From billets to wire rods

<table>
<thead>
<tr>
<th>Product</th>
<th>Diameter (mm)</th>
<th>Tolerances (mm)</th>
<th>Lengths (mm)</th>
<th>Straightness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round Bars</td>
<td>Ø ≤ 20</td>
<td>±0.25</td>
<td>3000 to 6000</td>
<td>0.15% x Ø</td>
</tr>
<tr>
<td></td>
<td>20 &lt; Ø ≤ 40</td>
<td>±1.25% x Ø</td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>40 &lt; Ø ≤ 125</td>
<td>±(0.1 + 1% x Ø)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>125 &lt; Ø ≤ 170</td>
<td>0 / ±3 Ø</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ø &gt; 170</td>
<td>±3 / ±3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flat Bars</td>
<td>Side ≤ 20</td>
<td>±0.20</td>
<td>3000 to 4400</td>
<td>±1.25% C</td>
</tr>
<tr>
<td></td>
<td>20 &lt; C &lt; 40</td>
<td>±1.25% C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40 &lt; C ≤ 70</td>
<td>±(0.1 + 1% C)</td>
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</tr>
<tr>
<td>Square Bars</td>
<td>Side ≤ 20</td>
<td>±0.20</td>
<td>2000 to 6000</td>
<td>±3% C</td>
</tr>
<tr>
<td></td>
<td>200 &lt; C &lt; 310</td>
<td>±2%</td>
<td></td>
<td></td>
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<tr>
<td>Square Billets</td>
<td>Side ≤ 20</td>
<td>±0.20</td>
<td>2000 to 6000</td>
<td>±5%</td>
</tr>
<tr>
<td>Blooms</td>
<td>Thickness: 120 to 220</td>
<td>±3 / ±5</td>
<td>2000 to 6000</td>
<td>4 mm/m</td>
</tr>
<tr>
<td></td>
<td>Width: 140 to 250</td>
<td>±2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In addition to general certifications (ISO 9001, ISO 14001, ISO 18001), our Service Center is certified to the most stringent industry specific standards: ISO 9100 (aero design and manufacturing), ISO 9120 (aero distribution) and AQAP 2110 (NATO). Also, our products are AMS, ABS and ASNA specified.

Aubert & Duval provides metallurgical solutions exhibiting excellent mechanical properties such as hardenability, corrosion resistance, toughness, fatigue performance, high temperature resistance or abrasion resistance. The combination of these advanced mechanical characteristics fulfils the metallurgical requirements for various critical applications:

Aerospace, Energy, Defense, Transportation, Tooling, Specialties
From billets to wire rods

Billets

Flat bars

Square bars

Sheets

Wire rods

PRODUCTS

DIAMETERS (mm)

(Please contact us for other requirements)

Tolerances (mm)

(Black bars)

LENGTHS (mm)

(Please contact us for other requirements)

STRAIGHTNESS

Wire Rod 5.5 ≤ Ø ≤ 25 mm
5.5 ≤ Ø ≤ 7.0: +0.15 / -0.10
Non applicable Non applicable
7.5 ≤ Ø ≤ 10.0: +0.20 / -0.12
10.5 ≤ Ø ≤ 17.0: +0.25 / -0.15
18.0 ≤ Ø ≤ 25.0: +0.40 / -0.00

Round Bars

(Black or peeled) 15 ≤ Ø ≤ 350 mm
Ø ≤ 20: +/-0.25
3000 to 6000
Ø ≤ 140 mm:
2 mm/m
0.12% x L
Ø > 140 mm:
3 mm/m
Ø > 170 mm:
-3 / +3

Flats Thickness < 170
Width

Square bars Sq. 70
Side < 20:
+/-0.20
3000 to 4400
20 < C < 40:
+/-1.25% C
40 < C < 70:
+/-1.25% C
125 < C < 170:
+/-0.1 + 1% C
125 < C < 220:
+/-3% C
220 < C < 310:
+/-2

Square billets
Side

2000 to 6000:
4 mm/m
50 < C < 105:
+/-3% C
115 < C < 220:
+/-2
2000 to 310:
+/-2

Blooms Thickness: 120 to 220
-3 / +5
2000 to 6000:
4 mm/m
Width: 140 to 250

From billets to wire rods

In addition to general certifications (ISO 9001, ISO 14001, ISO 18001), our Service Center is certified to the most stringent industry specific standards: ISO 9100 (aero design and manufacturing), ISO 9120 (aero distribution) and AQAP 2110 (NATO). Also, our products are AMS, ABS and ASNA specified.

Aubert & Duval provides metallurgical solutions, combining excellent mechanical properties such as hardenability, corrosion resistance, toughness, fatigue performance, high temperature resistance or abrasion resistance in a wide range of materials. These solutions provide components to the automotive, aerospace, oil and gas, power generation, marine, rail and defense markets.

