



**AMC**

# ALACV PROGRAM



## **ALACV Airburst Demonstration Fuze For 40mm Cannon Caliber Ammunition**

**Fred Herr  
US Army ARDEC  
Mark Tomes  
Alliant Techsystems**

**48<sup>th</sup> Annual  
Fuze Conference  
28 April 2004**



**Committed To Excellence**



AMC

# Presentation Outline



- Program objectives
- Program background
- 40mm projectile
- S&A
- Fuze Electronics
- Ballistic test data
- Fragmentation Data
- Test Video
- Summary



Committed To Excellence



AMC

# Program Objective



- Develop and Demonstrate improved Air Bursting Munitions and Advanced KE capability in 40mm.
- Goal: Achieve a 400% increase in lethal area for Air Bursting Munitions, and a 30% increase in Behind Armor Effects for Advanced KE



Committed To Excellence



AMC

# Program Background



- Science and Technology Objective (STO) FY00-03
- Caliber: Super 40
- Utilized IPT to combine in-house, contract, and CRADA efforts
- Projectile Body
  - Designed by ARDEC Warheads Team
  - Produced by General Dynamics
- Partnering with Alliant Techsystems to provide Demo Fuze for Air Bursting Warhead demonstration & development for 40mm round
  - S&A – ARDEC Fuze Division (in-house effort)
  - Electronics – ATK



Committed To Excellence



AMC

# Demonstration Fuze Requirements



FY03 ballistic test with ARDEC projectile for warhead evaluation.

- Provide AB at 1500m from launch.
- Environments:
  - Setback: 80,000 Gs
  - Spin: 48,000 RPM
- Safety:
  - No Arm Distance: 60 meters
  - All Arm Distance: Dependent on command arm signal
- Base Fuze dimensions:
  - Height: 1.25"
  - Diameter: 1.22"



Committed To Excellence



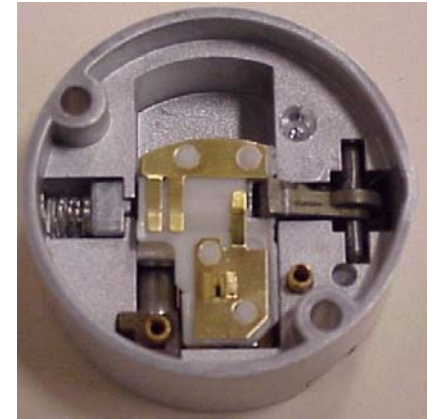
AMC

# ALACV S&A

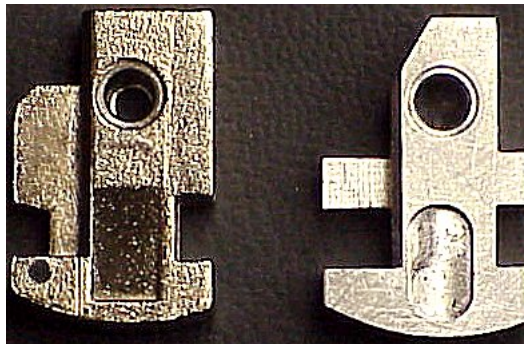
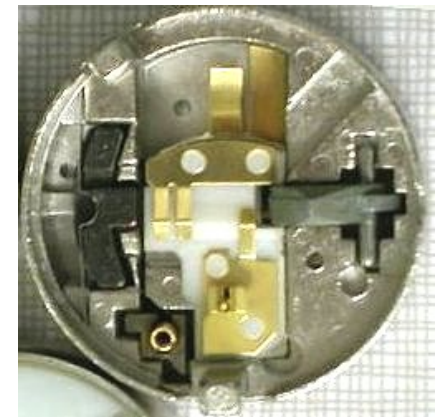


