Steels and Alloys for Gas and Steam turbines
Since the dawn of the 20th century, Aubert & Duval has been manufacturing products for the most stringent industries: power generation, oil & gas, aerospace, defense, nuclear, automobile.

From small (2 to 3 MW) to the biggest heavy duty turbines (above 500 MW), Aubert & Duval is the partner of choice to develop and to produce materials and parts meeting the most severe requirements including corrosion resistance, fatigue, high stress and high temperature resistance.

Aubert & Duval: a supplier of choice for OEMs and MRO

Gas and Steam turbines: Higher technologies to serve the sales trend of these demanding markets (Oil&Gas, electricity generation, heat recovery...)

Vertically integrated from melting - including superalloy big diameter triple-melt ingots - through to forged and machined near-net shape parts, Aubert & Duval offers one of the largest and most comprehensive capabilities to design and manufacture critical closed-die superalloy forgings for land-based turbines.

Aubert & Duval processes nickel-base alloys, high-performance steels, aluminum and titanium alloys.

Typical products for power generation applications:
- Large, medium and small rotating open and closed-die forgings for gas turbines, compressors and expanders: disks, spacers, shafts, impellers...
- Forgings for steam turbines
- PM HIP static and rotating parts for gas turbines and compressors
- Metal Powders for additive manufacturing
- Non-magnetic retaining rings for generators
- Long products for blades, nuts and bolts, rods...

NiSA Nickel-base Superalloys:
Nickel-based superalloys: materials keeping high surface integrity while withstanding severe mechanical stress in a high temperature and corrosive environment.

HPS High Performance Steels:
A range of alloyed steels with tightly controlled characteristics offering optimum value for customers.

PM Powder metallurgy:
Metal Powders (steels, superalloys, titanium) for additive manufacturing, HIP Net Shape parts.

Ti Titanium:
Pure or alloyed titanium, combining mechanical properties and corrosion resistant with light weight.

AL Aluminum:
For specific applications combining resistance with light weight.

Equipment

- MELTING
  Melting furnaces (EAF, AOD, VOD) up to 60 tons
  Vacuum Induction Melting (VIM) up to 20 tons
  Remelting furnaces (ESR, VAR) up to 30 tons
- POWDER METALLURGY
  Atomization (Air, VIM)
- FORGING
  Open-die forging presses from 1,500 to 10,000 tons
  Closed-die forging presses from 4,500 to 65,000 tons
- ROLLING MILL
  2-200 mm diameter bars
- HEAT TREATMENT
  Solution and ageing furnaces
  Horizontal and vertical quenching equipment
- TESTING
  Immersion UT up to 13 tons (28,000 lbs)
  Automated contact UT up to 20 tons

www.aubertduval.com
Forged and hipped parts for Power generation applications

- Diameter up to 2 m / 79 in
- From 20 kgs / 44 lbs up to 13,000 kgs / 28,600 lbs

Open-die forgings:
- up to 30,000 kgs / 66,000 lbs

PM HIPED parts
Metal powders for additive manufacturing

Combining metallurgical expertise, outstanding industrial capabilities and high manufacturing skill, Aubert & Duval is involved in development programs for advanced generations of steam and gas turbines. Whether working on homogeneous structure of closed-die forged superalloy massive discs for gas turbines, or wrought advanced materials for an ultra-high temperature steam turbine, Aubert & Duval is a partner for OEMs striving for technical, economic and environmental performance.

Aubert & Duval spends nearly 5% of its added value every year on Research & Development.

Main materials

- HPS
  - AD grade
    - NMF18: X10CrNiMoN18-18
    - X170DS/19N01: X10CrNiMoN18-12-3
    - X17CrNi8: X10CrNi18-8
  - AD grade
    - PER001
    - PER72
    - PER718
    - PER706
    - PER53
    - PER3

- NISA
  - AD grade
    - NIS601: 17-4PH
    - NIS706: 17-4PH
    - NIS718M: 17-4PH
    - NIS718: 17-4PH
    - NiCr18Mo18Ti18: 17-4PH
    - NiCr20Co13Mo4Ti3Al: Waspaloy

- PM
  - AD grade
    - NPM18: IN783
    - NPM55: IN800
    - NPM783: IN783
    - NPM783: In718
    - NPM783: In783
    - NPM783: IN783

Gas turbines

- Turbine stator - Astroloy (PM HIP)
- Rotor shaft – IN901
- Large turbine disc – IN716
- Large turbine spacer – IN706
- Turbo shaft – IN706
- Large turbine disc – IN716

