

# CAT

*Flight Services, Inc.*

# PERSUADER



# HYPERVELOCITY

# ROCKET



Visit our website at [www.catflight.com](http://www.catflight.com)

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# **INTRODUCTION**

- **This presentation provides a Summary Overview of an advanced 2.75 Hypervelocity Weapon developed in the private sector with private funding**
- **The technology was leveraged from a U.S. Army Missile Command Hypervelocity Rocket Technology Development program**
- **Superior accuracy and lethality, coupled with safety and durability offer state-of-the-art capability with an extremely low Cost/Kill from existing launchers/platforms**
- **Multiple K.E. Penetrator Warheads provide lethal capability against an extremely wide variety of threats**
- **The Weapon is a Non-Developmental Item, ready for Certification/Production and Combat Operations**

- **Army “SPIKE” Program (1980’s) demonstrated hypervelocity rocket (HVR) performance and lethality**
  - ▶ Used multi-penetrator warheads
  - ▶ 1.9” diameter
  - ▶ Lightweight composite motor case/composite propellant
- **CAT formed an industry team to leverage this technology into a 2.75” (70mm) HVR motor with KE Penetrator warheads**
  - ▶ Successfully flown from HYDRA-70 launcher (composite propellant and composite motor case)
  - ▶ Industry funded and passed certified insensitive munitions test (MIL-STP-2105B)
  - ▶ HERO compliance certified by U.S.Navy and U.S.Army
  - ▶ Successfully passed MICOM-requested worst-case environmental test sequence (temp, shock, vibration and thermal shock)
  - ▶ 900 penetrator KE warheads successfully flown

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## **PERSUADER 2.75 INCH ROCKET SYSTEM DEVELOPMENT TEAM**

### **CAT Flight Services**

Team Lead, System Design/Engineering/Integration,  
Kinetic Energy (KE) Penetrator Warhead Design,  
Component Manufacturing, Final Assembly,  
Test Direction/Support  
Company Lead: Larry Bradford

### **Atlantic Research Corporation**

Propellant Mixing/Loading, Nozzle Manufacturing,  
Motor Static Testing  
Company Lead: Steve Rockwood/Charlie Clarke

### **Lincoln Composites**

Composite Motor Case Manufacturing  
Company Lead: John Bomberger

### **Teledyne Metalworking Products**

KE Warhead Tungsten Penetrator Manufacturing  
Company Lead: Dr. Steve Caldwell

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# The PERSUADER was Technology Leveraged From MICOM-SPIKE Hypervelocity Technology Development Program (1978 - 1990)

- **SPIKE Lightweight Composite Motor (1.9") development/flight demonstration**
  - Single one-pound KE Penetrator
  - 130 flight tests
- **SPIKE Multi-Penetrator warhead development/flight demonstration (over 200 flight tests)**
  - 18 penetrators (forward release)
  - 18 penetrators (center release)
  - 80 penetrators
  - 88 penetrators
  - 100 penetrators
  - 216 penetrators
- **SPIKE Demonstrated platform compatibility**
  - Helicopter (COBRA)
  - Robotic Ground Vehicle
  - HMMV (PMS); Pedestal Mounted Stinger
- **SPIKE Demonstrated accuracy from fixed launcher: 3.2 mil CEP**

