



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



***TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.***

## Technology Demands on the Future Industrial Base

Dr. Joseph Lannon

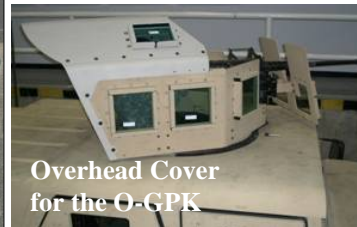
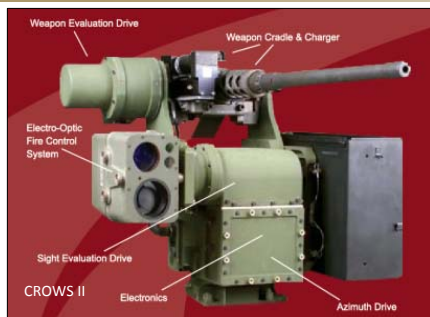
Director, ARDEC

Picatinny Arsenal, NJ



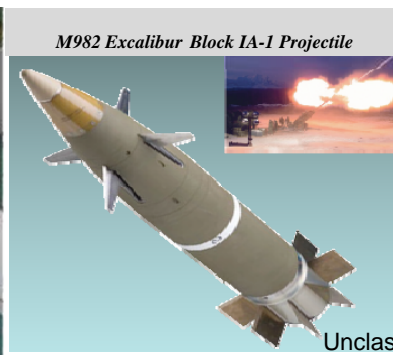
# Bottom-line Upfront

- New technologies are being developed and new materials are being used that will affect the Industrial Base
- To successfully transition these new technologies and materials the Industrial Base needs to be prepared to manufacture these new technology