- Utilized modified M762A1 artillery S&A (30Kg, 30Krpm)
  - M762A1 is nose mounted
  - ALACV is base mounted
    - Replaced M762 spin lock with M550 spin lock
    - Redesigned slider
    - M762 made of zinc die-casting alloy
      - ALACV made of aluminum 7075-T6
      - ALACV slider redesigned to decrease material

ALACV S&A



M762A1 S&A



M762A1 Slider

ALACV Slider



Committed To Excellence



AMC

# ALACV S&A Testing



- Explosive Train Test
  - Ensure PA537 detonator initiates PBXN-5 lead and PAX-2A main charge
  - Air gap spacing worst case
  - All units functioned
  - Testing was conducted at the Explosive Development Facility bldg. 3024, Picatinny Arsenal, NJ (Fuchs – Poulos)
- Spin Test
  - 5 inert S&As subjected to 60,000 rpm spin environment
  - All units armed
- Out of Line Test
  - 8 S&As functioned out of line using PETN as acceptor
    - PETN did not function



Committed To Excellence



AMC

# ALACV Fuze Electronics



- Proven design repackaged for 40mm application
  - XM29 20mm hundreds of successful tests
  - PAF 30mm 36 successful air burst demonstration tests
  - XM29 20mm MEMS S&A, initial testing very promising
- Turns Counting Circuitry
  - Reliable and accurate range estimation
- Fuze Modes
  - Only air burst mode implemented
  - Design compatible with additional modes such as PD and PDD
- Inductive set fuze
  - Reliable fuze setting