## Successful PERSUADER Development Overview & Summary Milestones

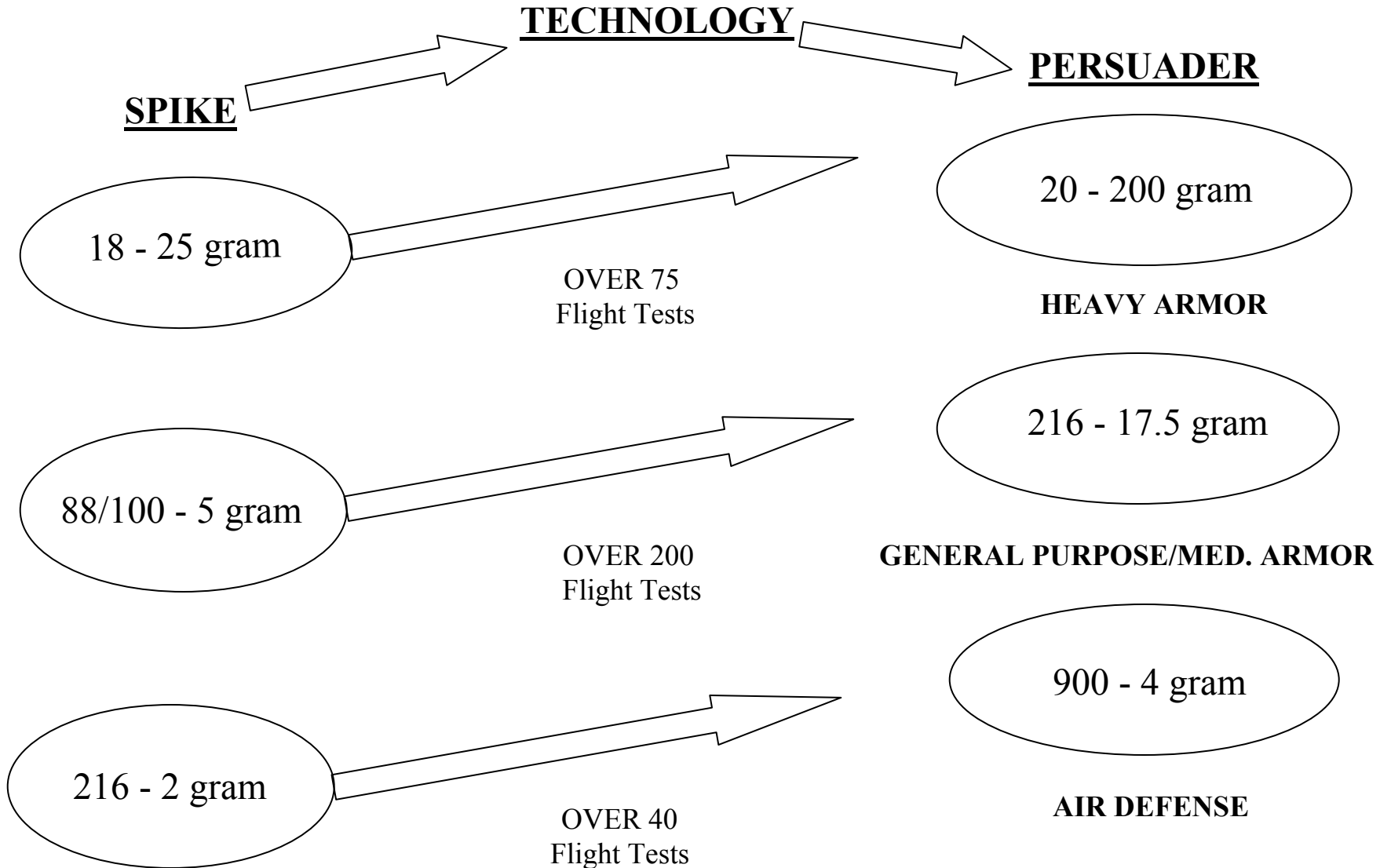
- Tri-service user survey of deficiencies/requirements
- Concept definition and system design
- Component development/verification testing
- Seven successful flight tests out of M261 HYDRA-70 launcher
  - Four with 7-pound warhead: 1490 m/s
  - Three with 10-pound warhead: 1250 m/s
- Successfully passed Insensitive Munitions (IM) Tests
  - Fast “Cook-off”
  - Bullet Impact
  - Fragment Impact
  - Sympathetic Detonation
- Successfully passed MICOM requested worst-case environmental test sequence (Jointly Funded: MICOM/CAT Team)
  - Accelerated aging
  - Shock
  - Vibration
  - Thermal Shock
  - Statically fired at temperature extremes
- Successful flight tests with 900 Penetrator warhead from M261 launch pod integrated into Hawk launcher/radar/fire control (Jointly Funded: MICOM/CAT Team)

# KE PENETRATOR WARHEAD DEVELOPMENT

- PERSUADER Team supported MICOM and developed five multiple-penetrator warhead designs
- PERSUADER Team also supported over 300 flight tests of these Warheads
- Developments included single KE rod and Multi - Penetrator designs with 1, 2, and 3 bays of penetrators
- Target Menu included Anti-personnel/Air-defense, medium armor, and heavy armor (defeats tanks thru top, sides, rear, cannot penetrate frontal armor)

