**General comments**

1.4031 is used in the quenched and tempered condition in a host of constructional applications where moderate corrosion and abrasion resistance is required. Due to its higher carbon content, 1.4031 is more hardenable than 1.4028 and as such is suitable for use as a blade material. As for other martensitic grades, optimal corrosion resistance is attained when the steel is in the hardened condition and the surface is finely ground or polished.

**Relevant current and obsolete standards**

<table>
<thead>
<tr>
<th>Standard</th>
<th>1.4031</th>
<th>X39Cr13</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 10088-3</td>
<td>1.4031</td>
<td></td>
</tr>
<tr>
<td>AISI</td>
<td>420</td>
<td></td>
</tr>
<tr>
<td>BS</td>
<td>420S45</td>
<td></td>
</tr>
<tr>
<td>DIN 17440</td>
<td>1.4031</td>
<td></td>
</tr>
<tr>
<td>SIS</td>
<td>2304</td>
<td></td>
</tr>
</tbody>
</table>

**Special grades for particular applications**

- wire drawing grade
- fine wire drawing grade

**General properties**

- corrosion resistance: average
- mechanical properties: very good
- forgeability: good
- weldability: with care
- machinability: average

**Special properties**

- ferromagnetic grade

**Physical properties**

- density (kg/dm³): 7.70
- electrical resistivity at 20 °C (Ω mm²/m): 0.65
- magnetizability: yes
- thermal conductivity at 20 °C (W/m K): 30
- specific heat capacity at 20 °C (J/kg K): 460
- thermal expansion (K⁻¹): 20 – 100 °C: 10.5 x 10⁻⁶
  - 20 – 200 °C: 11.0 x 10⁻⁶
  - 20 – 300 °C: 11.5 x 10⁻⁶
  - 20 – 400 °C: 12.0 x 10⁻⁶

**Typical applications**

- decorative applications and kitchen utensils
- medical and pharmaceutical industry
- mechanical engineering
- cutlery and blades

**Processing properties**

- automated machining: yes
- machinable: yes
- hammer and die forging: yes
- cold forming: no
- cold heading: no
- suited to polishing: yes

**Conditions**

- annealed, tempered

**Demand tendency**

- rising

**Corrosion resistance**

PRE = 12.5 – 14.5

Good corrosion resistance in moderately corrosive environments that are free of chlorides, such as soaps, detergents and organic acids. Optimal corrosion resistance is obtained in the hardened condition with a polished surface finish. From a corrosion point of view, 1.4031 displays a slightly improved resistance to corrosion than 1.4028. This is due to the slightly higher chromium content which sufficiently compensates for the removal of more chromium from solution, due to the increased carbon content, and the development of a more highly stressed microstructure in 1.4031.
**Heat treatment and mechanical properties**

1.4031 can be soft annealed by holding at a temperature in the range 750 °C to 850 °C followed by slow cooling in an oven or air. In this condition, the following mechanical properties can be expected:

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>tensile strength (N/mm²)</td>
<td><em>Rm</em> ≤ 800</td>
</tr>
<tr>
<td>hardness</td>
<td>HB ≤ 245</td>
</tr>
</tbody>
</table>

Note: the HB values could be 60 units higher and the tensile strengths 150 N/mm² higher due to cold work during straightening of profiles ≤ 35mm.

1.4031 can be hardened by holding at a temperature between 950 °C – 1050 °C followed by cooling in air or oil. Care must be taken to ensure that the time at the hardening temperature is sufficient to take any carbides that might be present into solution.

After hardening and stress relieving at 200 °C, the hardness should not exceed 52 HRC (520 HB).

The tempering temperature is dependent on the desired strength. Due to the precipitation of undesirable phases, the temperature range 400 °C to 600 °C should be avoided.

The mechanical properties (d ≥ 160 mm) have to be agreed on for thicker dimensions, or the delivered product is based on the values given.

**Welding**

In general, 1.4031 is not welded.

**Forging**

Gradual heating to a temperature of about 800 °C is recommended prior to more rapid heating to a temperature of between 1050 °C and 1100 °C. Forging then takes place between 1100 °C – 800 °C followed by slow cooling in an oven or in dry ash or similar material to promote slow cooling.

**Machining**

The machinability of this grade of stainless steel is directly related to its hardness. 1.4031 machines similar to carbon steels of the same hardness. Although it must be realised that the machining parameters will vary depending on the structure/hardness of the steel, the following parameters can be used as a guideline when machining with coated hardmetal tools:

<table>
<thead>
<tr>
<th>Depth of cut (mm)</th>
<th>6</th>
<th>3</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed rate (mm/r)</td>
<td>0.5</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Annealed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Rm</em> 650 – 750 N/mm²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tempered</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Rm</em> 850 – 950 N/mm²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutting speed (m/min)</td>
<td>140</td>
<td>170</td>
<td>190</td>
</tr>
<tr>
<td>Cutting speed (m/min)</td>
<td>145</td>
<td>190</td>
<td>225</td>
</tr>
</tbody>
</table>