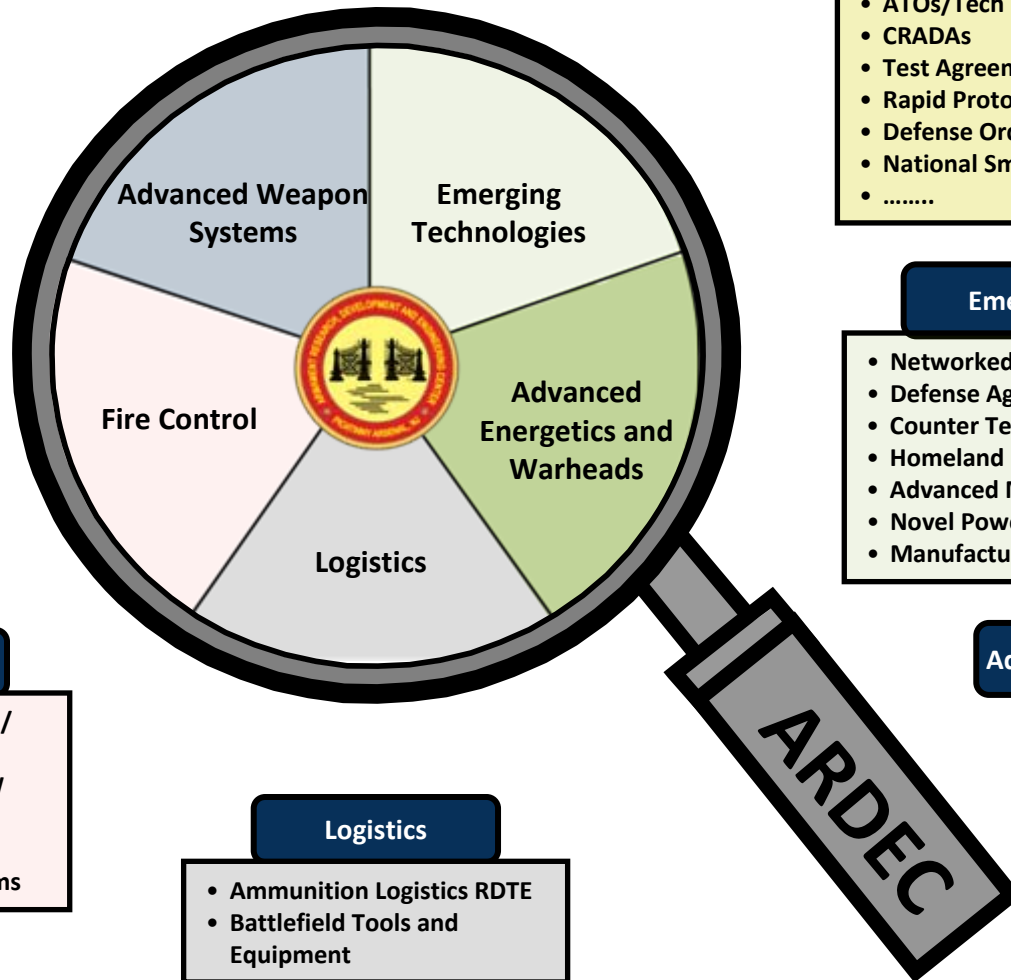


**Vision:**  
Innovative Armaments Solutions for Today and Tomorrow.

**Mission:**  
To develop and maintain a customer focused, world-class workforce that will execute, manage and continuously improve integrated life cycle engineering processes required for the research, development, production, field support and demilitarization of munitions, weapons, fire control and associated items.



# ARDEC Technology Focus Areas



## Advanced Weapon Systems

- Direct Fire
- Indirect Fire
- Scalable Effects
- Non-Lethal Systems
- Small/Medium/Large caliber ammunition
- Directed Energy
- Remote Armaments
- Insensitive Munitions
- Fuzes
- Telemetry
- Precision Armaments
- Grenades
- Maneuver Support Munitions
- Demolitions

## Fire Control

- Battlefield Digitization / SW Applications
- Embedded Systems SW
- Firing Tables
- Ballistics
- Automated Test Systems

## Logistics

- Ammunition Logistics RDTE
- Battlefield Tools and Equipment

## Collaboration Mechanisms

- ATOs/Tech Base
- CRADAs
- Test Agreements
- Rapid Prototyping
- Defense Ordnance Technology Consortium
- National Small Arms Consortium
- .....

## Emerging Technologies

- Networked Lethality
- Defense Against Unmanned Systems
- Counter Terrorism Technologies
- Homeland Defense Technologies
- Advanced Materials / Nanotechnologies
- Novel Power & Energy Systems
- Manufacturing Science Technologies

## Advanced Energetics and Warheads

- Propellants
- Explosives
- Pyrotechnics
- Warheads
  - Kinetic Energy
  - Chemical Energy
  - Shaped Charges
  - EFPs
  - Fragmentation



- Lightweight Small Arms Technologies (LSAT)
- Composite and Reactive Materials
- Nano Materials
- Coated Propellants
- MEMS Safe & Arm (S&A)
- Hyper X Chip
- Insensitive Munitions (IM) Energetics
- Electronic Assembly and Soldering

- Cased Telescoped Ammunition
  - Capacity to produce injection molded parts with high-grade polymers
  - Modifications to existing ammunition load, assemble and pack facilities
- Caseless Ammunition
  - Use of HMX-based propellant
  - Mixing and molding of monolithic grain into near net shape, with tight tolerance for dimensions and density
  - Significant change to load, assemble and pack process

Linked belt of CT Ammo



Injection molded components for CT



HMX Powder

Caseless Cartridge bodies drying on mold cores



Linked belt of caseless ammo

- Scalable & Adaptive Munitions

- Cost effective processes for Non-metallic & metallic structural composite projectile & munition components

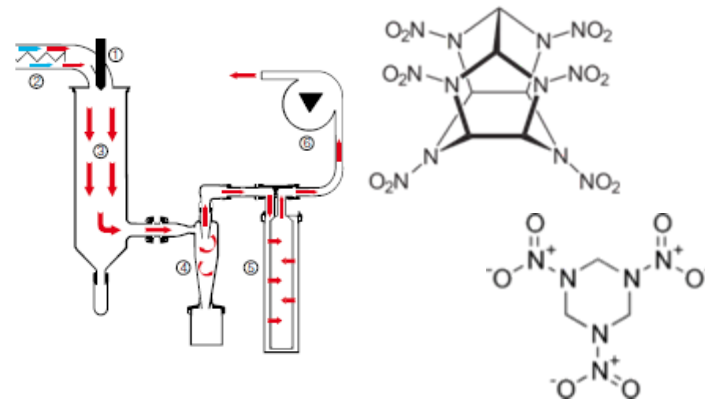
Composite Artillery Projectile



Sintered Tungsten Alloy Matrix

- Nano & High Energy Explosives

- Continuous Manufacturing Process for Improved Morphology & Lower Cost



- Coated Propellants

- *Propellant Coating Processes* – precise coating control & consistency (thickness & coverage)



