1. Main characteristics and applications

Steel with high level wear properties associated with insensitivity to thermal fatigue: this steel can be air hardened which makes it possible to reduce distortions caused by heat treatment.

Amongst the properties of this steel, it is worth remembering that it also possesses excellent toughness and is therefore suitable for use in particularly severe operating condition.

This steel is used to construct:
• dies for the pressure casting of light alloys
• moulds for plastic materials
• dies for friction and mechanical presses for hot forming of steels, brass, aluminum and its alloys
• dies for extrusion aluminum
• hot work shear blades

To raise the duration of the equipments we remember that this steel can be submitted to surface hardening thermo chemical treatments on the tools as nitrided (ion - saline - gaseous). Before machining, the tools must be preheated to a temperature range of between 250 - 300 °C.

2. Comparable standards

<table>
<thead>
<tr>
<th>UNI</th>
<th>W.Nr</th>
<th>DIN</th>
<th>AFNOR</th>
<th>AISI/SAE</th>
<th>BS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(X37CrMoV51KU) 12343</td>
<td>X38CrMoV5.1</td>
<td>Z38CDV5</td>
<td>H11</td>
<td>BH11</td>
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3. Chemical analysis

<table>
<thead>
<tr>
<th>C</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>Mo</th>
<th>Ni</th>
<th>V</th>
<th>P+S</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.36</td>
<td>0.30</td>
<td>0.90</td>
<td>4.80</td>
<td>1.10</td>
<td>0.30</td>
<td>0.015</td>
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<tr>
<td>0.42</td>
<td>0.50</td>
<td>1.20</td>
<td>5.50</td>
<td>1.40</td>
<td>0.50</td>
<td>0.015</td>
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</tr>
</tbody>
</table>

4. Critical points

Ac₁  840 °C
Ms   310 °C

5. Supply Conditions

Annealed HB max 230

6. Heat treatments

Isothermal annealing
• Heat to 880 °C, hold at temperature for 1/2 h to 1 h
• Furnace cooling to 780 °C and hold at temperature for at least 5 hours
• Cool by 10 °C/h to 750 °C
• Cooling in air
• Maximum hardness 230 HB

Stress relieving
• To be carried after machining and before final heat treatment
• Heat to 650 - 700 °C hold for 4 - 6 h
• Furnace cooling to 300 - 350 °C
• Cooling in air

Hardening
• Initial preheating to 350 - 450 °C
• Second preheating to 750 - 850 °C
• Heat to hardening temperature in the range 1000 - 1030 °C and hold at temperature
• Cooling in air
• Quenched hardness: 52 - 56 HRC

Tempering
• In the range 556 - 635 °C for at least 3 h according to hardness requirements and condition of use
• Cooling in still air
• Tempering must be repeated a second time at a temperature equal to or 20°C lower than the previous
• Before tempering, the parts must be preheated to 200 - 300°C
### 7 C.C.T. curve

Austenitizing temperature: 1000°C

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>1200</th>
<th>1000</th>
<th>800</th>
<th>600</th>
<th>400</th>
<th>200</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time [s]</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td>100</td>
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</tbody>
</table>

- Carbide precipitations intensity

### 8 Tempering curve

<table>
<thead>
<tr>
<th>Tempering temperature [°C]</th>
<th>Rm [M/mm]</th>
<th>Hardness [HRC]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1600</td>
<td>58</td>
</tr>
<tr>
<td>100</td>
<td>1400</td>
<td>54</td>
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<tr>
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<tr>
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<tr>
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<td>600</td>
<td>44</td>
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<tr>
<td>1100</td>
<td>400</td>
<td>42</td>
</tr>
</tbody>
</table>

- HRC
- Kz