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**...RESULTED IN SUCCESSFUL SCALE UP  
OF KE PENETRATOR WARHEAD**





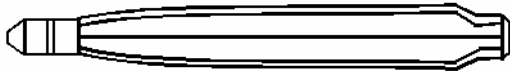
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## PERSUADER WARHEAD OPTIONS FOR ENHANCED VERSATILITY

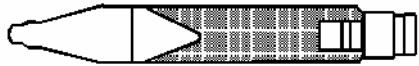
### Applicable Existing HYDRA-70 Warheads



**M151**



**M229**



**M247**

### Others

**Personnel Anti-Armor/Personnel**

### Why are they valuable?

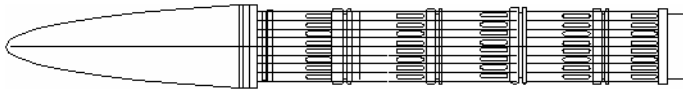
- Qualified and available
- Force Structure exists
- Applications and lethality established
- Training warheads are qualified and available

### What does Persuader offer?

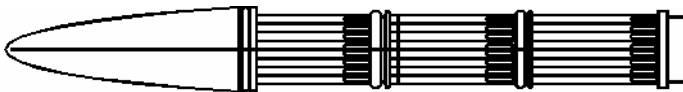
- Minimum time to target for improved survivability
- Accuracy and speed to provide increased lethality
- Accuracy, range and speed for additional applications and increased standoff
- IM compliant motor for increased safety