Expanders

- Expander discs – Waspaloy
- Expander disc – NiSA

Compressors

- Impeller - IN625M (PM HIP)
- Impeller – IN625M (PM HIP)

Steam turbines (New generation)

- Steam Turbine Rotor Shaft – Superalloy
- Steam Turbine Rotor Shaft – Superalloy

Powder metallurgy (PM and HIP)

Brochures “Hot Isostatic Pressing” and “Additive Manufacturing” are available on www.aubertduval.com

Generators

Please ask for the retaining rings brochure on www.aubertduval.com
The initial quality of the selected material is key in the final performance of the part. We offer a wide range of products in several forms of bars (round, flat and square), billets, sheets and wire rods to better fit customers' requirements. Because we offer more than just a bar of material, we bring technical support and innovation to our customers as well as different services in heat treatment and logistic.

A complete long products offer for Power generation applications

**Main Materials**

<table>
<thead>
<tr>
<th>HPS</th>
<th>NISA</th>
<th>High Performance</th>
<th>Ni-base Superalloys</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD grade</td>
<td>Common name</td>
<td>PER718</td>
<td>AD730®* New*</td>
</tr>
<tr>
<td>66GE™</td>
<td>X20CrMoWVb12-0 - AISI 422</td>
<td>Ni16Cr19Fe19Nb5Mo3</td>
<td>NiCr16Co9Mo3W3Ti3Al2</td>
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<tr>
<td>S307</td>
<td>X10CrMoVNb12</td>
<td>NiCo20Cr20MoTi</td>
<td>NiCo20Cr20MoTi</td>
</tr>
<tr>
<td>MARVAL® 13X</td>
<td>X10MoVTi12-2</td>
<td>Waspaloy®</td>
<td>NiCr20Co13Mo4Ti3Al</td>
</tr>
<tr>
<td>MLX® 17 New*</td>
<td>X10CrNiMoAlTi12-1</td>
<td>HARPER5</td>
<td>NiCr19Fe19Nb5Mo3</td>
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</tbody>
</table>

**NISA AD grade Common name**

<table>
<thead>
<tr>
<th>PER263</th>
<th>IN263</th>
<th>NiCr19Fe19Nb5Mo3</th>
</tr>
</thead>
<tbody>
<tr>
<td>PER263</td>
<td>IN263</td>
<td>NiCr20Cr20MoTi</td>
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</tbody>
</table>

**Innovation**

A&D continuously develops new processes and new products able to face technical and economic challenges.

**MLX® 17**

One of the main technical challenges to improve efficiency and reduce construction costs of power generation plants is to extend the last stage blades. MLX® 17 is a precipitation hardening martensitic stainless steel capable of tensile strength up to 1700 MPa, combined with high toughness, high fatigue and stress corrosion cracking resistance. Together with another of Aubert & Duval’s grade - MARVAL® X12H, MLX® 17 is currently among the best steel grades to design the longest end-blades of steam turbines.

**AD730®**

Is a fully innovative nickel-base superalloy. It withstands higher temperatures (750 °C / 1,382 °F), while preserving strength, creep and fatigue resistance at a competitive cost. Targeted applications: turbines blades, buckets, fasteners, as well as rotating parts for gas turbines.

**Main Processes**

- Melting / Remelting
- Rolling
- Forging

**Applications**

<table>
<thead>
<tr>
<th>Round bars</th>
<th>Square bars</th>
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</thead>
<tbody>
<tr>
<td>Flat bars</td>
<td></td>
</tr>
<tr>
<td>Sheets</td>
<td>Wire rods</td>
</tr>
<tr>
<td>Nuts &amp; bolts</td>
<td>Injection components</td>
</tr>
<tr>
<td>Pins</td>
<td>Blinds</td>
</tr>
<tr>
<td>Tie rods</td>
<td>Tubular components/ couplings</td>
</tr>
</tbody>
</table>

**Surface conditions**

- Black
- Peeled
- Ground
- Others

**Heat treatment conditions**

- Annealed
- Hyperquenched
- Normalized
- Heat treated
- Aged

**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.
The information and the data presented herein are typical or average values and are not a guarantee of maximum or minimum values. Applications specifically suggested for material described herein are made solely for the purpose of illustration to enable the reader to make his own evaluation and are not intended as warranties, either express or implied, of fitness for these or other purposes. Aubert & Duval’s liability shall not extend, under any circumstances, to the choice of the Product and its consequences.