Sweetie Barrel & Fluidized Bed Coating of Propellants

# MEMS Technology

- Micro-Electromechanical Systems (MEMS) for munitions
  - Utilize metal micro-machining processes for gun-launch environment (not Silicon)
  - Integrating a micro-scale firetrain for fuzing applications
  - MEMS-based Safe and Arm (S&A) achieved TRL6/MRL7
  - Currently in EMD for MK19 40 mm HEPD application
    - MEMS S&A solicitation currently under technical evaluation
- Applicable to high-volume low cost applications or volume constrained systems
  - E. g. Medium cannon-caliber, Grenades, Precision artillery
- **A paradigm shift for the Fuze Industry**

**Traditional Approach - Watchworks used in Fuzes**





# HyperX Technology Platform

## Key HyperX Advantages and Features:

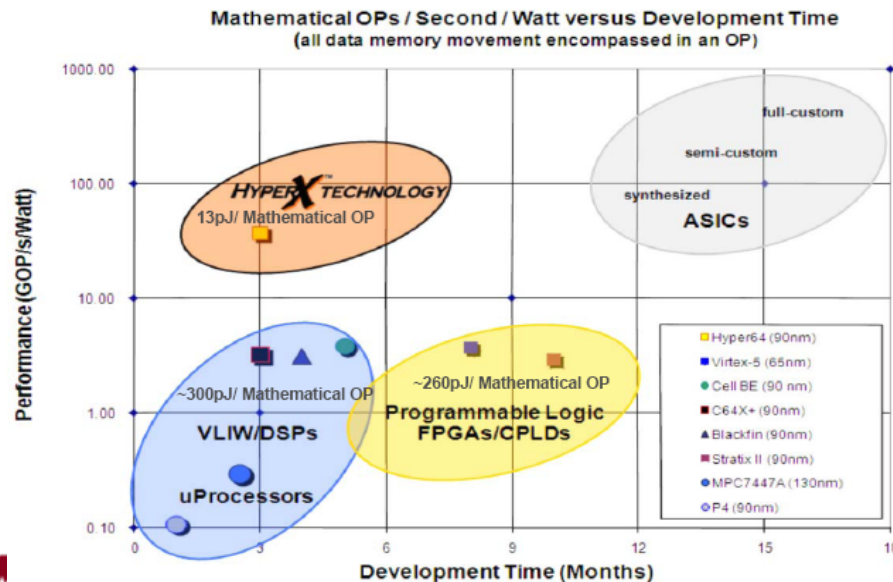
- Internal power management
- Flexible computational power
- Ideal for multi-sensor fusion
- Easily reconfigured
- Rapid extensibility
- Good power to performance profile