### New PENETRATOR Warheads

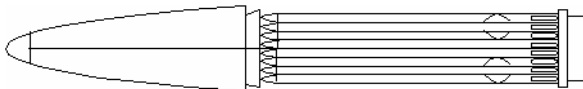
**4 grams**



**17.5 grams**



**200 grams**

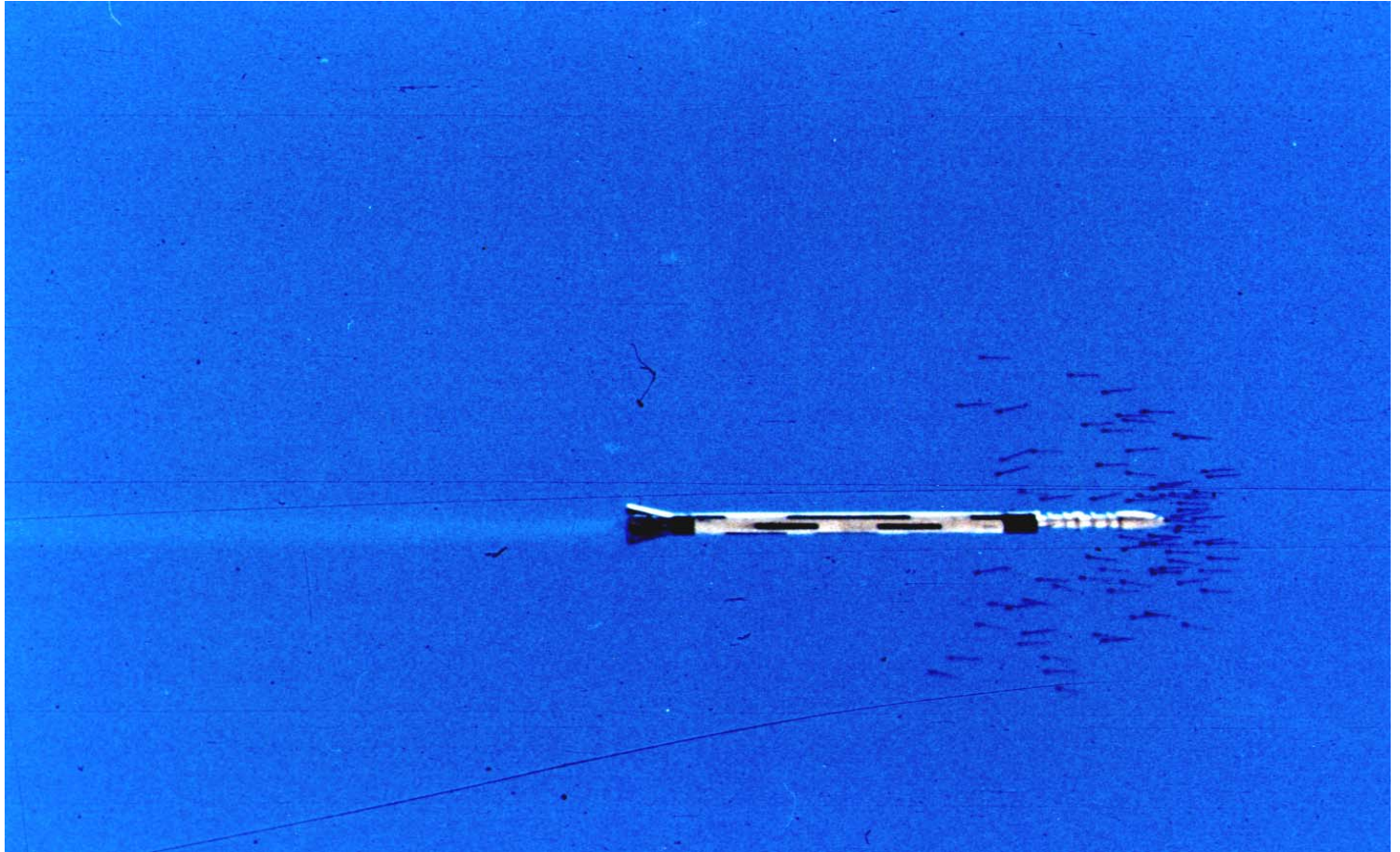


### What do new KE Penetrator warheads offer?

- Proven lethality for air defense at extended ranges
- New capabilities to engage light-to-medium armor targets
- New capabilities for application to material and troops at longer ranges
- New capabilities for deep interdiction against bunker storage, etc.
- Capability for significant damage to heavy armor
- Inert to IM stimuli

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**Clean (no tumble) Penetrator Release  
Conserves Velocity, Delivers Maximum  
KE on Target**



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# PERSUADER HYPERVELOCITY ROCKET

## VERY SAFE, VERY LETHAL.....



**PERSUADER is a Fully Developed State of the Art 2.75 Inch Rocket**

- COMPATIBILITY:** Compatible with all existing HYDRA-70 launchers/platforms
- LETHALITY:** Dramatically superior to any existing 2.75 inch rocket
- SAFETY:** Exceeds the CRV series and substantially exceeds HYDRA-70
- COST:** Competitively priced, with a substantial reduction in rounds required for kill

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**.....COMPATIBLE WITH EXISTING HYDRA-70  
LAUNCHERS, PROVIDING THE LOWEST  
COST/KILL OF ANY 2.75 ROCKET.....**

**LETHALITY**

- Extremely accurate delivery of Multi-Penetrator Warheads dramatically increases hit probability
- Substantially higher velocity greatly increases penetration/kill probability
- Penetrator energy on-target is over 300% greater than HYDRA-70

**SURVIVABILITY**

- Extended range capability provides increased platform standoff
- Quicker kills
- Reduced number of rounds required/kill enhances both defensive and offensive capability



