Titanium Demand and Trends in the Aero Engine Market

Wade Leach, Senior Vice President Commercial

September 26, 2016
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, 2015.
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Traffic (RPMs)

Market Drivers

Commercial Aerospace Market Forecast

Revenue Passenger Miles (Billions)

Source: Airline Monitor, IATA, ICAO
Market Drivers

- Traffic (RPMs)
- Capacity (ASMs)

![Graph showing Commercial Aerospace Available Seat Miles from 1970 to 2020 with History and Forecast lines.](source: Airline Monitor)
Market Drivers

Traffic (RPMs)
Capacity (ASMs)
Airline Profitability

Global Commercial Airline Profitability

Source: IATA Economics
Market Drivers

- Traffic (RPMs)
- Capacity (ASMs)
- Airline Profitability
- Fuel Costs

Jet Fuel Price and Crude Oil Price

Source: U.S. Energy Information Administration
Market Drivers

- Traffic (RPMs)
- Capacity (ASMs)
- Airline Profitability
- Fuel Costs
- Economic Turmoil
Market Drivers

- Traffic (RPMs)
- Capacity (ASMs)
- Airline Profitability
- Fuel Costs
- Economic Turmoil
Aero Engine Forecast

Commercial Jet Engines by OEM Deliveries and Forecast

- B787
- A350
- C-Series A320neo
- B737max A330NEO
- MRJ C919 E-190-E2 MS-21
- E-195-E2
- B777x E-175-E2

Source: Airline Monitor, ICFSH&E
Legacy vs Next Generation Commercial Jet Engines
Deliveries and Forecast

- **Legacy**
- **Next Generation**

Source: Airline Monitor, ICFSH&E

- T900GP7267
- GEnx-2B
- Trent XWB
- PW1100G
- CFM LEAP 1A
- T900
- RR1000
- GEnx-1B
- CFM LEAP 1B
- PW1500G
- PW GTF
- PW1700/1900G
- PW1200G
- CFM LEAP 1C
- RR1000-TEN
- GE9X
- RR Ultrafan
- RR Advance

Future Engines
Aero Engine Trends

Source: Journal of Propulsion and Power
Development Trends in Aero Engine

Next Generation Engines:

- Green Technology
- Enhanced Fuel Efficiency:
  - Higher Engine Temperatures
  - Increased Thrust
- Lower Operating Cost
Demand Drivers in Aero Engines

- Higher Build Rates
- Larger Engines
- Larger Global Fleet (Spares)
- Emerging Economies
Titanium’s role in Aero Engines

- Premium Melted Titanium
- Additive Manufacturing
- Complex and New Ti Based Materials (TiAl, ATI 6-2-4-2™, ATI 6-2-4-6™, ATI 8-1-1™)
- Advanced Manufacturing Practices
Commercial Aero Engine Titanium Demand

Aero Engine Titanium Demand

Source: Airline Monitor, ICFSH&E
Commercial Aero Engine Titanium Demand

Aero Engine Titanium Demand

- **Aero Engine Ti**
- **Engine Builds**
- **Avg Ti Per Engine**

Source: Airline Monitor, ICFSH&E

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