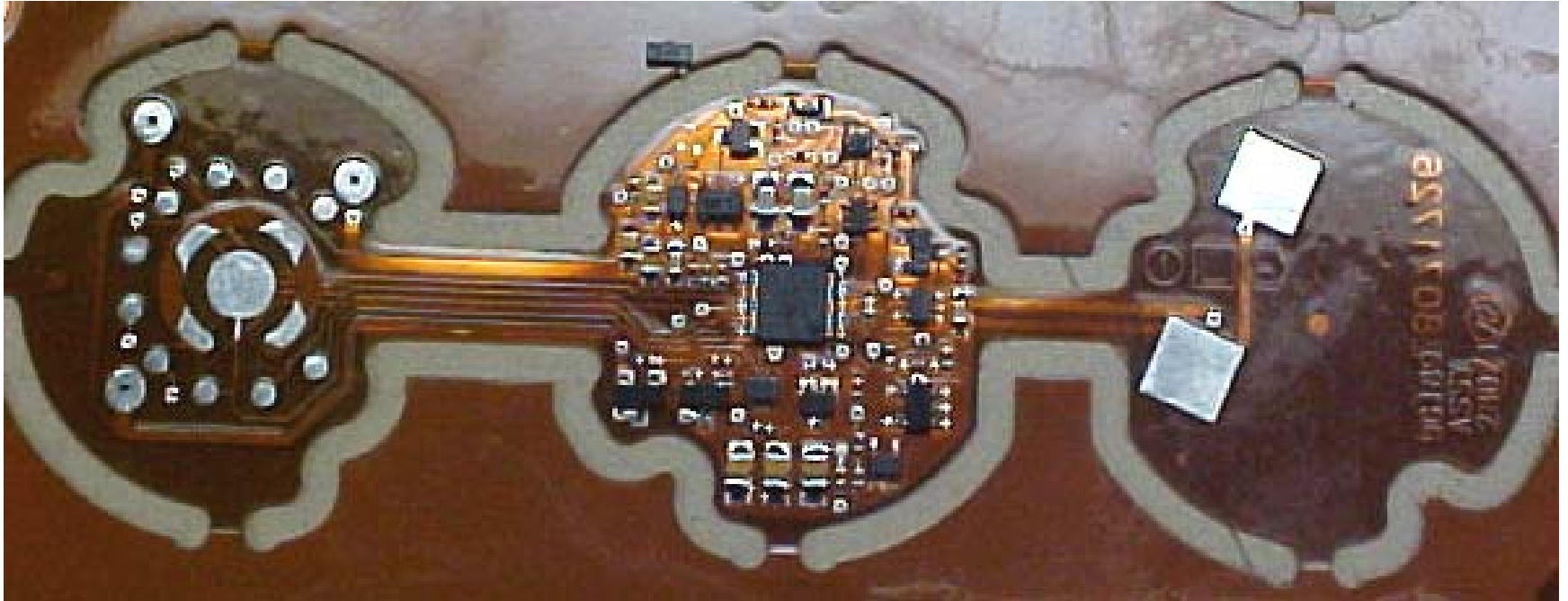
Committed To Excellence





AMC

# Fuze Circuit Panel



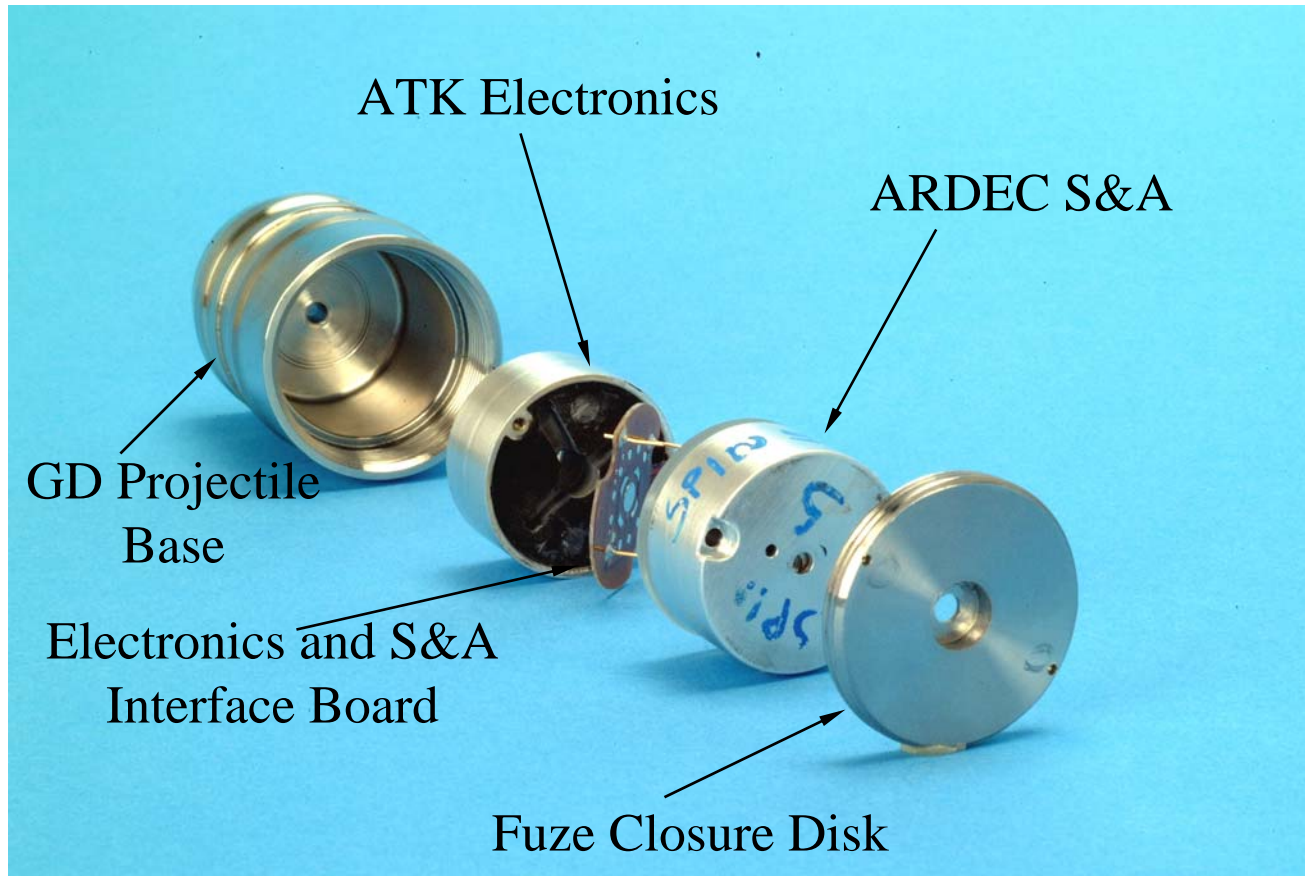
Designed To Meet Small Volume Requirements



