US ARMY RDECOM

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT, & ENGINEERING CENTER (ARDEC)

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

The Expanded Use of Titanium in the Services

Stephen Luckowski
Chief, Materials, Manufacturing and Prototype Technology Division
Chairman, Metals Subpanel – Joint Defense Manufacturing Technology Panel

9 October, 2012

Agenda

- Who Is ARDEC
- ARDEC Warfighter Support
- Development of Titanium in Army Systems
- One Area of Titanium Investment within the Department of Defense (DoD)
- Manufacturing Technology Program (ManTech)
- Summary

ARDEC at a Glance

- Established track-record supporting transition of technologies to the field
  - 40 Full Materiel Release (FMR) FY08-FY11
  - 70 Urgent Materiel Release (UMR) FY08-FY11
  - Enabled fielding of 217 New Ammunition, Weapons and Equipment since 9/11
- Streamlined product development by extensive Modeling and Simulation and Systems Engineering

Dept. of the Army (DA)

AMC

US ARMY RDECOM

ARDEC

- Partnered with Industry, Academia, and other Government agencies – 126 CRADA
- Steward of Government Data Rights and Intellectual Property
  - 215 Invention Disclosures FY09-FY11
  - 176 Patent Applications FY09-FY11
  - 89 Patents Issued FY09-FY11
  - 18 Active Patent License Agreements

AT4 CONFINED SPACE

M982 EXCALIBUR BLOCK IA-1 PROJECTILE

XM110 SASS

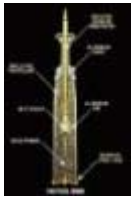
XM135 CROWS

"Center of Mass" for Armament Systems and Munitions for Joint Services

ARDEC Mission: Total Warfighter Support

Total Lifecycle Support

- **Research**
- **Development**
- **Production**
- **Field Support**
- **Demilitarization**



M900 Armor Piercing Cartridge

CROWS Lightning

XM25 Grenade Launcher

Lightweight Handheld Mortar Ballistic Computer

M240B 7.62MM Machine Gun

M211/M212 Aircraft Countermeasure Flares

Mine Roller Brackets/Extensions

M777A2 Lightweight 155mm Howitzer

Electro-Magnetic Gun

Lightweight Dismounted Mortar

Excalibur

M110 Semi-Automatic Sniper System

M829A3 AFPSDS-T 120mm

40mm Multi-Shot Launcher

Gunner Protection Kits

Small/Cannon Caliber Ammunition

Advanced Crew Served Weapon

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

ARDEC Development of Titanium in Army Systems

120mm Mortar Base Plate

M777 Lightweight Howitzer Parts

M240L Lightweight Parts

FCS Blast Hull

Stryker Mortar Carrier Variant (MCV) Doors

Abrams Tank Reactive Armor Tiles

Excalibur CAS Components

Stryker Cupola Shield

Lightweight Trailer

HMMWV Ballistic Doors

USASOC GPK

USASOC Lightweight Tactical Seat

ARDEC Development of Titanium in Army Systems

The Evolution of Warfighter Protection

- Special Operations Command (SOCOM) requirements have been instrumental in driving recent titanium-based warfighter protection improvements (USASOC GPK, Titanium Tactical Seat)
- ARDEC has continued to demonstrate the benefits of titanium with the development of the prototype, lightweight Titanium Protective Crew Compartment

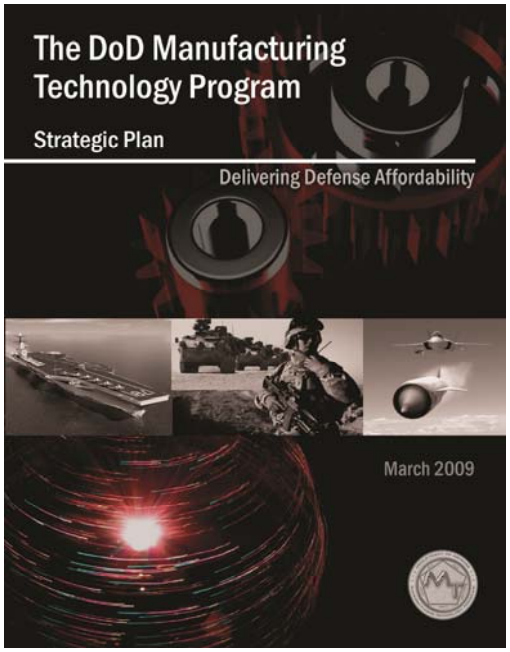
Titanium Warfighter Protection Makes Sense for US Armed Services

- Titanium warfighter benefits:
  - Light weight for transportability
  - Superior ballistic qualities for survivability
  - High corrosion resistance for durability
- High titanium production costs have traditionally delayed more widespread adoption
- ARDEC prototyping and rapid response manufacturing projects have demonstrated the feasibility of titanium-based defense solutions
- A range of other titanium programs, across the services, are funded and administered as part of the Department of Defense's (DoD's) Manufacturing Technology (ManTech) Program*

