Thierry VIGUIER
VP Materials Purchasing

TITANIUM EUROPE 2019
ITA's 35th annual Conference & Exhibition
Vienna, Austria – May 13-15
<table>
<thead>
<tr>
<th><strong>5 CORE BUSINESSES:</strong></th>
<th><strong>WORLD’S No.3 AEROSPACE COMPANY:</strong></th>
<th><strong>More than 92,000 EMPLOYEES in 30 COUNTRIES</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace propulsion</td>
<td>(excluding aircraft manufacturers)</td>
<td></td>
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<tr>
<td>Aircraft equipment</td>
<td></td>
<td></td>
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<tr>
<td>Defense</td>
<td></td>
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<tr>
<td>Aerosystems</td>
<td></td>
<td></td>
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<tr>
<td>Aircraft interiors</td>
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<tr>
<td><strong>€21 BILLION</strong> in revenue</td>
<td><strong>€3 BILLION in adjusted recurring operating income</strong></td>
<td><strong>€1.5 BILLION in R&amp;D expenditures</strong></td>
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<td><strong>850 INITIAL PATENTS filed</strong></td>
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*in 2017
TITANIUM’S EVOLVING ROLE IN MODERN AIRCRAFT ENGINES

May 2019
Aerospace propulsion business within Safran

REVENUE BY BUSINESS SECTOR IN 2018*

- Aerospace Equipment: 26%
- Defense: 7%
- Aerosystems: 8%
- Aircraft Interiors: 9%

Aerospace Propulsion: 50%

No. 1 WORLDWIDE
- single-aisle commercial jets engines, in partnership with GE*
- helicopter turbine engines
- mechanical power transmissions systems**

- landing gear
- wheels and carbon brakes**
- seats for commercial airplanes***
- electrical wiring interconnection systems for aircraft

No. 2 WORLDWIDE
- electrical power generation
- aircraft engine nacelles

A WORLD LEADER
- onboard power electronics
- APUs for business jets, helicopters and military aircraft

*through CFM International, a 50/50 joint company between Safran Aircraft Engines and GE
**mainline commercial jets with over 100 seats
Aerospace propulsion business within Safran

- **1 Single-aisle commercial jet takes off every 2 seconds**, powered by our engines**
- **More than 62,000 landings** a day using our equipment
- **80+ successful Ariane 5 launches** in a row***
- **3,000 military aircraft** fitted with our inertial navigation systems
- **1 out of every 3 helicopter turbine engines** sold worldwide
- **Over 40,000 power transmissions** totalling over 1 billion flight-hours
- **More than 21,000 nacelle components** in service
- **500 km of electrical wiring** on an Airbus A380
- **1 million seats** in service in airline fleets worldwide

**In partnership with GE, through CFM International**

***In partnership with Airbus, through ArianeGroup**
Innovation at Safran

(12/31/2018)

- **€1.5 BILLION**
  IN R&D EXPENDITURES

- **20% OF EMPLOYEES INVOLVED IN R&D**

- **1,300 EXPERTS IN THE GROUP**

- **OVER 850 INITIAL PATENTS FILED**

- **€740 MILLION**
  IN CAPITAL EXPENDITURES

Safran is ranked among the **TOP 100 GLOBAL INNOVATORS** by Thomson Reuters

*in 2017
CFM, 47 years after...

34,500+ engines delivered

600+ customers worldwide

Every 2”, a CFM-powered aircraft takes off

CFM carries 7M+, passengers daily

99,98% dispatch reliability

900M+ Engine Flight hours

René Ravaud (Snecma) and Gerhard Neumann (GEAE) in the early 70’s
... we are defining history

34,500+
total CFM deliveries to date

17,300+
LEAP engines on order

100+
LEAP operators

LEAP
1,100+ engines shipped in 2018
1,800+ LEAP in 2019

4M+
LEAP engine flight hours

96%+
Utilization

75%
BUY

25%
MAKE
What is CFM’s market?

