PEO-AMMUNITION

PROJECT MANAGER – MANEUVER AMMUNITION SYSTEMS

PA171 IM Packaging Container/Cartridge, 120mm, APFSDS-T, M829E3

Presented by
Frank Altamura

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AGENDA

- System Overview (Reference)
- IM Technical Approach
- Logistical and Tactical LifeCycle
- Historical Test Data
- Final Container Design
- IM Testing & Results
- Future Plans / Conclusions

M829A3 APFSDS-T CARTRIDGE

4th Generation 120mm APFSDS-T cartridge

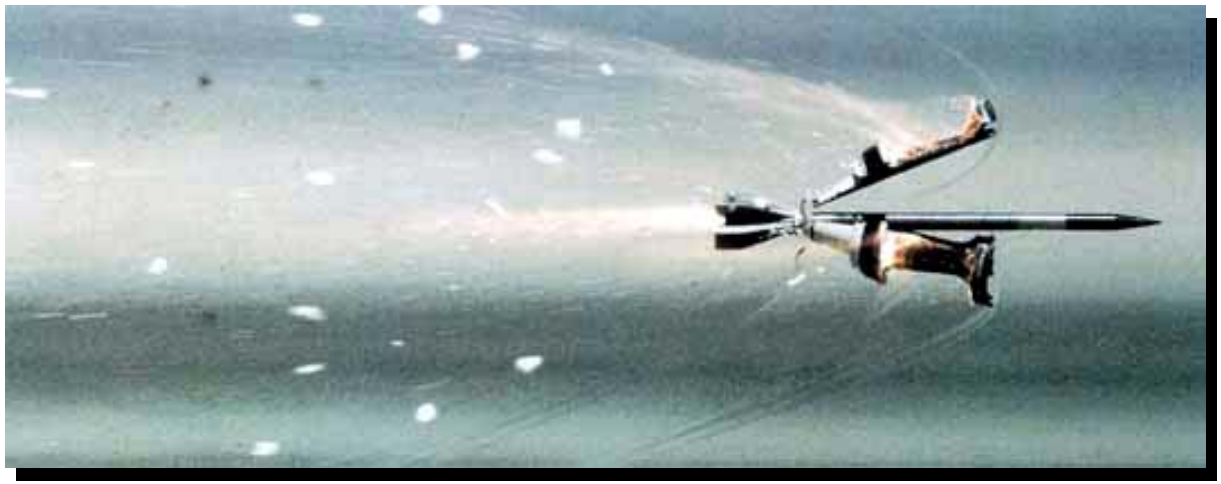
Fired from Abrams MBT

New Higher Energy Propellant (Multiplex Stick Charge)