**KINETIC ENERGY WARHEAD**

**20 - 900 PENETRATORS**

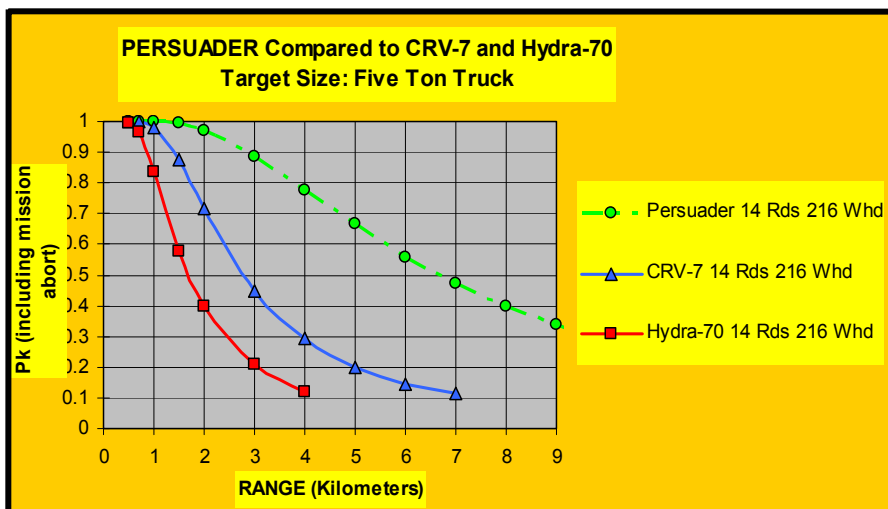
## .....MINIMIZES LOGISTICS AND SUBSTANTIALLY INCREASES PLATFORM STAND-OFF.....

### SAFETY

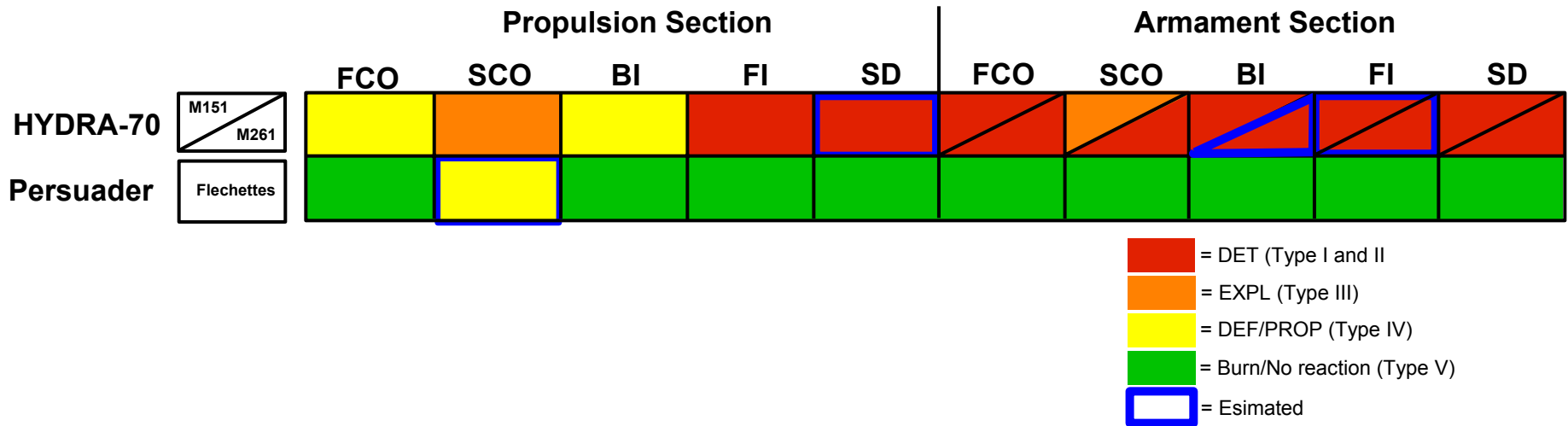
- NATO class 1.3 propellant
- Meets US specifications for HERO, EMD
- Meets MIL-2105B, U.S. insensitive munitions spec. (with exception of SCO, estimated to go propulsive based on similarity)

### COMPATIBILITY

- Compatible with all launchers capable of firing HYDRA-70: mechanically & electrically (designed, demonstrated, and verified)
- Soft Launch: launch loads are well below established upper limits
- Logistics: force structure exists, standard operating procedures for HYDRA-70 apply, lowest number of rounds required/mission
- Warheads: New KE Penetrator Warheads, but compatible with most existing HYDRA-70 type Warheads