## System Uses

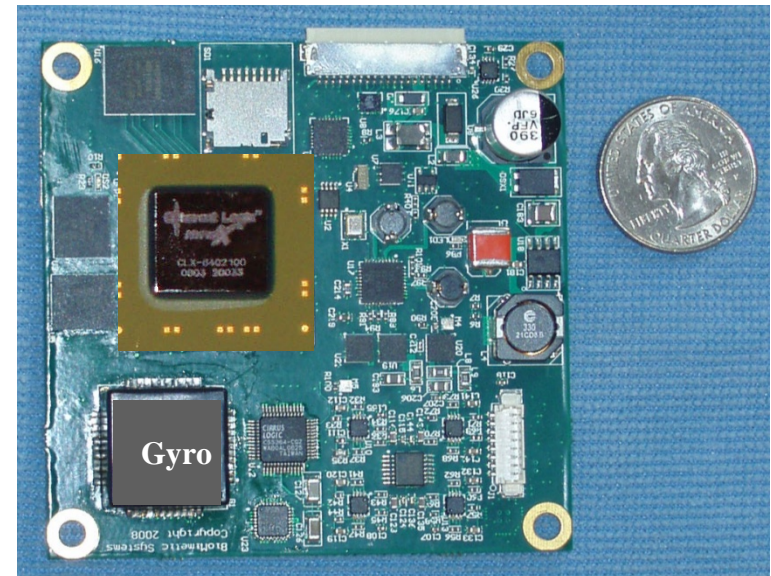
- Complex Computational Environments (Acoustic Sensors, multi-sensor networks, etc)
- Extended battery power applications (hand-held or man-wearable computers)

## HyperX Drawbacks and Disadvantages

- Tools are still being developed
- Limited third party support of technology



## Hybrid HyperX System

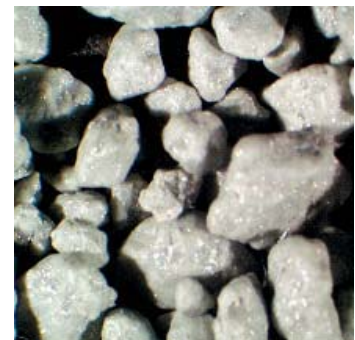


## • New Inensitive Munitions Formulations

- Contain new novel ingredients requiring novel manufacturing technologies
- Significant changes to load, assemble and pack process
- Performance and Quality are strongly affected by minor process and formulation variations



**PAP-8386: Etherless  
Propellant for 120 mm Tank  
Training Rounds**

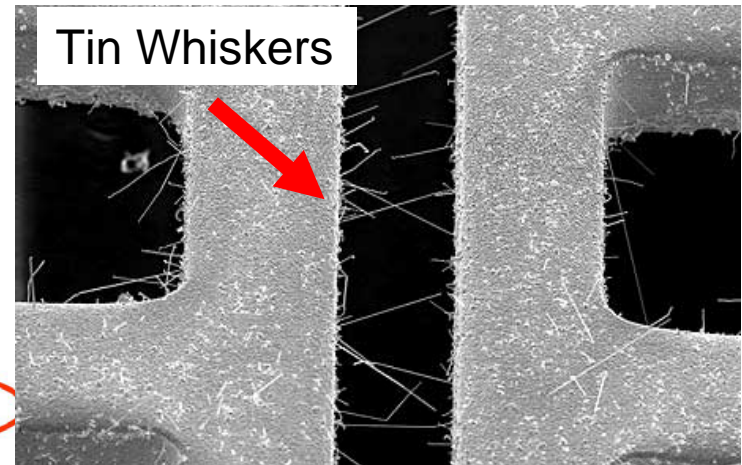
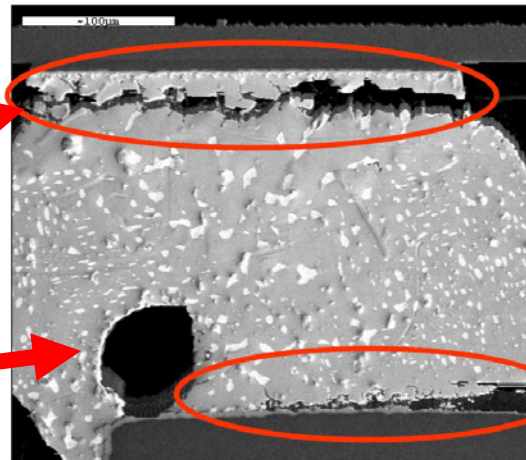


**PAX 3**

- **Solder technology is being driven to change by commercial industry ( i.e. Reduction of Hazardous Substances – RoHS)**
  - RoHS compliance is forcing early obsolescence of tin/lead packages
  - RoHS paste formulas are evolving. All come with new reliability issues
  - Mixed solder processes (i.e. SnPb & Pb Free) create new reliability issues

Stress induced failure

VOID  
(acceptable)



# Summary



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