

### Our metallurgical expertise at your service

Fully integrated from grade design to part finishing, we are melting and processing materials for the Aerospace market: specialty alloys – including stainless steels – superalloys (Ni, Co), aluminum and titanium. We also gas-atomize and hip our own powder materials.

### One-stop shopping

We offer the widest range of product formats: closed-die forged, open-die forged and cast parts, bars, sheets, flats, just name it.

### Specialized in critical parts

- Optimum quality guaranteed by cleanest steel and superalloy technologies: VIM/VAR or triple melt VIM/ESR/VAR. Depending on our customers' requirements, our products are built to last 100 'intensive' seconds or more than 25 years...
- Very tight tolerances allowing thinnest material walls, and saving in weight!
- Oblong-shaped tanks can be made by welding only 2 parts, instead of 3 with a regular process.

### Flexibility and service

We can provide all kinds of finishings and dimensions, this even for small, non-repetitive series.

### Unique equipment and technologies

Our renowned 65 KT closed-die forging press is one of the two largest presses in the world. It allows to cold-press parts as large as 8 m (26 ft), or combine 2 siamese parts in the same tool.

Another unique feature is our 'Flash' Quenching Equipment for high resistance Ti hemispheres. It minimizes the transfer time between heating and quenching down to 6 seconds. Depending on the customers' requirements, we can obtain either a resistance to rupture over 1100 MPa (160 Ksi) or an ideal compromise between fracture toughness and tensile characteristics.

We have also developed an advanced technology for near-net-shape parts, where, to target even more complex geometries with about 25% material saving, we have combined traditional closed-die forging with super plastic forming.

Composite processing: we can cast low-thermal expansion (Invar) mold-units up to 12 m (40 ft) for resin-transfer molding (RTM).

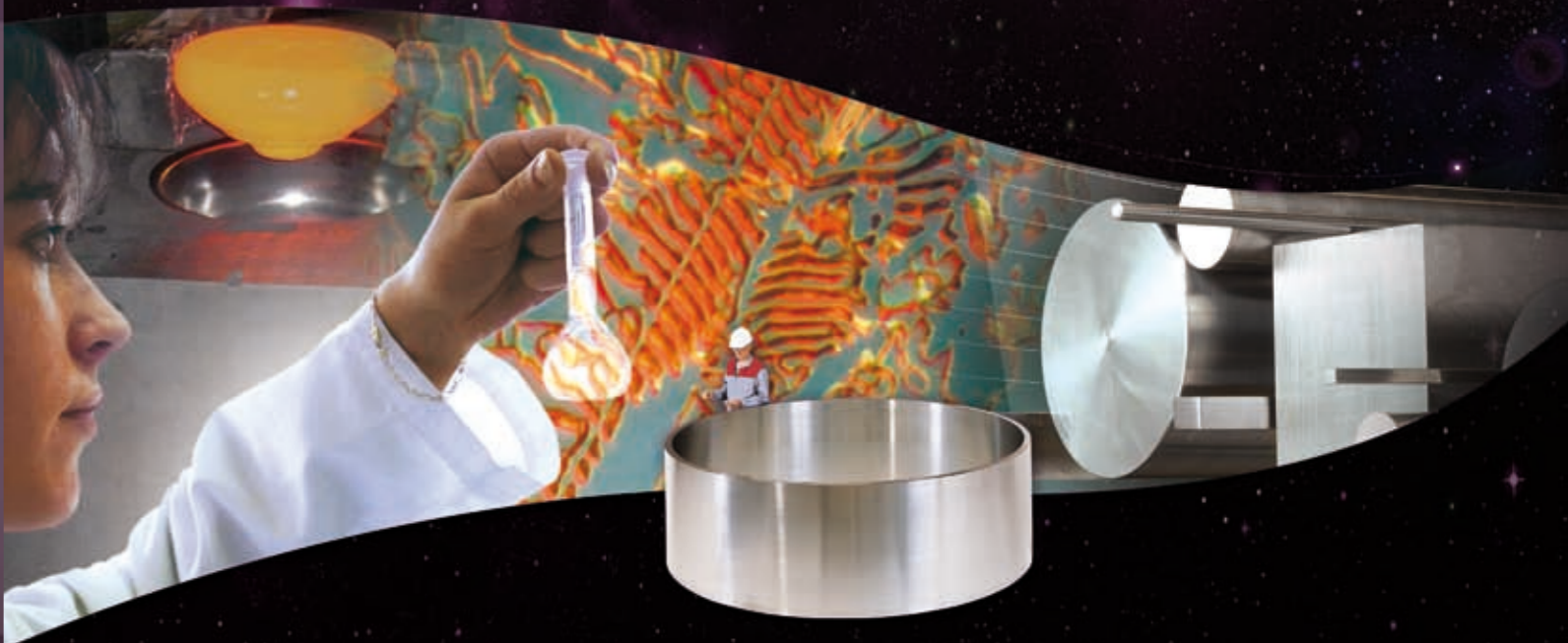


The information and the data presented herein are typical or average values and are not a guarantee of maximum or minimum values. Applications specifically suggested for material described herein are made solely for the purpose of illustration to enable the reader to make his own evaluation and are not 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.