2017-2036 market forecasts

- Economic growth: +2.8%
- RPK traffic growth: +4.5%
- Global fleet growth: X 1.9
- New Aircraft deliveries: 38,900

Planned 20-year deliveries of new aircraft

- 2,800 Turboprop aircraft
- 3,700 Regional jets
- 23,800 Short-medium range jets
- 8,600 Long range jets

Nearly 24,000 new short-medium range A/C

Source: CFM information
Typical production downturn has not occurred in over 10 years

Aircraft production cycle

Demand
% change, RPKs

<table>
<thead>
<tr>
<th>Year</th>
<th>Demand</th>
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<tbody>
<tr>
<td>'17</td>
<td>7.6</td>
</tr>
<tr>
<td>'18F</td>
<td>6.0</td>
</tr>
<tr>
<td>'20F</td>
<td>6.4</td>
</tr>
</tbody>
</table>

Load factors
% PEP

<table>
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<th>Year</th>
<th>Load Factors</th>
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<tr>
<td>'17</td>
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<tr>
<td>'20F</td>
<td>81.5</td>
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6%+ RPK growth 2018-2020
CFM56 deliveries ramp-down, but shop visit volume still growing... will continue to drive material demand.

2018 deliveries 1,000+

2017 orders continued 400+

Fleet growing 21,000+

Shop visits don’t peak until ~2020+

60% of in-service fleet still hasn’t reached its first shop visit
What were our promise to the market in 2008

Combining technology, experience and execution

- Fuel efficiency: 15% reduction
- NOx: Up to 50% lower vs. CAEP 6
- Noise: New regulation a/c compliance (chapter 14)
- Reliability: Same as CFM56 ... best in industry
- Life cycle maint. cost

Performance and reliability
What we have accomplished ...

- 15% fuel efficiency
- NOx and noise targets
- 96% utilization
- 17,300+ engines ordered and 1,600+ engines delivered
How we have accomplished ...

- Optimized thermodynamic design,
- Higher bypass and compression ratios,
- Advanced 3-D aerodynamic design
- Greater use of lightweight materials.

The materials used to make engine parts play a significant role in environmental performance. Choosing the right ones is very important, because lighter parts help reduce fuel consumption and emissions. And their resistance to high temperatures means we can improve the thermal efficiency of turbomachines.
Greater use of lightweight materials

Composites on Fan blades / Case

+30% of titanium per LEAP engine

Leap-1B compared to CFM56-7 – Safran share

Titanium main parts for LEAP

- Fan Disk and Fan Blade Leading Edge
- Fan Hub Frame and LPC vanes and blades
- Fan Frame Shroud, Strut and Shroud link
- Bearing housing and supports
- Kit Engines: tubes, struts, ...
Use of different type of grade and production route

6.4 for LP static and rotating parts

Ti17 & 6.2.4.2 for rotating parts

TiAl 48-2-2 for LPT blades (last stages)

Casting for numerous small and medium size parts
Fan Hub Frame, LPT blades (TiAl)

Forging for static and rotating parts
Fan Frame shroud, Leading Edge, Fan Disk, Booster spool, Bearing housing
WHAT’S ABOUT THE FUTURE OF TITANIUM?

May 2019
Weakness and opportunities

Composite materials are catching a bigger share on the engine...

500 lb weight savings on LEAP

Stakes are for Ti based alloy for higher temperature HPC rotating part

Aluminum materials are much more cheaper than titanium...

by 10 times on plates

Casting of complex titanium parts is always challenging

AM could be an answer
Safran expects support from the supply chain to ...

Save weight:
Challenge for the future on rotating parts is to have a Ti based alloy that can replace the 6.2.4.2 without the problems of relaxation at "low temperature" (Dwell Effect) or even replace Inconel 718.

Save cost:
Safran uses 2000+ mt of high strength Titanium for its landing gears (UTS ≥ 1200 Mpa), good compromise between mechanical properties (ultimate tensile stress, fatigue), density and easier maintenance (corrosion)...
... but, volumes are declining to the profit of 6.4 or even 300M because of the price

Obtaining titanium powder in production quantities at a competitive cost:
Is the classical Sponge – Ingot – Billet – Bars – Powder an answer?
Bringing back home...

Aerospace is still a growing market (6%+ RPK growth) and Safran has a major share on this story. For the next decades, every working day, Safran will use 20 mt of titanium.

Titanium based alloys have a great future in this industry: lighter parts help reduce fuel consumption & emissions and the resistance to high temperatures means the thermal efficiency of turbomachines can be improved.

Titanium powders could be extensively used by additive manufacturing new technologies, if they reach the market price.
POWERED BY TRUST

Every day, every part matters

Every day, every part is made of materials