Committed To Excellence



# ALACV Fuze Assembly

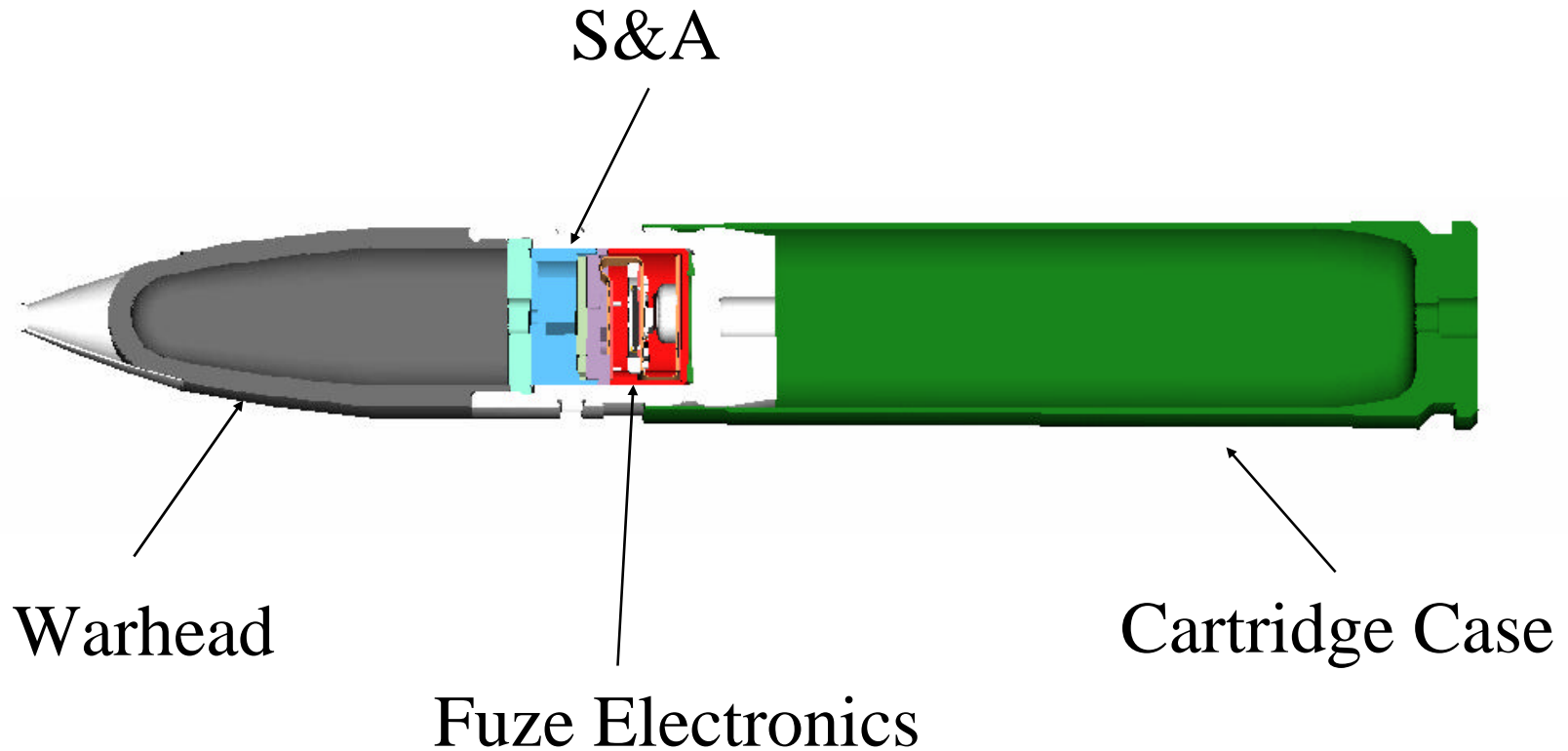


Committed To Excellence



AMC

# ALACV Cartridge Assembly



Committed To Excellence



AMC

# Tested ALACV Round Configuration



Rotating Band  
(Sintered Iron)

Windscreen  
(bonded w/ 3M  
adhesive)

Generation II  
Air Burst  
Warhead

Obturator Groove  
(Obturator is Nylon)



Committed To Excellence



AMC

# Fuze Development Tests



- Performed twelve 1500m soft-catch tests to assess fuze & projectile performance
  - Soft-catch series #1: S&A not arming, improved detonator and piston actuator contacts
  - Soft-catch series #2: Projectile compressing S&A on launch, turned down rotating bands
  - Soft-catch series #3: Good fuze function

**Development Tests Paved The Path to Air Burst Demonstration**



Committed To Excellence



AMC

# Successful Air Burst Demonstration



- December 2003, Alliant Techsystems Proving Ground in Elk River, Minnesota
  - 12 rounds fired
    - 6 rounds from Mann barrel
    - 6 rounds from MK44 auto gun including 3 round burst
  - Target
