General

M30NW is an austenitic stainless steel grade for implants. In comparison with the classic 316LVM, the higher chromium, manganese and nitrogen levels in M30NW produce:

- Better corrosion resistance, and thus improved biocompatibility
- Higher mechanical properties after cold working
- Better austenite stability and thus non-magnetic properties even after cold working. These non-magnetic properties allow MRI examination to take place without inconvenience for the patient and with improved image quality.

M30NW is stabilised by niobium because of its relatively high carbon content.

M30NW is manufactured by primary melting, then AOD refining and finally consumable electrode remelting.

Chemical analysis

- C: ≤ 0.06%
- Cr: 21.00%
- Ni: 9.00%
- with Nb addition
- Mn: 4.00%
- Mo: 2.20%
- N: 0.40%

Physical properties

- Density: 7.9 g/cm³ (0.285 lb/in³)
- Coefficient of thermal expansion between 20° C and 200° C (68° and 390° F): 16.6 x 10⁻⁶ m/m °C (9.2 in/(in.°F))
- Relative magnetic permeability < 1.01


**Forging**

- Between 1150 and 950°C (2100°F and 1740°F)

**Machining**

Machining parameters are developed from those for 316LVM. In particular, the following should apply:

- **Turning:**
  - Speed: 25 m/min (80 ft/min)
  - Depth of cut: 0.5 mm (0.02 in)
  - Feed: 0.5 mm/rev (0.02 in/rev)
  - Tool material: carbide, preferably coated

- **Milling:**
  - Speed: 25 m/min (80 ft/min)
  - Depth of cut: 0.2 mm (0.008 in)
  - Feed: 0.01 mm/rev (0.0004 in/rev)
  - Tool material: carbide, preferably coated

Cooling should be abundant and the machine should be rigid and powerful.

**Heat treatment conditions**

Solution treatment - Solution annealing:
- 1050 - 1150 °C (1920°F - 2100°F)
- Rapid cooling, air cool or water quench, depending on the thickness of the parts.

**Mechanical properties**

Mechanical properties on the bars as-delivered are as follows:

<table>
<thead>
<tr>
<th>Condition</th>
<th>UTS</th>
<th>YS</th>
<th>E % (in 5D)</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution treated</td>
<td>850 N/mm²</td>
<td>650 N/mm²</td>
<td>40</td>
<td>270 HB</td>
</tr>
<tr>
<td></td>
<td>125 ksi</td>
<td>95 ksi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold worked</td>
<td>1200 N/mm²</td>
<td>1000 N/mm²</td>
<td>20</td>
<td>350 HB</td>
</tr>
<tr>
<td></td>
<td>175 ksi</td>
<td>145 ksi</td>
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<tr>
<td>Heavily cold worked</td>
<td>/</td>
<td>/</td>
<td>/</td>
<td>≥ 40 HRC</td>
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<tr>
<td>Ø ≤ 15 mm</td>
<td>/</td>
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</table>
Final mechanical properties depend on the amount of cold work. The presence of nitrogen means that the rate of increase in strength with cold work is more rapid than with 316LVM. Graphs of mechanical properties against cold work, and fatigue resistance against yield strength are shown hereafter:

**Graph showing**

% cold work / mechanical properties

<table>
<thead>
<tr>
<th>%</th>
<th>E%</th>
<th>N/mm²</th>
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</thead>
<tbody>
<tr>
<td>10</td>
<td>30</td>
<td>1400</td>
</tr>
<tr>
<td>20</td>
<td>40</td>
<td>1200</td>
</tr>
<tr>
<td>30</td>
<td>50</td>
<td>1000</td>
</tr>
<tr>
<td>40</td>
<td>60</td>
<td>800</td>
</tr>
<tr>
<td>50</td>
<td>70</td>
<td>600</td>
</tr>
</tbody>
</table>

Graph showing

σ fatigue strength / yield strength curves

<table>
<thead>
<tr>
<th>σ</th>
<th>YS</th>
<th>σ</th>
<th>YS</th>
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</thead>
<tbody>
<tr>
<td>800</td>
<td>600</td>
<td>1600</td>
<td>1400</td>
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<tr>
<td>1600</td>
<td>1400</td>
<td>800</td>
<td>600</td>
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</tbody>
</table>
**Referenced Standards**
- ISO 5832 - 9
- ASTM F 1586

**Precautions in use**
As with all austenitic stainless steels, M30NW is subject to sensitization to grain boundary corrosion after hot work between 450°C and 850°C (840°F and 1560°F). M30NW is capable of a high polish. However, the presence of niobium produces fine carbides. In order to achieve a mirror finish it may be necessary to repolish several times. Finally, as with all austenitic stainless steels, a metal/metal friction contact is not recommended due to the tendency for galling.

**Applications**
Thanks to its higher strength and excellent non-magnetic properties, M30NW is tending to replace 316LVM in many applications. Moreover, its better biocompatibility reduces the risk of prosthesis rejection.

M30NW is used in the production of:
- **Joint prostheses**:
  The high mechanical properties result in:
  - More streamlined shapes, allowing more travel and better final product capabilities
  - Thinner section, thus weight decrease

For hip prostheses, results are excellent and the use of M30NW is becoming increasingly widespread.

- **Trauma screws, plates and nails**: better mechanical properties mean thinner sections are possible for the same overall strength of the component.

- **External fixators for traumatology**: non-magnetic properties are particularly beneficial at the initial set-up and subsequent MRI examinations.