20MnCr5 is a case-hardening steel with low carbon content but good hardenability reaching good wear resistance due to high surface hardness after hardening. The small grain size benefits in good ductility and fatigue strength. Suitable for gearboxes and axle gears.

Ovako 236F is a standard variant with controlled sulphur content for consistent machining properties.

Ovako 236Q is an IQ (isotropic quality) variant.

**IQ-Steel®** (Isotropic Quality) is an isotropic quality ultra clean steel. IQ-Steel is optimized for fatigue strength by a strict control of steel cleanliness. IQ-Steel, a further development of BQ-Steel, is an isotropic and ultra clean steel with properties that match re-melted steels. Based on thousands of examinations by Ovako into the effects of defects on fatigue performance, the metallurgy of IQ-Steel is purer and far more consistent than conventional grades, and designed specifically to perform well in multi axial loading. This enables the manufacturing of lighter, slimmed down components like gears, bearings and other critical parts. The steels are helping our customers to achieve new design solutions and implement higher standards of finished product performance. Key to these practical advantages are Ovako's own unique, clean and consistent modern steelmaking processes that remove harmful inclusions and impurities from within the steel. IQ-Steels contain smaller and more fragmented inclusions and can handle much higher mechanical forces in all directions than conventional steels. IQ-Steels are newer, but already now well established in high pressure automotive applications. Modern diesel engines, with high and cyclic injection pressures, have proven to be an ideal application. Transmission components are another emerging area of strong interest.

For additional Heat Treatment Data, please visit the Heat Treatment Guide.

**Similar designations**

20MnCr5S5, 1.7147, 20MnCr4

**Chemical composition**

<table>
<thead>
<tr>
<th>Variant</th>
<th>Cast</th>
<th>Weldability</th>
<th>C %</th>
<th>Si %</th>
<th>Mn %</th>
<th>P %</th>
<th>S %</th>
<th>Cr %</th>
<th>Ni %</th>
<th>Mo %</th>
<th>Al %</th>
</tr>
</thead>
<tbody>
<tr>
<td>236Q</td>
<td>IC</td>
<td>CEV0.73&lt;sub&gt;max&lt;/sub&gt;</td>
<td>0.17</td>
<td>0.10</td>
<td>1.10</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>0.10</td>
<td>-</td>
<td>0.050</td>
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<tr>
<td></td>
<td></td>
<td>Pcm 0.38&lt;sub&gt;max&lt;/sub&gt;</td>
<td>0.22</td>
<td>0.25</td>
<td>1.30</td>
<td>0.025</td>
<td>0.002</td>
<td>1.20</td>
<td>0.25</td>
<td>0.08</td>
<td>0.200</td>
</tr>
<tr>
<td>236F</td>
<td>IC</td>
<td>CEV0.79&lt;sub&gt;max&lt;/sub&gt;</td>
<td>0.17</td>
<td>0.20</td>
<td>1.10</td>
<td>-</td>
<td>0.015</td>
<td>1.10</td>
<td>-</td>
<td>-</td>
<td>0.020</td>
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<tr>
<td></td>
<td></td>
<td>Pcm 0.4&lt;sub&gt;max&lt;/sub&gt;</td>
<td>0.22</td>
<td>0.35</td>
<td>1.40</td>
<td>0.025</td>
<td>0.025</td>
<td>1.30</td>
<td>0.25</td>
<td>0.08</td>
<td>0.040</td>
</tr>
<tr>
<td>20MnCr5:EN10084</td>
<td>Std</td>
<td>CEV&lt;sub&gt;max&lt;/sub&gt;</td>
<td>0.17</td>
<td>-</td>
<td>1.10</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pcm&lt;sub&gt;max&lt;/sub&gt;</td>
<td>0.22</td>
<td>0.40</td>
<td>1.40</td>
<td>0.025</td>
<td>0.035</td>
<td>1.30</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>
# Mechanical Properties

