Stainless chromium steel for razor blades
**Razor blade steel**

**Sandvik 13C26**

For more than eighty years Sandvik Materials Technology has manufactured stainless strip steel. The knowledge and experience which we have gained is invested in the active and ongoing development of our products.

With our own metallurgy and strip production, we control the whole production chain from steel melt to finished product, using the latest, most reliable technology.

Sandvik 13C26 is a martensitic stainless chromium steel used mainly for razor blades.

**Forms of supply, finishes and dimensions**

Razor blade steel, Sandvik 13C26, is supplied as cold rolled strip in coils. The tensile strength is 1070±100 MPa (155±14.5 ksi). The strip is supplied with a dull, very fine surface, slit edges and extra accuracy on straightness. Wide strip is slit into finished sizes in special slitters with cemented carbide tools, which give very high edge quality and very close width tolerances. A corrosion-preventive oil is applied to the strip. Coils are carefully packed, with various packing materials being used, according to customer requirements, destination and method of transport.

**Coil sizes**

Razor blade strip is wound into pancake coils on plastic cores with an inner diameter of 280 mm (11.0 inches). The coils can be supplied in weights between 1 and 5 kg/mm (55-280 lbs PIW) strip width, which means an outer diameter from about 500 to 1000 mm (20-40 inches).

**Width**

Widths range between 5 and 26 mm (0.2 – 1.0 inches).

Other dimensions and forms of supply can be produced to meet specific requirements.

<table>
<thead>
<tr>
<th>GRADE</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>P Max</th>
<th>S Max</th>
<th>Cr</th>
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</thead>
<tbody>
<tr>
<td>Sandvik</td>
<td>13C26</td>
<td>0.68</td>
<td>0.4</td>
<td>0.7</td>
<td>0.025</td>
<td>0.010</td>
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</tbody>
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**Dimensions and tolerances**

<table>
<thead>
<tr>
<th>STRIP THICKNESS</th>
<th>THICKNESS TOLERANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>inch</td>
</tr>
<tr>
<td>0.076</td>
<td>0.0030</td>
</tr>
<tr>
<td>0.099</td>
<td>0.0039</td>
</tr>
</tbody>
</table>

Our integrated production, combined with R&D, ensure ongoing product development and our ability to meet customers’ individual requirements.
Microstructure

Unhardened condition ‘as delivered’
In the ‘as delivered’, unhardened condition, Sandvik 13C26 consists of finely dispersed carbides in a ferritic matrix, see figure 1.

The carbides are of type M₂₃C₆, where M stands for iron and chromium. This type of carbide is easily dissolved during heat treatment, which is important for good hardening results. The fine dispersion of the carbides also helps to speed up their dissolution, allowing lower furnace temperatures and higher speeds during hardening.

The ferritic matrix has low contents of carbon and chromium, because these elements are bound in carbides. Since the chromium content in the matrix determines the corrosion resistance of the steel, the material has limited resistance to corrosion in the ‘as delivered’ condition.

Careful process control ensures that the chemical composition can be kept within very close limits, which results in consistent steel properties.

Hardened and tempered condition
After hardening and tempering, Sandvik 13C26 consists of a martensitic matrix with undissolved carbides and some retained austenite, as shown in figure 2. In this condition the steel has good corrosion resistance.

Heat treatment
The recommended heat treatment for Sandvik 13C26 follows the temperature cycle illustrated in figure 3.

During heating [1], or austenitising, the ferrite is transformed into austenite and the carbides are partly dissolved. Because of the carbide dissolution, the contents of carbon and chromium in the matrix increase. The subsequent quenching to room temperature [2] will transform most of the austenite into martensite. During deep freezing of the material to -70°C (-94°F) [3], even more austenite is transformed into martensite. The remainder, about 15%, is known as retained austenite. Finally, since the material is now very brittle, the toughness, and also the hardness, is increased by a tempering treatment [4].

Corrosion resistance
Due to the dissolution of carbides during heating, the chromium content of the matrix increases. Good corrosion resistance is achieved with a chromium content of 11–12%. This is obtained by a heat treatment that leaves about 15% of retained austenite after quenching and deep freezing, see figure 3.

Properties

Hardness
The martensite content and the amount of retained austenite mainly determine the hardness in the hardened and tempered condition. Martensite becomes harder with increasing carbon content. The higher the austenitising temperature, the higher the content of carbon in the subsequently formed martensite.

On the other hand, the more carbon in the matrix at austenitising, the more austenite will be retained after quenching and deep freezing. Since austenite is softer than martensite, this will reduce the hardness.

These two contradictory effects indicate that for Sandvik 13C26, there is an optimum combination of hardening temperature and time. This heat treatment cycle is shown in figure 3.
Further information
Additional technical information can be found in the following brochures/datasheets.
S-333-ENG Strip steel for edge applications
S-300-ENG Special strip steel
S-3822-ENG Sandvik 13C26 knife steel

Figure 3. Temperature cycle for hardening of Sandvik 13C26. [1] 25 seconds above 1000°C (1830°F); 10 seconds at top temperature 1080–1100°C (1975–2010°F). All values are approximate and only for guidance.

| HV 0.3 kg | 340 | – | 720 | 770 | 780 |
| Ferrite, % | 88 | – | – | – | – |
| Carbides, % | 12 | 5 | 5 | 5 | 5 |
| Austenite, % | – | 95 | 25 | 15 | 15 |
| Martensite, % | – | – | 70 | 80 | 80 |

Sandvik Group
The Sandvik Group is a global high technology enterprise with around 300 subsidiary companies, 37,000 employees and activities in more than 130 countries.

Sandvik’s operations are concentrated on its three core businesses of Materials Technology, Tooling and Mining and Construction – areas in which the group holds leading global positions in selected niche markets.

Sandvik Materials Technology
Sandvik Materials Technology is a world-leading supplier of products with extensive added value in advanced metals, special alloys, metallic and ceramic resistance materials as well as process plants based on steel conveyor belts, and sorting systems.

Quality assurance
Sandvik Materials Technology has a quality management system, approved by internationally recognised organisations. We hold for example: ASME Quality System Certificate as a Materials Organisation, approval to ISO 9001 as well as approvals from LRQA, JIS and other organisations as a materials manufacturer.

Environment
Environmental awareness is an integral part of our business and is at the forefront of all activities within our operation. We hold ISO 14001 approval.
Sandvik 13C26 offers the following advantages

- Excellent metallurgical properties
- Close tolerances
- Smooth surface, extra accuracy on flatness and straightness
- Good blanking properties
- Good hardening properties
- Good grinding and honing properties, facilitating the manufacture of high quality edges
- Good corrosion resistance (hardened and tempered condition)
- Consistent material properties from coil to coil, from delivery to delivery