Design by: Makheia Affinity, Aubert & Duval 05-2010  
Photo credit: Air Liquide, EADS-Astrium, ESA - P. Carril, Jean-Philippe Ehrmann, MT Aerospace



## Special steels, Superalloys, Aluminum and Titanium alloys for the Space Industry



# A Proven Record in the Space Industry



Our pledge:  
**Your satisfaction**

Too far away to compromise

Around 20 geostationary satellites are launched every year, each having an expected life of over 25 years. Eurostat has announced a whopping 1,185 satellites over the coming decade, representing approximately 80 launches per year. This industry becomes every day more challenging: performance and quality assurance are equally crucial. Answering requirements for flying longer, lighter and cheaper, we commit to help optimize weight and efficiency, along with an undisputable service.

## A proven history in Launchers and Satellites

For more than 20 years, Aubert & Duval is proud to participate in the global space industry challenge, starting with the Ariane 4 launchers and continuing on PSLV, Ariane 5 and GSLV.

Reputation has gained customers all over the world: Astrium, Thales-Alenia, Snecma Propulsion Solide, MT Aerospace, LPSC, SABCA, Pyroalliance, Altal, Avio...

## Qualified Products and Process

A&D follows the most stringent requirements in terms of grade composition, microstructural integrity, dimensional tolerances and quality control. Grades designed for satellites can withstand temperatures down to -200°C!

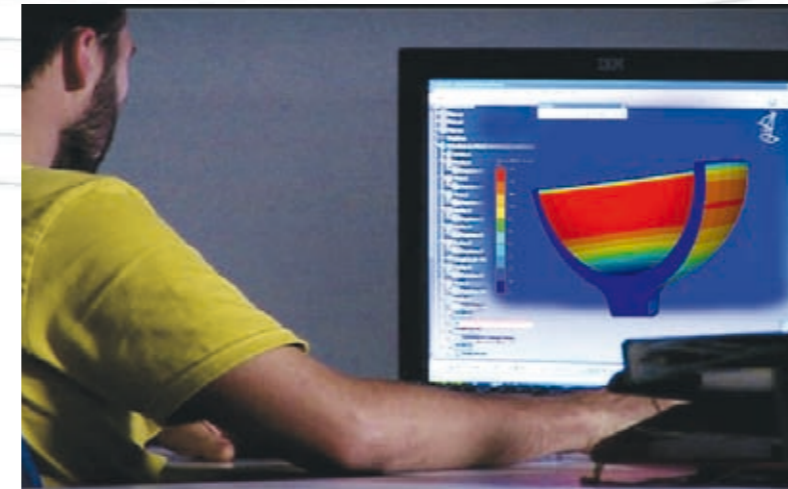
All our products comply with the most demanding standards. And, as a leading supplier of the aerospace industry, we also are NADCAP certified.



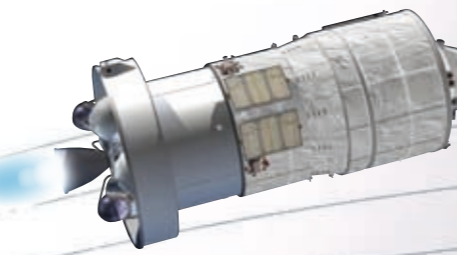
Today, several hundred satellites are flying thanks to Aubert & Duval technology!

Propellant tanks, engines, boosters, structural parts... Everywhere Aubert & Duval contributes to the safety of launchers and to the life of satellites and space-stations: Spacebus, XMM-Newton, Integral, Sentinel, Galileo, Herschel & Planck, ISS...

We produce titanium and aluminum hemispherical shells for buffer tanks containing high pressure gas (Helium or Xenon). They play a key role in the propulsion phase of launchers and of automated transport vehicles. Once assembled, the 2 hemispherical shells guarantee the mechanical resistance of the composite structure and contribute to the economy of the launch by decreasing the load.



3D simulation software and experienced engineers for continuous R&D.