Aubert & Duval is a world leader in designing new grades or optimizing legacy alloys in close cooperation with customers. Aubert & Duval offers a wide range of products in several forms of bars – round, flat and square – and also in billets, sheets and wire rods to better fit customers’ requirements.

Aubert & Duval’s technical support includes different services in heat treatment and logistics.

Our customers transform our bars offering the most relevant metallurgical solutions.
Aubert & Duval is a world leader in designing new grades or optimizing legacy alloys in close cooperation with customers. Thanks to the world-renowned expertise of its metallurgists, Aubert & Duval continuously co-develops and optimizes new product grades to provide reliable solutions to customers’ requirements: MLX®17, MLX®19, ARMAD®, AD730®, ML340…

Whether used in Aerospace, Energy, Medical or Defense, many parts are manufactured from bars in High Performance Steels, Superalloys or Titanium. The initial quality of the selected material is therefore key in the final performance of the part. We offer a wide range of products in several forms of our bars – round, flat and square – and also in billets, sheets and wire rods to better fit customers requirements.

Because a bar is not only a bar, we bring technical support and innovation to our customers as well as different services in heat treatment and logistics.

Our customers transform our bars into applications in the fields of Aerospace, Energy, Defense, Transportation, Tooling, Specialties and more...

Special Steels and Superalloys Bars

From billets to wire rods

Certifications and specifications

In addition to general certifications (ISO 9001, ISO 14001, ISO 18001), our Service Center is certified to the most stringent industry specific standards: ISO 9100 (aero design and manufacturing), ISO 9120 (aero distribution) and AQAP 2110 (NATO). Also, our products are AMS, ABS and ASNA specified.

Aerospace, Energy, Defense, Transportation, Tooling, Specialties
<table>
<thead>
<tr>
<th>Grade</th>
<th>UNS</th>
<th>Composition</th>
<th>Application</th>
</tr>
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<tbody>
<tr>
<td>X12CrNiMoV12-3</td>
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<td>12CrNiMoV12-3</td>
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<tr>
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<tr>
<td>X80Cr35Mo16</td>
<td>1.4926</td>
<td>X80Cr35Mo16</td>
<td>Turbines, compressors for energy and aerospace industries</td>
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</tbody>
</table>

**MECHANICAL PROPERTIES**

- **UTS** (Ultimate Tensile Stress):
  - 1610 N/mm²
  - 1500 N/mm²
  - 1410 N/mm²
  - 1490 N/mm²
  - 1800 N/mm²

- **0.2% YS** (Yield Strength):
  - 110 (N/mm²)
  - 120 (N/mm²)
  - 110 (N/mm²)
  - 105 (N/mm²)

- Other data includes:
  - Hardness: 630 HV
  - Fatigue life: up to 500°C
  - Strength: very high strength
  - Corrosion resistance: includes stress crack corrosion
  - Applications: Nuclear energy, weldable safety-critical parts exposed to marine corrosion.

**SUB-ZERO TREATMENT**

- **F** - Solution Treated and Aged
- **H + V** - Sub-Zero Treatment

**THERMO-MECHANICAL TREATMENT**

- **T + Rv** - Quenched and Tempered
- **T + Rv** - Tempered

**APPLICATIONS**

- Engine disk, buckets, fasteners, blades.
- Turbochargers for internal combustion engines.
- Turbochargers for energy and aerospace industries.
- Turbines, compressors for energy and aerospace industries.
- Turbochargers for internal combustion engines.
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- Turbochargers for internal combustion engines.
- Turbochargers for energy and aerospace industries.
- Turbochargers for internal combustion engines.
- Turbocharger...
### Mechanical Properties

<table>
<thead>
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<th>Specification</th>
<th>Standard Symbol</th>
<th>Numerical Grade</th>
<th>Parts</th>
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<td>A473</td>
<td>-</td>
<td>1590</td>
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<td>A314</td>
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<tr>
<td>A276</td>
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<td>A471</td>
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<td>1300</td>
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<tr>
<td>F899</td>
<td>-</td>
<td>1020</td>
<td>1120</td>
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<td>F899</td>
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<td>1120</td>
<td>1200</td>
</tr>
<tr>
<td>F899</td>
<td>-</td>
<td>1200</td>
<td>1300</td>
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</table>

The list of products in the table is not exhaustive, please consult us for other materials.