    - Dismounted infantry squad
    - ATGM site



Committed To Excellence



AMC

1500 Meter 40mm ALACV Air Burst

# ALACV Air Burst Data

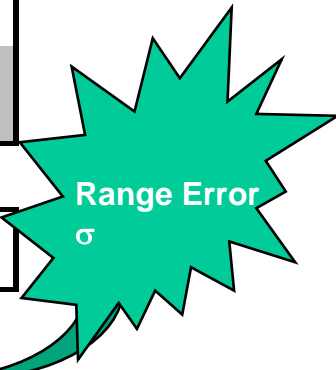


Date	Air Press. (mbars)	Air Temp (°C)	Barrel	Test ID	Radar Data		
					Velocity m/s	Burst Range m	TOF sec
10-Dec	976.6	-5	Mann	AB-1	935.7	1528.8	2.281
10-Dec	976.9	-5	Mann	AB-2	941.2	1502.5	2.208
10-Dec	977.2	-6	Mann	AB-3	940.2	1526.1	2.259
11-Dec	982.3	-18.9	Mann	AB-4	940.8	1520.3	2.279
11-Dec	982.3	-18.9	Mann	AB-5	943.2	1521.4	2.270
11-Dec	982.3	-18.9	Mann	AB-6	943.7	1527.1	2.271
11-Dec	983.1	-13.9	Auto Gun	AB-7	945.3	1531.6	2.297
11-Dec	983.1	-13.9	Auto Gun	AB-8	949.1	1521.6	2.263
11-Dec	983.1	-13.9	Auto Gun	AB-9	942.9	1526.9	2.289
11-Dec	983.7	-12.2	Auto Gun	AB-10	936.5	1518.1	2.286
11-Dec	983.7	-12.2	Auto Gun	AB-11	947.5	1530.4	2.285
11-Dec	983.7	-12.2	Auto Gun	AB-12	934.2	1515.4	2.295

Fuze Range Adjustments

- For Zeroing
- For MET

All Rounds	Average	941.69	1524.3	2.279
	Std Dev	4.59	5.3	0.013



Legend

	AB-2 Data excluded from statistics due to loss of rotating band
	Auto Gun Three Round Burst



