Titanium in the Defense Market: Driving Growth through Innovation

Eric Roegner
President, Alcoa Titanium and Engineered Products
President, Alcoa Defense
• The European defense market is responding to regional instability

• While the market has bright spots, the challenges are increasing

• Titanium will thrive when leading with innovation
Global defense market fundamentals are changing

Geo-political tensions and active conflicts are increasing

Source: Information from the Stockholm International Peace Research Institute (SIPRI), public news sources
US Defense budgets are responding

- Acquisition focused on priority programs
- Growth in USAF & Navy investment accounts

Source: The Cohen Group and Government Accountability Office; photos: see appendix
European defense spending is responding

**Regional instability reversing 20 years of declines**

- Addressing three mission sets:
  - Insurgency – conventional weapons
  - Assertions – long range, interceptor, ISR
  - Humanitarian – cargo, medevac

Source: Defence Budgets and Cooperation in Europe: Developments, Trends and Drivers Edited by Alessandro Marrone, Olivier De France and Daniele Fattibene; photos: see appendix
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Challenge: Fewer primary aerospace programs

Continued life in legacy programs

Healthy growth in new programs

Source: IHS Jane’s Teal Group; photos: see appendix
Strong titanium content in aero structures

Materials % by weight on military airframes

- C-17, KC-46, A400M: Transports
- F-18, Rafale, Eurofighter: Fighters
- F-22, F-35: Fighters
- AH-64, Eurocopter, V-22: Rotorcraft

Notes: (1) not including propulsion engines, auxiliary engines and props

Aggressive multi-material challenges

FS 496 Bulkhead (titanium)
FS 518 Bulkhead (Aluminum)
FS 556 Bulkhead (Aluminum)
FS 472 Bulkhead (Aluminum)
FS 450 Bulkhead (Aluminum)
FSW 425 Bulkhead (Aluminum)
Fwd Root Rib (Aluminum)
Hi-Bypass Turbofan Blade (Aluminum-Lithium)

Trades are being made

Source: Lockheed Martin; photo: see Appendix
Arms crossing new borders creating complexity

Global arms imports of $100B (USD)
2011-15

Asia and Oceania, 46%
Middle East, 25%
Europe, 11%
Americas, 9.6%
Africa, 8.0%

And the continuously evolving mission landscape

World UAV Market 2002-2024

- Every incremental unmanned mission displaces a traditional system

Source: Teal Group to AIA, July 2015; photos: see appendix

- Every incremental unmanned mission displaces a traditional system
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Innovation across value chain is the path to success

INGOT
Melting
(Ingot, Cast Slab)

PLATE
Billetizing, Rolling
(Mill Products)

CASTINGS
Conversion
(Forging, Extruding, Investment Casting)

FORGINGS
Machining, Assembly,
Testing

FINISHED PART

INNOVATIONS

New Materials

Productivity

Additive Mfg.

Adv. Fabrication

Source: Alcoa
Thank you