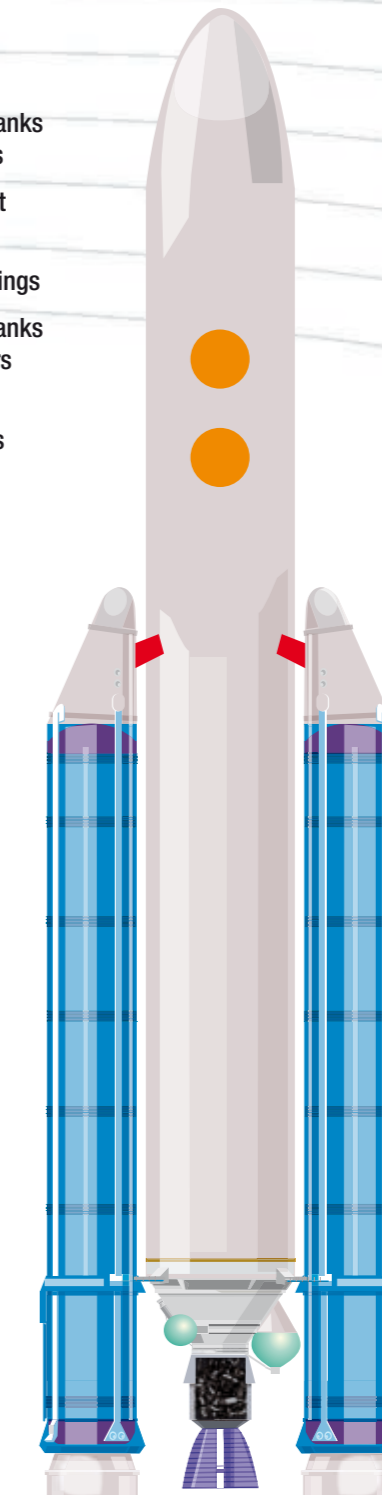


A unique and complete offering

Aerospace, as our major sales segment, led us to build dedicated organization and tools in order to meet the most demanding specifications.

As laborators and experts in the Art of metallurgy, we keep on designing special grades for each specific application to be ever closer to any requirement.

- Propellant tanks for satellites
- Attachment brackets
- Booster casings
- Propellant tanks for launchers
- Cryogenic engine parts
- Domes



Grade	Type	AMS	Applications
<b>High purity steels</b>			
819B	35NCD16	-	Hinges for doors and other swivel systems
	36NiCrMo16 1.6773		
MARVAL18	X2NiCoMo18-8-5 K92890 1.6359	AMS 6512	Launcher engines
	MARAGING 250		
M06ACW	48CrMoNiV4-10 K24728 D6AC	AMS 6431	Ring rolled and flowformed shells for powder boosters, Booster casings
	15CDV6 15CrMoV6 1.7734	-	
SCV	15CDV6 15CrMoV6 1.7734	-	Engine casings
EXL036F	Low thermal expansion alloy FeNi36	-	Moulds for RTM
<b>High purity stainless steels</b>			
X15U5W	X5CrNiCu15-5 S15500 1.4545	AMS 5659 AMS 5862	Actuators, Fittings
	15-5PH		
X18BCYW	X2CrNi19-11 S30403 1.4306	-	Separation elements for pyrotechnic devices
	304L		
X18PA	X6CrNiTi18-0 S32100 1.4541	AMS 5645	Cryogenic applications
	S32100		
XD15NW	X40CrMoVNi16-2 S42025 1.4123	AMS 5925	Bearings
	S42025		
XDBD	X105CrMo17 S44004 1.4125	AMS 5630 AMS 5880 AMS 5618	Bearings
	440C		
<b>Superalloys</b>			
NY276	NiMo16Cr15W	-	Propulsion engines
PER3	NiCr20Co13Mo4Ti3Al N07001	AMS 5703 AMS 5708 AMS 5709	Propulsion engines
PER625	NiCr22Mo9Nb N06625	AMS 5666	Propulsion engines
PYRAD53NW	NiCr19Fe19Nb5Mo3 N07718	AMS 5662 AMS 5663	High Temperature applications
XN26TW	X6NiCrTiMoVB25-15-2 S66286	AMS 5731 AMS 5732 AMS 5734 AMS 5737 AMS 5853 AMS 5525	Cryogenic engines
XSH	KC20WN CoCr20W15Ni	AMS 5796 AMS 5537 AMS 5759	Engine casings
<b>Aluminum Alloys</b>			
Al 2000 series	2214 2219	AMS 4135 AMS 4143	Spherical tanks
	7050		
Al 7000 series	7075	AMS 4107 AMS 4108 AMS 4126 AMS 4141 AMS 4147	Spherical tanks, attachment brackets
5083	A95083	-	Spherical tanks
6061	A96061	AMS 4127	Engines
<b>Titanium Alloys</b>			
TA6V	Ti-6Al-4V R56400	AMS 2380 gr 1 AMS 6931 AMS 4928	Spherical tanks
TA5E_ELI	Ti-5Al-2.5Sn (ELI)	AMS 4924	Spherical tanks

## Titanium hemispherical forgings - Mechanical properties

Hemispherical forgings Ti-6Al-4V (TA6V)								
References	Heat treatment	Thickness	YS 0.2	UTS	A5d %	RA %	K1C MPa m <sup>1/2</sup>	Micro Structure Equiax α-β
WL 3.7164.7 AMS 2380 gr 1	STA (Solution Treated and Aged)	< 25 mm	1030 MPa	1100 MPa	10	20	> 30	
		25 to 50 mm	960 MPa	1030 MPa	10	20	> 30	
AMS 6931 AMS 4928	Annealing	< 50 mm	850 MPa	920 MPa	10	25	> 50	
Hemispherical forgings Ti-5Al-2.5Sn (TA5E_ELI)								
AMS 4924	STA (Solution Treated and Aged)	< 50 mm	730 MPa	800 MPa	10	15	> 65	

Depending on mechanical performances requested by customers, A&D selects the temperature and deformation levels to obtain the relevant microstructures in the various areas of the part.