Titanium Demand and Trends in the Jet Engine Market

Wade Leach - Senior Vice President, Commercial
ATI Specialty Materials
May 12, 2015
Forward Looking Statements

This presentation contains forward-looking statements. Actual results may differ materially from results anticipated in the forward-looking statements. These and additional risk factors are described from time to time in the Company’s filings with the Securities and Exchange Commission, including its Annual Report on Form 10-K for the year ended December 31, 2014.
## Commercial Aerospace Market Drivers

<table>
<thead>
<tr>
<th></th>
<th>Change</th>
<th>Specialty Metals Market Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic (RPMs)</td>
<td>🚀</td>
<td>📈</td>
</tr>
<tr>
<td>Capacity (ASMs)</td>
<td>🚀</td>
<td>📈</td>
</tr>
<tr>
<td>Airline Profitability</td>
<td>🚀</td>
<td>📈</td>
</tr>
<tr>
<td>Fuel Costs</td>
<td>📉</td>
<td>📈</td>
</tr>
<tr>
<td>International Carriers</td>
<td>🚀</td>
<td>📈</td>
</tr>
<tr>
<td>Growth of Low-Cost Carriers</td>
<td>🚀</td>
<td>📈</td>
</tr>
</tbody>
</table>

(Sources: Airline Monitor, IATA press releases)
Commercial Aircraft Engine Build Rates

Sources: Airline Monitor, February 2015 & ATI

Build rates of Next Generation Aircraft & Engines Accelerating
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Commercial Aircraft Build Rates

Sources: Airline Monitor, February 2015 & ATI
### Major Engine Programs - Firm Order Book (February 28, 2015)

<table>
<thead>
<tr>
<th>Engine Program</th>
<th>Firm Order Book</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFM56 - 5B</td>
<td>1,352</td>
</tr>
<tr>
<td>CFM56 – 7B</td>
<td>3,142</td>
</tr>
<tr>
<td>V2500</td>
<td>922</td>
</tr>
<tr>
<td>CFM LEAP</td>
<td>8,446</td>
</tr>
<tr>
<td>PW 1000G</td>
<td>2,646</td>
</tr>
<tr>
<td>GEnx</td>
<td>928</td>
</tr>
<tr>
<td>Trent 1000</td>
<td>460</td>
</tr>
<tr>
<td>Trent XWB</td>
<td>1,558</td>
</tr>
<tr>
<td>Trent 7000</td>
<td>240</td>
</tr>
<tr>
<td>GE90</td>
<td>544</td>
</tr>
<tr>
<td>GE9X</td>
<td>572</td>
</tr>
</tbody>
</table>

**Source:** Aero Engine News April 2016

- **Legacy Single Aisle 5,416** (Boeing 737, Airbus A320)
- **Future-Gen Single Aisle 11,092** (737 Max, A320Neo)
- **Boeing 787**
- **Airbus A350XWB**
- **Airbus A330neo**
- **Boeing 777**
- **Boeing 777X**

**Large Commercial Engine Backlog over 21,000. 2/3 are Next Generation!**
Commercial Engines in Service
History and Forecast

The larger the fleet, the greater the demand for spare parts.

Source: Airline Monitor

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Jet Engine Materials

- **Low Pressure Compressor**
  - Titanium

- **Combustor**
  - Superalloys

- **High Pressure Compressor**
  - Titanium/Superalloys

- **Low Pressure Turbine**
  - Superalloys, Gamma Ti Aluminides

- **High Pressure Turbine**
  - Superalloys/Powder Alloys

- **Fan**
  - Titanium/Composites

- **High Pressure Compressor**
  - Titanium/Superalloys

- **Engine Shaft**
  - High Strength Steels, Superalloys
Fan & compressor cases, disks, blisks, impellers, blades, vanes, and fasteners
Engine Development Trends

- Demand for “Green” engines
  - Reduced noise
  - Reduced emissions (SO$_2$, CO$_2$, NO$_2$)
- Improved fuel efficiency
  - Higher operating temperatures
    - Higher temperature capable materials
  - Lighter materials
- Lower operating costs for airlines
  - Reduced maintenance intervals
  - Reduced part count

New Designs and Materials
Changes in Jet Engine Design

- Limited introduction of composites
- Larger thrust engines
  - Consume more nickel-based and titanium alloys per engine
- Higher engine temperatures
  - Nickel-based alloy content in compressor growing
  - High temp powder/cast & wrought alloys
- New titanium-based materials
  - Gamma TiAl
- Advanced Manufacturing
- Additive Manufacturing

Evolutionary Change
Titanium in Jet Engines

Demand Drivers

• Higher build rates
• Larger engines
• Larger global fleet for spare parts
• New engine designs
• Fuel efficient hotter burning engines

CFMI LeapX