<table>
<thead>
<tr>
<th>Variant</th>
<th>Condition</th>
<th>Format</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>20MnCr5:EN10084</td>
<td>+S</td>
<td>Round bar</td>
<td>&lt; 255 HB</td>
</tr>
<tr>
<td></td>
<td>+A</td>
<td>Round bar</td>
<td>&lt; 217 HB</td>
</tr>
<tr>
<td></td>
<td>+FP</td>
<td>Round bar</td>
<td>140-187 HB</td>
</tr>
</tbody>
</table>

\[ Rp_{0.2} \text{ } R_{e,t} \] **Ref**

## Transformation temperatures

<table>
<thead>
<tr>
<th>Temperature °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS 385</td>
</tr>
<tr>
<td>AC1 731</td>
</tr>
<tr>
<td>AC3 831</td>
</tr>
</tbody>
</table>

## Heat treatment recommendations

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Condition</th>
<th>Temperature cycle</th>
<th>Cooling/Quenching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot forging</td>
<td></td>
<td>850 - 1 200</td>
<td>Slowly or in air</td>
</tr>
<tr>
<td>Annealing</td>
<td>+A</td>
<td>670 - 710</td>
<td>Slowly (15°C/h) until 600°C</td>
</tr>
<tr>
<td></td>
<td>+FP</td>
<td>950 - 1 000</td>
<td>Quickly to following stage</td>
</tr>
<tr>
<td></td>
<td>+FP</td>
<td>630 - 650</td>
<td>Keeping about 3 hours, after that: in air</td>
</tr>
<tr>
<td>Normalizing</td>
<td></td>
<td>860 - 890</td>
<td>In air</td>
</tr>
<tr>
<td>Stress relieve annealing</td>
<td></td>
<td>650 - 680</td>
<td>In air</td>
</tr>
<tr>
<td>Carburizing</td>
<td></td>
<td>860 - 900</td>
<td>In air</td>
</tr>
<tr>
<td>Hardening</td>
<td></td>
<td>830 - 870</td>
<td>Quenching in oil or water</td>
</tr>
<tr>
<td>Tempering</td>
<td></td>
<td>150 - 200</td>
<td>In air</td>
</tr>
</tbody>
</table>
Hardenability

The hardenability is estimated from cast analysis. The hardenability can be verified with the end quench test if agreed on enquire and order. Jominy hardenability of Ovako 236F: Measured average value with +/-standard deviation. 20MnCr5 :EN10084 is a reference.

Carburizing response

Heat treatment

Steel cleanliness

<table>
<thead>
<tr>
<th>Micro inclusions - steel grade 236F</th>
<th>Macro inclusions - 236F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied standard</td>
<td>ISO 3763</td>
</tr>
<tr>
<td>Sampling</td>
<td>Statistical testing on</td>
</tr>
<tr>
<td></td>
<td>billets.</td>
</tr>
<tr>
<td>Maximum formula</td>
<td>Limits</td>
</tr>
<tr>
<td>Average limits</td>
<td>&lt; 2.5 mm/dm²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Micro inclusions - steel grade 236Q</th>
<th>Macro inclusions - 236Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied standard</td>
<td>ISO 3763</td>
</tr>
<tr>
<td>Sampling</td>
<td>Statistical testing on</td>
</tr>
<tr>
<td></td>
<td>billets.</td>
</tr>
<tr>
<td>Limits</td>
<td>&lt; 10 defects/dm³</td>
</tr>
</tbody>
</table>

Other properties (typical values)

<table>
<thead>
<tr>
<th>Youngs modulus (GPa)</th>
<th>Poisson’s ratio (-)</th>
<th>Shear modulus (GPa)</th>
<th>Density (kg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>210</td>
<td>0.3</td>
<td>80</td>
<td>7800</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average CTE 20-300°C (µm/m°K)</th>
<th>Specific heat capacity 50/100°C (J/kg°K)</th>
<th>Thermal conductivity Ambient temperature (W/m°K)</th>
<th>Electrical resistivity Ambient temperature (µΩm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>460 - 480</td>
<td>40 - 45</td>
<td>0.20 - 0.25</td>
</tr>
</tbody>
</table>
IQ

Inclusion limits IQ-processed steel

Contact us

Would you like to know more about our offers? Don’t hesitate to contact us:

Via e-mail: info@ovako.com

Via telephone: +46 8 622 1300

For more detailed information please visit http://www.ovako.com/en/Contact-Ovako/

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