### Maraging Steels

<table>
<thead>
<tr>
<th>MARAGING STEELS</th>
<th>MATERIALS</th>
<th>GRADES</th>
<th>APPLICATIONS</th>
<th>MECHANICAL PROPERTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>50NILYW 13MoCrNiV42-16-14</td>
<td>M50NIL</td>
<td>6278</td>
<td>Aerospace bearings exposed to high stresses.</td>
<td>140 - Parts requiring excellent fatigue and impact resistance.</td>
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<tr>
<td>50NILYW 13MoCrNiV42-16-14</td>
<td>B61</td>
<td>0.13</td>
<td>3.40</td>
<td>4.15</td>
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<tr>
<td>33CrMoV12-9</td>
<td>32CDV13</td>
<td>6481</td>
<td>Aerospace parts with high loads.</td>
<td>40 - High strength parts for the aerospace and space industry</td>
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<tr>
<td>33CrMoV12-9</td>
<td>6417</td>
<td>0.30</td>
<td>3.00</td>
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<td>1.7736</td>
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### Stainless Steels with Structural Hardening

<table>
<thead>
<tr>
<th>STAINLESS STEELS WITH STRUCTURAL HARDENING</th>
<th>MATERIALS</th>
<th>GRADES</th>
<th>APPLICATIONS</th>
<th>MECHANICAL PROPERTIES</th>
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<tr>
<td>X60NiMnCr13-5-3</td>
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<td>41NiCrMo7-3-2</td>
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<td>17-4PH</td>
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### Special Alloys

<table>
<thead>
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<th>SPECIFICATIONS</th>
<th>MAIN STANDARDS</th>
<th>CHEMICAL COMPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNS: S13800 PH13-8Mo - 1.4534 5629 X3CrNiMoAl13-8-2</td>
<td>A564</td>
<td>XM13</td>
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<tr>
<td>UNS: S64152</td>
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<td>MARVAL PYRAD53NWNiCr19Fe19Nb5Mo3UNS: N07718 INCO 718 NC19FeNb</td>
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<td>XN26TW X6NiCrTiMoVB25-15-2</td>
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<tr>
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<tr>
<td>X17CrNi16-2</td>
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### Fasteners

<table>
<thead>
<tr>
<th>Fasteners</th>
<th>Aerospace parts with high loads.</th>
<th>MECHANICAL PROPERTIES</th>
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<tbody>
<tr>
<td>AISI: 300M</td>
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<td>AISI / SAE: E52100</td>
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### Tool Steels

<table>
<thead>
<tr>
<th>Tool Steels</th>
<th>Aerospace parts with high loads.</th>
<th>MECHANICAL PROPERTIES</th>
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</thead>
<tbody>
<tr>
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<tr>
<td>1.3552</td>
<td>1.6660</td>
<td>0.20</td>
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</tbody>
</table>

### Aerospace and Industrial Applications

- Ball screws
- Blade propellers
- Gears
- Various safety-critical mechanical parts

- Aerospace bearings exposed to high stresses.
- Large mechanical parts of complex shape exposed to high stresses.
- Various heavily stressed mechanical parts.
- Transmission parts such as gears, shafts, actuators and various wear-resistant parts exposed to fatigue for aerospace industry, motor sport and mechanical parts.

- Structural and defence components, centrifuge components.
- Fasteners used for assembly of light alloy components working at high temperatures.
- Fasteners or diverse components.
**Main Materials**

- **HPS** (High Performance Steels)
- **NiSA** (Ni-base Superalloys)
- **Ti** (Titanium)

**Main Processes**

- Melting / Remelting
- Rolling
- Forging

**Certifications and specifications**

In addition to general certifications (ISO 9001, ISO 14001, ISO 18001), our Service Center is certified to the most stringent industry specific standards: ISO 9100 (aero design and manufacturing), ISO 9120 (aero distribution) and AQAP 2110 (NATO). Also, our products are AMS, ABS and ASNA specified.

**Innovation**

- Designing new grades of optimizing performance
- Continuous improvement of all its production processes
- Providing solutions for metal usage and optimization, mini product solutions and innovation

**Our customers transform our bars**

Offering the most relevant metallurgical solutions

Aubert & Duval provides metallurgical solutions, exhibiting excellent mechanical properties such as hardenability, corrosion resistance, toughness, fatigue performance, high temperature resistance or abrasion resistance. The combination of these advanced mechanical characteristics fulfils the metallurgical requirements for various critical applications:

- **Aerospace**
- **Energy**
- **Defense**
- **Transportation**
- **Tooling**
- **Specialties**

**From billets to wire rods**

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Tolerances (mm)</th>
<th>Lengths (mm)</th>
<th>Straightness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø ≤ 20</td>
<td>+/-0.25</td>
<td>3000 to 6000</td>
<td>2 mm/m</td>
</tr>
<tr>
<td>20 &lt; Ø ≤ 40</td>
<td>+/-1.25</td>
<td>+0.025% x Ø</td>
<td>20 &lt; Ø ≤ 40</td>
</tr>
<tr>
<td>40 &lt; Ø ≤ 125</td>
<td>+/-0.1 + 1% x Ø</td>
<td>-3 / +3</td>
<td>125 &lt; Ø ≤ 170</td>
</tr>
<tr>
<td>Ø &gt; 140</td>
<td>±0.1</td>
<td>±0.1 mm/Ø</td>
<td></td>
</tr>
</tbody>
</table>

**From bars to sheets**

- **Wire Rod**
  - Thickness < 170
  - Width: 140 to 250

**From sheets to wire rods**

- **Special Steels and Superalloys Bars**

**Enhancing your performance**

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