Committed To Excellence





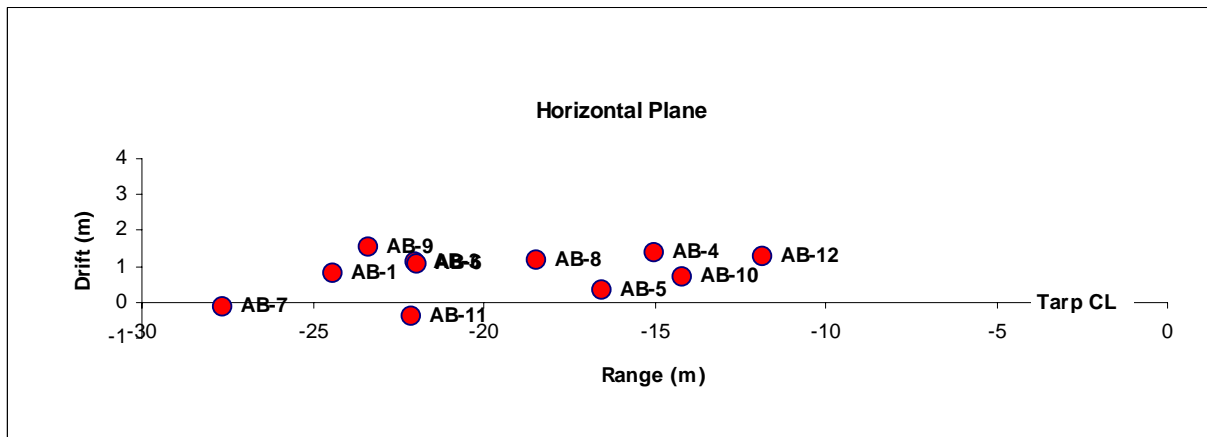
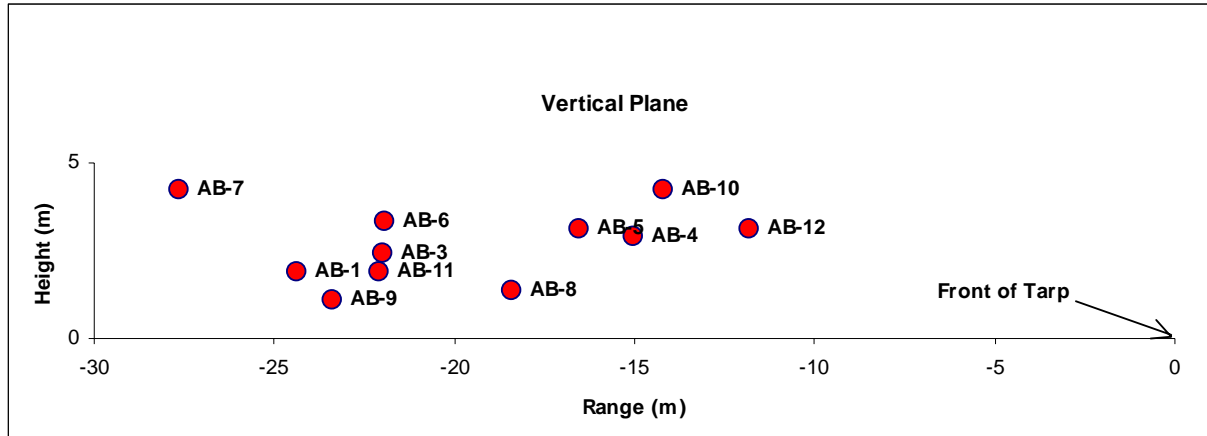
AMC