## Persuader Substantially Improves 2.75 Inch IM Capability



- **Persuader motor IM testing was done at Tera Socorro, NM**

Fast cook-off DI-SAFT-81130 S/N 22, S/N 17

Bullet Impact DI-SAFT-81132 S/N 21

Fragment Impact DI-SAFT-81133 S/N 20

Sympathetic Detonation DI-SAFT-81134 S/N 16, S/N 18

- **Definitions**

**FCO:** Fast Cookoff

**SCO:** Slow Cookoff

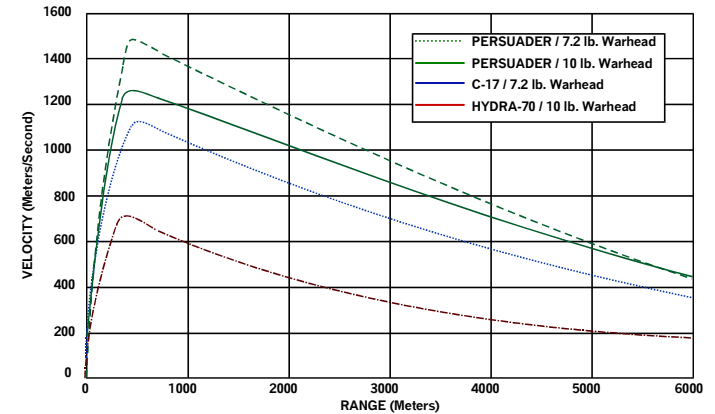
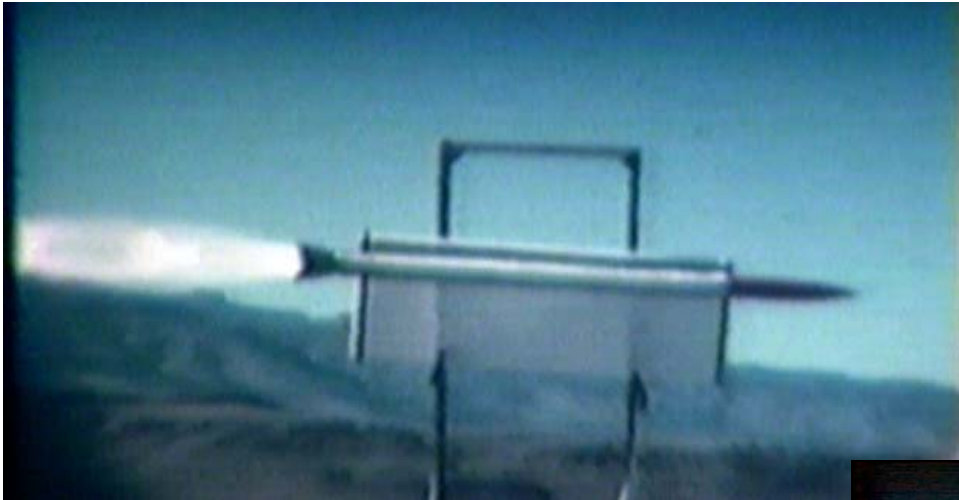
**BI:** Bullet Impact

**FI:** Fragment Impact

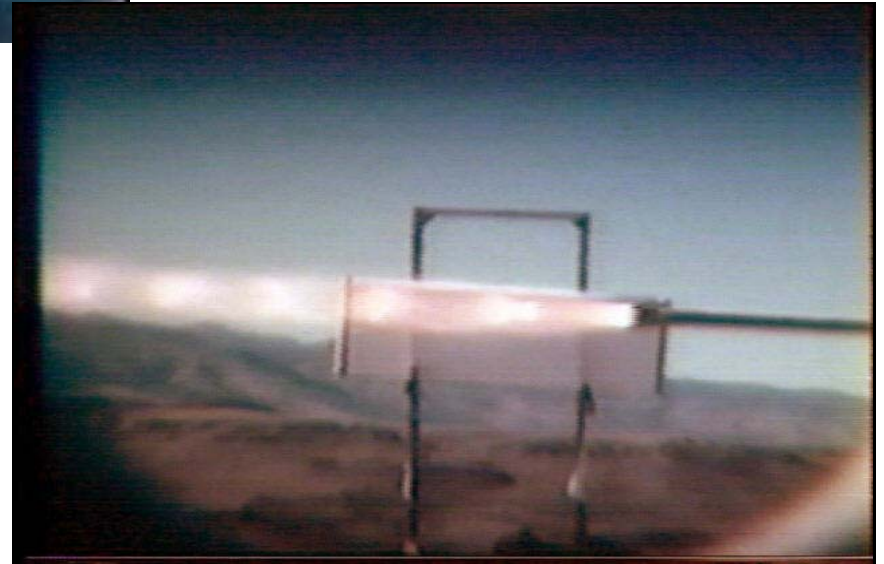
**SD:** Sympathetic Detonation

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..... MINIMUM TIME-TO-TARGET RESULTS IN QUICKER KILLS,  
WHILE FLIGHT VERIFICATION DEMONSTRATES SUPERB  
VEHICLE STABILITY AND MINIMUM PLUME SIGNATURE.....