*ManTech Program initiatives do not represent the entire scope of DOD titanium investment

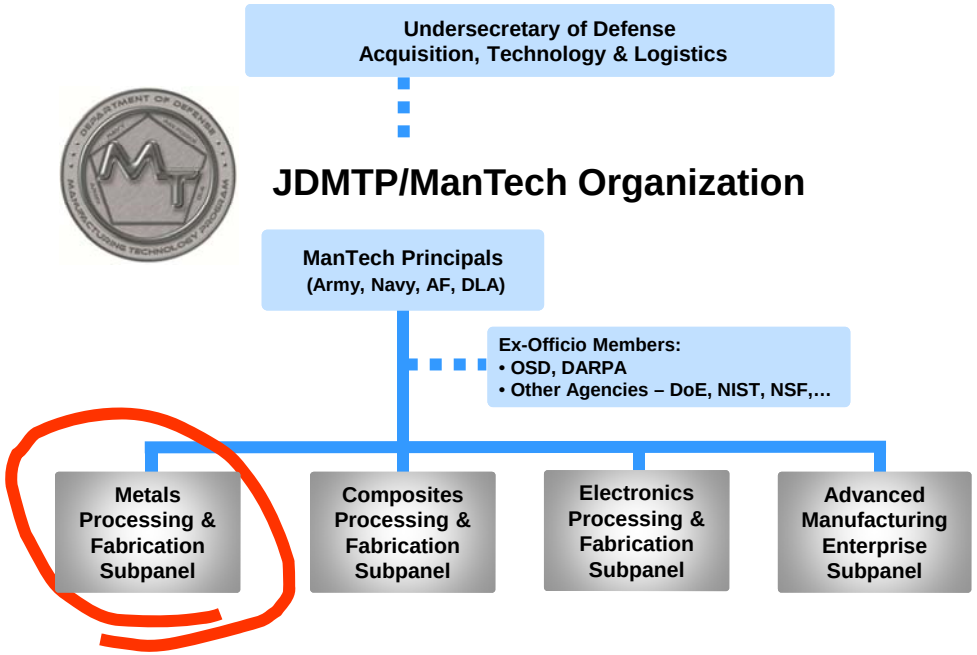
One Area of DoD Investment in Titanium: ManTech

ManTech anticipates and closes gaps in manufacturing capabilities, allowing for affordable, timely and low-risk development, production and sustainment of defense systems



One Area of DoD Investment in Titanium: ManTech

ManTech Program oversight is through the Joint Defense Manufacturing Technology Panel (JDMTP)



Titanium-related projects coordinated through Metals Subpanel

Subpanel members include Army, Navy, Air Force, Defense Logistics Agency (DLA) and other government agencies

Subpanel meets annually to evaluate project portfolios:

Review: Review and rate projects
Analysis: Ensure no conflicts, identify best-in-class
Recommendations: Enterprise-level investments

Recent Examples of DoD Titanium ManTech Investment

ManTech titanium programs focus on reducing costs, improving manufacturability, developing new processes, and testing new alloys, to increase applicability and affordability across the services

Additive Manufacturing: electron beam, laser-engineered net shaping (LENS), laser cladding

Improved Processes: near net shape technologies, forging, casting, low-cost powders, advanced machining

Recent Examples of DoD Titanium ManTech Investment

Army ManTech Program

Abrams Tank

M240L
Machine Gun

M777
Lightweight
Howitzer

Excalibur

Army

Development of low-cost powder and processing for near-net shape weapons parts

Ti Metal Matrix Composite armor plates for combat vehicles

Low-cost Ti armor for Stryker O-GPK shields

Low-cost Ti extrusion billets for appliqué armor attachments

Laser engineered net shaping for repair of Ti bearing housings

Recent Examples of DoD Titanium ManTech Investment

Navy ManTech Program

Non-destructive inspection for electron-beam additive manufacturing of Ti

Reduced cost Ti exhaust ducts for LCS

Laser cladding of Ti for repair and coating of RBP cylinders

Low-cost roll-compacted sheet from Ti powders

Cost reductions for Ti coupler housing manufacture

Laser additive manufacturing in the repair and inspection of Ti compressor blades

Advanced Ti machining for V-22/H-1

Titanium-ceramic encapsulated armor

Near-net-shape reduced cost Ti warheads

Recent Examples of DoD Titanium ManTech Investment

Air Force ManTech Program

Electron Beam additive manufacturing of Ti aircraft parts

Advanced Ti Alloy microstructure and Mechanical Properties Modeling

Use of Ti alloys in structural/thermal protection systems

Ti components for F135 engines

Forgings of affordable, solid-state titanium

Ti 5553 alloy manufacturing development

F135

Air Force

F-35 Joint Strike Fighter

Na

Summary

- Titanium is a key material to meet Armed Services needs for higher strength, lower weight, better ballistic performance and corrosion resistance in structural and armor components
- A range titanium programs, across the services, are funded and administered as part of the Department of Defense (DoD) Manufacturing Technology (ManTech) Program
- Each service has a portfolio of programs that include titanium affordability efforts