Electric Primer

Metal Can Packaging

IHC - 1.3C

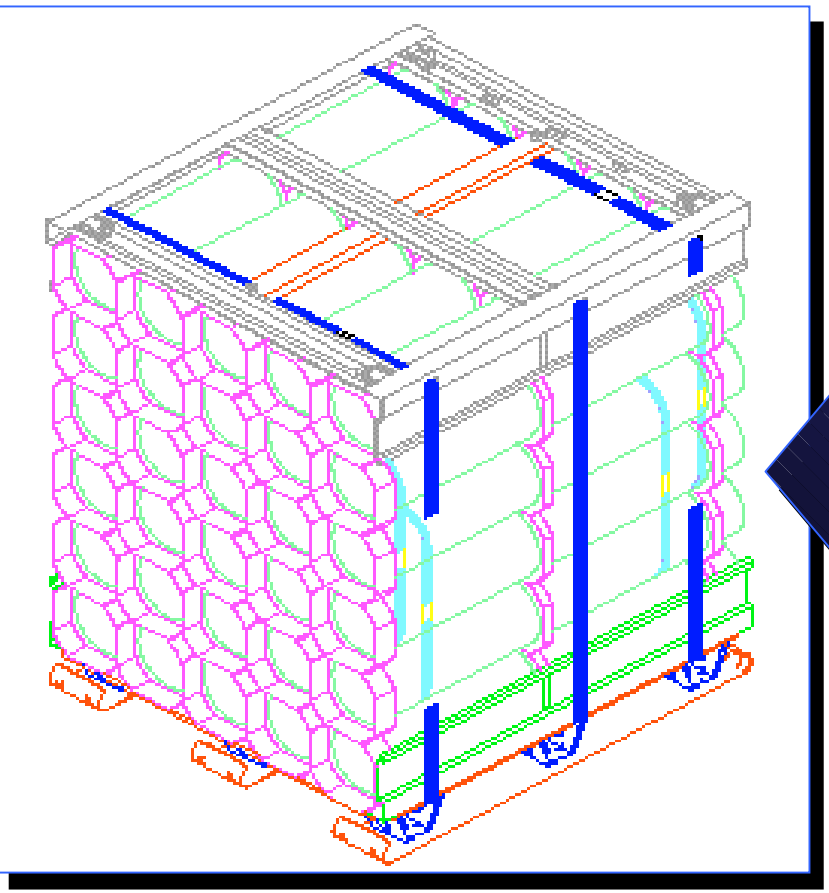


ORGANIZATIONS PROVIDING IM TECHNICAL SUPPORT

- **GOVERNMENT**
  - PEO AMMO/PM-MAS
  - CCAC / AMSTA-AR-CCH-A
  - WECAC / AMSTA-AR-WEP

- **CONTRACTORS**
  - ALLIANT TECH SYSTEMS, INC
  - CONCO, INC

LOGISTICS CONFIGURATION



PA116 Container Stores 1 M829A3

- Container Dimensions:

  7.75” X 7.75”x 44.5”

- Loaded Container Weight ~72 Lbs.

30 Pa116 Containers / Unit Load

- Metal Pallet W/4 Way Entry Base and Top Lift Adapter
- 5 PA116s Across X 6 PA116s High
- Unit Load Weight ~2300 Lbs.(*HEMTT Limit 2,500 Lbs*.)

PLANNED LIFE CYCLE FOR M829A3 CARTRIDGE

- **Logistical**
  - **Cartridge Assembly at U.S. Load Plant (Rocket City, WV)**
  - **Transport Via Rail, Truck, Ship, & Aircraft**
  - **Primary Storage in CONUS**
    - Bunker, Stradley Magazine, Igloo, Etc. (Protected Environment)
  - **Palletized Ammunition Placed in MILVANS for OCONUS Shipment (30 Pallets Max / MILVAN)**
- **Tactical**
  - **Deployed OCONUS on Demand (Preposition / Combat)**
  - **Stored at Ammo Supply & Transfer Points in Theater**
  - **Moved Via HEMTT & Other MHE**
  - **Retrograde Back to CONUS After Deployment Complete**
  - **Minimize Upload Time**

DESIGN CONSIDERATIONS

VENTS

- Sufficient Venting Area
- Optimal Location (Close as Possible to Energetics)
- Correct Orientation: Downward, Not Skyward; Minimize Interference w/Adjacent Containers

VENT WINDOWS

- Proper Melting and/or Fracture Under Desired Conditions
- Resistance to Damage & Environmental Conditions
- Preserve EMI Shielding (via copper paint)

DESIGN CHRONOLGY

- **CONTAINER VENT CONFIGURATIONS EVALUATED STARTED 1993**
- **PA171 DESIGN CONFIGURATIONS**
  - **2, 3 PANE WINDOW (180°, 44 IN^2) - 1996**
  - **2, 3 PANE WINDOW (180°, 59 IN^2) - 1998**
  - **2, 3 PANE WINDOW (180°, 63 IN^2) - 1998**
  - **4, 3 PANE OPEN WINDOW (90°, 137 IN^2) - 1998**
- **4, 3 PANE WINDOW (90°, 137 IN^2) - 1998**
  - **2, 3 PANE WINDOW (90°, 68 IN^2) - 1999**
  - **2, 2 PANE WINDOW (90°, 75 IN^2) - 1999**
  - **2, 1 PANE WINDOW (90°, 79 IN^2) - 1999**
  - **4, 1 PANE OPEN WINDOW (90°, 159 IN^2) - 1998**
  - **4, 1 PANE WINDOW (90°, 159 IN^2) - 2000**

HISTORICAL TEST RESULTS

- **2, 3 PANE WINDOW (180°, 44 IN^2)**
  - M829 PASSED FCO (SIMULATED STACK) BARELY
- **2, 3 PANE WINDOW (180°, 59 IN^2)**
  - M829E3 PASSED FCO (Single Container)
- **2, 3 PANE WINDOW (180°, 63 IN^2)**
  - M829E3 FAILED FCO STACK & SCO
- **4, 3 PANE OPEN WINDOW (90°, 137 IN^2)**
  - PASSED SCO
- **4, 3 PANE WINDOW (90°, 137 IN^2)**
  - PASSED SCO2, 3 PANE WINDOW (90°, 68 IN^2)
  - M82A2 PASSED FCO, SCO & BI
  - M829E3 PASSED FCO & SCO& BI .50 CAL
  - M829E3 FAILED BI 7.62MM & FI
  - M829A2 FAILED FI (ARMY FRAG BARELY)

HISTORICAL TEST RESULTS (continued)