- Hypervelocity speed and superb aerodynamic stability support the weapons inherent accuracy
- Reduced smoke composite propellant not only contributes to weapon safety but provides substantially reduced plume signature



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## .....FLAT TRAJECTORY, MINIMUM DISPERSION AND NO COUNTERMEASURES DRAMATICALLY ENHANCE WEAPON EFFECTIVENESS !

Motor Weight: 13.9 lbs

Velocity: Warhead:

1250 m/s 10 lb

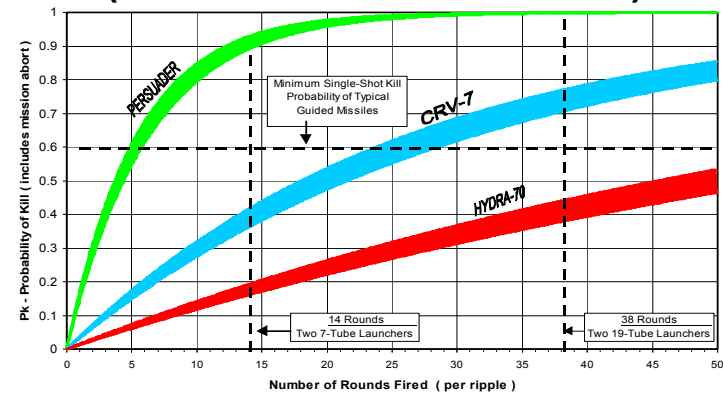
1490 m/s 7 lb

Inner Boundary: <500 meters

Maximum Range: 16 Km

Dispersion: <5 mils CEP

### BROAD THREAT MENU AT 3 Kilometers ( 216 Penetrator Warhead )



### COST

- PERSUADER unit price is competitive with both HYDRA-70 and CRV series
- Substantial Reduction in required rounds/kill, provides the lowest cost/kill of any 2.75 weapon



# SUMMARY

- **PESUADER MEETS THE NEED FOR AN IMPROVED ROCKET**

## HYPERVELOCITY PERSUADER PROVIDES UNIQUE ADVANTAGES

- **Quicker Kills** ...Enemy has much less time to maneuver or counter
- **Greater Accuracy** ...Much Less dispersion  
...Much Less wind effect
- **Simplified Engagements** ...Support Turn-and-Shoot tactics  
...Minimizes quadrant elevation adjustment
- **Longer Range** ...Matches improved (longer-range) sensor capabilities
- **Greater Survivability** ...Survivability significantly improved with increased stand-off
- **Air-to-air Engagement** ...NEW rocket capability
- **Lower Cost** ...Substantially higher number of stowed kills per launcher/mission

## **CONCLUSIONS**

### **DISPERSION COMPENSATING MULTI-PENETRATOR WARHEADS PROVIDE THE PERSUADER WITH UNMATCHED LETHALITY IN 2.75 INCH ROCKETS**

- **THIS PROVIDES THE USER WITH SUBSTANTIALLY DECREASED COST PER KILL**
  - significantly less rockets/target
  - minimizes platform time-on-target and rounds/target
  - frees up assets faster for other missions
- **MINIMIZES LOGISTICS SUPPORT FOR WEAPON SYSTEM / PLATFORM**
- **NEW CAPABILITY IN AIR -to- AIR COMBAT**
- **IN ADDITION PERSUADER CAN USE EXISTING HYDRA-70/CRV SERIES OF WARHEADS FOR EVEN GREATER VERSITILITY**

**PERSUADER..... STATE-OF-THE-ART 2.75 INCH WEAPON**