      - 20
    - Thickness over 100mm
      - 10
      - 20
      - 50
      - 100
      - Air-cooling
      - 5~8hr
      - 5~10hr
      - 15~20hr
      - 20~25hr
      - 20~40hr

**Tempering**

- Low-Temperature: 180~200°C
- High-Temperature: 500~550°C
- Air-cooling
- 60~90min/25mm
- Repeated twice

**Vacuum quenching**

- **Quenching**
  - 1020~1040°C
  - 800~850°C
  - 500°C hot bath
  - Gas-cooling

### Quality Characteristics

**Relationship Between Tempering Temperature and Impact Value**

![Relationship Between Tempering Temperature and Impact Value](image)

**Abrasion Test (Ohgoshi Method)**

![Abrasion Test (Ohgoshi Method)](image)

**Durability of Drilling Tool**

![Durability of Drilling Tool](image)

**Dimensional Changes due to Heat Treatment**

![Dimensional Changes due to Heat Treatment](image)

**Relationship Between Hardness and Impact Value**

![Relationship Between Hardness and Impact Value](image)

**Retained austenite (%)**

![Retained austenite (%)](image)