- **2, 2 PANE WINDOW (90°, 75 IN^2)**
  - M829E3 PASSED BI
- **2, 1 PANE WINDOW (90°, 79 IN^2) (CURRENT CONFIG.)**
  - **M829E3 PASSED FCO, SCO & BI WITH EMI PROTECTION**
  - **M829E3 PASSED ARMY** FI **WITH PALLET BARRIER**
  - **M829E3 FAILED ARMY FI (NO PALLET BARRIER)**
- **4, 1 PANE OPEN WINDOW(90°, 159 IN^2)**
  - M829E3 FAILED ARMY FI (BODY HAD NO REINFORCEMENT)
- **4, 1 PANE WINDOW (90°, 159 IN^2)**
  - M829E3 PASSED ARMY FI

CONTAINERS DESIGNS

PA116

- *2 Single Pane Windows*
- *Fiberglass Reinforced Polyethylene Ionomer*
- *90° Offset (downward orientation in pallet)*
- *79 In^2 Vent Area*

PA171

IM TEST SYNOPSIS

PROTOTYPE & PRE PRODUCTION CONFIGURATIONS

- Successfully Completed Slow Cookoff Tests
- Successfully Completed Fast Cookoff Tests
- Successfully Completed Bullet Impact Tests
- Completed Fragment Impact Test
- Successfully Completed Shaped Charge Jet Impact Test
- Sympathetic Detonation Test Not Conducted Due To Successful SCJ Results
- Successfully Completed Sequential Rough Handling

IM TEST SYNOPSIS

Test	M829A1 in PA116	M829A2 in PA116	Passing Criteria	M829A3 in PA171
Fast Cook-Off	Fail (Type III)	Fail (Type III)	Type V (Burn)	Pass Type V
Slow Cook-Off	Fail (Type III)	Fail (Type III)	Type V (Burn)	Pass Type V
Bullet Impact	Fail (Type III)	Fail (Type III)	Type V (Burn)	Pass Type V
Fragment Impact	Fail (Type II)	Fail (Type II)	Type V (Burn)	Fail (Type IV) vastly improved
Shape Charge Jet	Pass (Type II)	Pass (Type II)	No Type I Reaction	Pass (Type III)
Sympathetic Detonation	Pass (Type II)	Pass (Type II)	No Type I Reaction	Pass (Type III)

No M829A3 Type I or II Reactions

Test Result Legend

Type I	Type II	Type III	Type IV	Type V
Detonation	Partial Detonation	Explosion	Deflagration	Burning

TEST RESULTS IN PA171

- **Fast / Slow CookOff**
  - Containers Remained Intact
  - No Harmful Fragments Expelled
- **Bullet Impact**
  - Containers Remained Intact
  - No Harmful Fragments Expelled
- **Fragment Impact**
  - Containers Failed Test Criteria but Showed Marked Improvement Over Standard Container
  - CAIV Analysis Conducted for FI Test with 2 Vent Design Container with No Pallet Barrier Fail Test Criteria
- **SCJI / SD**
  - SCJI Testing was successful, Passed test requirements
  - SD not conducted based on SCJI Test Results

ARMY FRAGMENT IMPACT TEST RESULTS

- **SHOT 1 (PA116)**
  - FRAG VELOCITY 6,062 FT/SEC
  - TYPE III REACTION
    - COVER AND CASE BASE THROWN ~ 195’& 180’
    - SLIGHT DAMAGE TO WITNESS PLATE
    - AVERAGE PRESSURE (3 GAGES) 6.71 PSIG
- **SHOT 2 (PA171)**
  - FRAG VELOCITY 6,110 FT/SEC
  - TYPE IV REACTION
    - COVER AND CASE BASE THROWN ~107’ & 69’
    - AVERAGE PRESSURE (3 GAGES) 4.71 PSIG

CONCLUSION

- M829A3 in a PA171 Container is the Army's Most IM Compliant 120mm Tactical Tank Ammunition Cartridge

- Early Design Selection Criteria Included IM Performance as a Significant Factor
  - Over $16 Million Spent on Propellant and Packaging Design Evaluations and Testing
  - 10 Different Propellant Formulations and Numerous Geometric Configurations Evaluated
  - Over $4 Million Spent Directly on IM Tests
  - Production Costs Will be Increased by $3.25 Million to Improve IM Performance

CONCLUSION

- The PA171 Container Has Also Been Used in the XM1028 and the XM1002. These Programs are Both Currently in PQT Phase and Have Completed IM Testing

- The US Army IM Board Has Scored the Testing Results for Both Programs and Has Concluded That Both Cartridge Systems to be IM Compliant