# Air Burst Locations



Range &  
Vertical

Range &  
Horizontal



Committed To Excellence



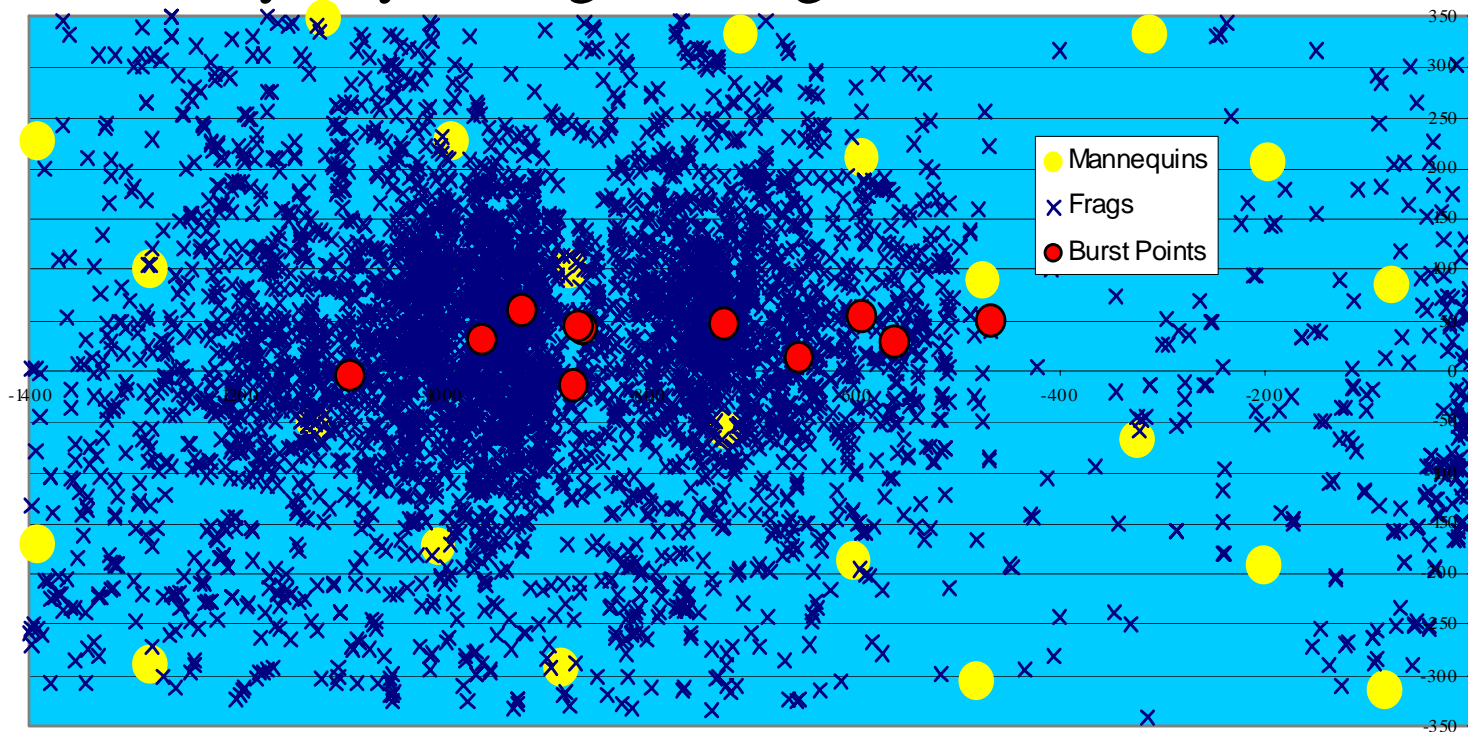


AMC

# Vulcan System Identifies Fragment Position



- Data collected by Ray Young from Eglin, AFB



Bottom Tarp - Located 5164 Fragment Impacts

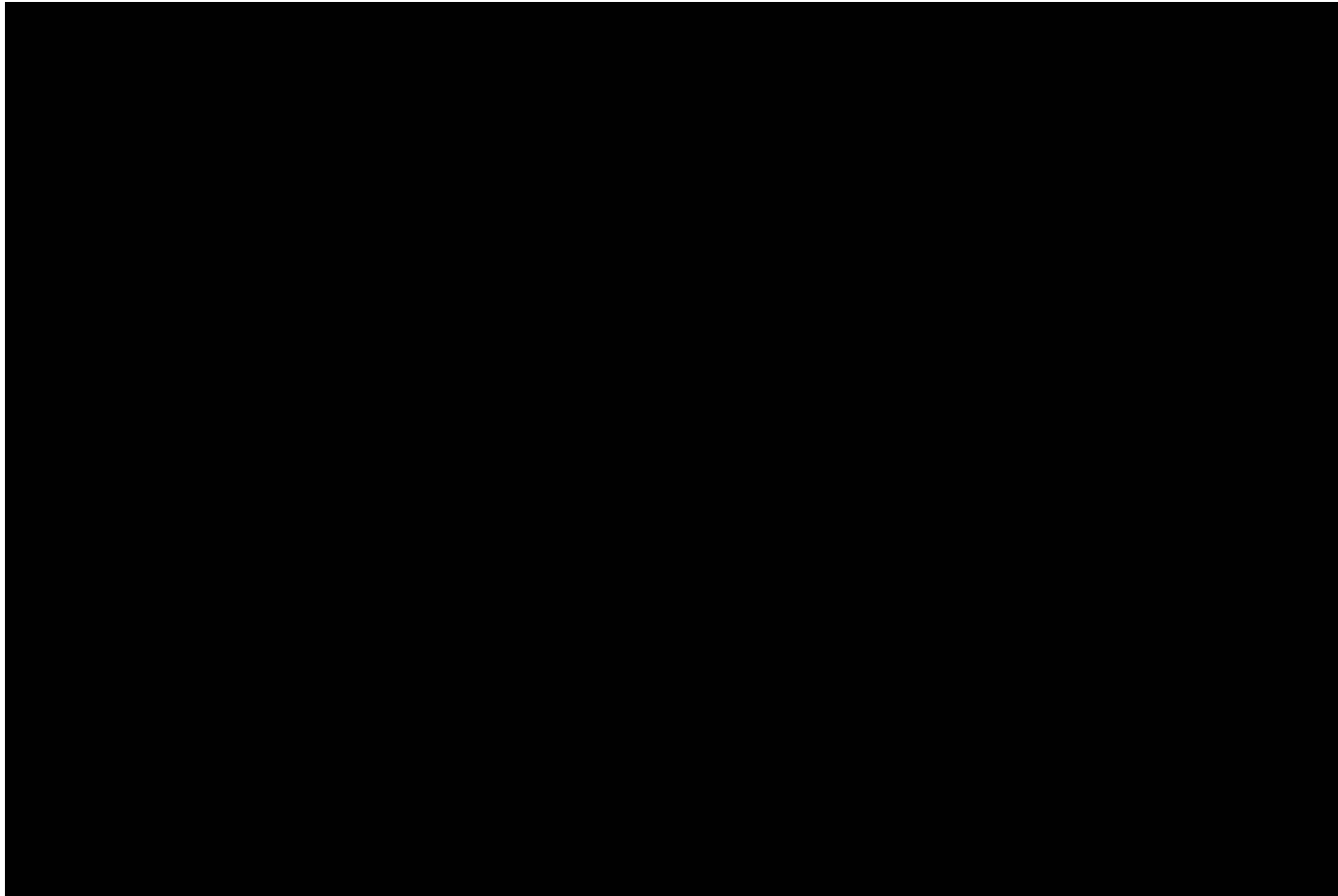


Committed To Excellence



AMC

# ALACV 40mm Demonstration Video



Committed To Excellence



AMC

# Summary



- Demonstrated airburst capability in a Super 40mm round
- Demonstrated increased lethality over current medium caliber ammunition
- Demonstrated accuracy of 5.3 meters at 1500 meter range



Committed To Excellence