GENERAL DYNAMICS

Ordnance and Tactical Systems

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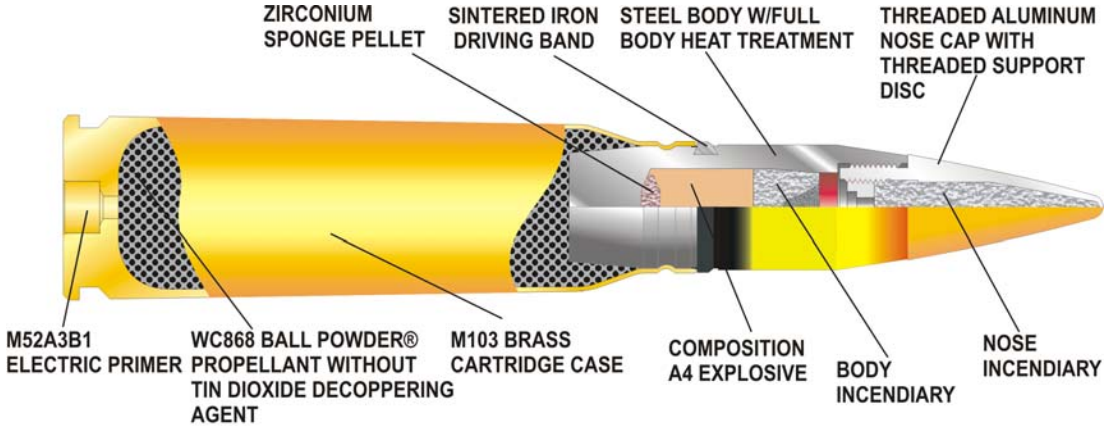
Charlotte, North Carolina

"Meeting Warfighter Needs for the Asymmetric Threat"

GD-OTS 20mmx102mm Mechanically Fuzed Projectile Program

Introduction:
GD-OTS 20mm Fuzed Cartridge Alternative

- For the last several years, GD-OTS has invested funds into the development of a mechanically fuzed variant to the 20mm PGU-28A/B.



PGU-28A/B Cartridge

- GD-OTS has made a conscious effort to make safety a number one priority during the development process.
- Fuze has been designed to operate with delay or point detonating mode.
- Fuze has capabilities in calibers other than 20mm.

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Cartridge Safety and Performance Requirements

- **Configuration Requirements**
  - Fully compliant with current PGU-28A/B Cartridge envelope.
  - Ballistic match with current 20mm PGU family of ammunition.

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Performance Requirements

- **Design Requirements (Delay Fuze) per AS6120**
  - Function after impact with .063 inch aluminum plate at 200 yards
  - Function delay of 400-800 microseconds after impact with .080 inch aluminum plate at 200 yards
  - Function after impact with .080 inch aluminum plate @ 75° NATO at 200 yards
  - Produce a low order reaction of the body explosive after initiation
  - Defeat 3/8 inch RHA @ 45°obliquity with a probable ballistic limit velocity of 2786 ft/sec
- **Design Requirements (Point Detonating)**
  - Function after impact with .063 inch aluminum plate at 200 yards
  - Function after impact with .080 inch aluminum plate @ 75° NATO at 200 yards
  - Produce a high order reaction of the body explosive after initiation
  - Defeat 3/8 inch RHA @ 45°obliquity with a probable ballistic limit velocity of 2786 ft/sec

Identify Fuze Requirements

- Must fit within PGU 28A/B Nose envelope.
- Must be within reasonable range of current PGU 28A/B pyrotechnic nose mass.
- Must be able to function across all temperature extremes.
- Must be able to defeat light skin targets at both low and high graze angles.
- Safety
  - Survive acceleration at high temperature and pressure launch
  - Fully compliant with Mil-Std-1316
  - Fully compliant with Mil-Std-331 and Mil-Std-810 cartridge safety and environmental requirements
  - Fully compliant with Mil-Std-1751

Approach

- **Identify Fuze Requirements**
- **Conduct Market Survey**
  - **Conduct Risk Assessment.**
    - **Key parameters:**
      - Method of initiation
      - S&A type
      - Firing train
      - Fuze interface with projectile body
      - Maximum commonality to existing 20mm
    - **Other Factors**
      - Performance history
      - Minimize fuze design changes to interface with existing 20mm projectile configuration
      - Ease of qualification
- **Acquire Test Hardware**
- **Conduct Design Demonstration Testing**

Cartridge Description

- **The General Dynamics-OTS solution utilizes the following:**
  - A ball rotor approach fuze similar to the M505 that employs dual independent safeties and can function in either the delay or point-detonating mode.
  - Ballistic match to the 20mm PGU family of ammunition.
  - Meets the 20mmx102mm Cartridge envelope.
  - Utilizes components common to the 20mm PGU family of ammunition.

GD-OTS developed a cartridge to meet the requirements of the USAF and leverage commonality with existing technology and manufacturing processes.

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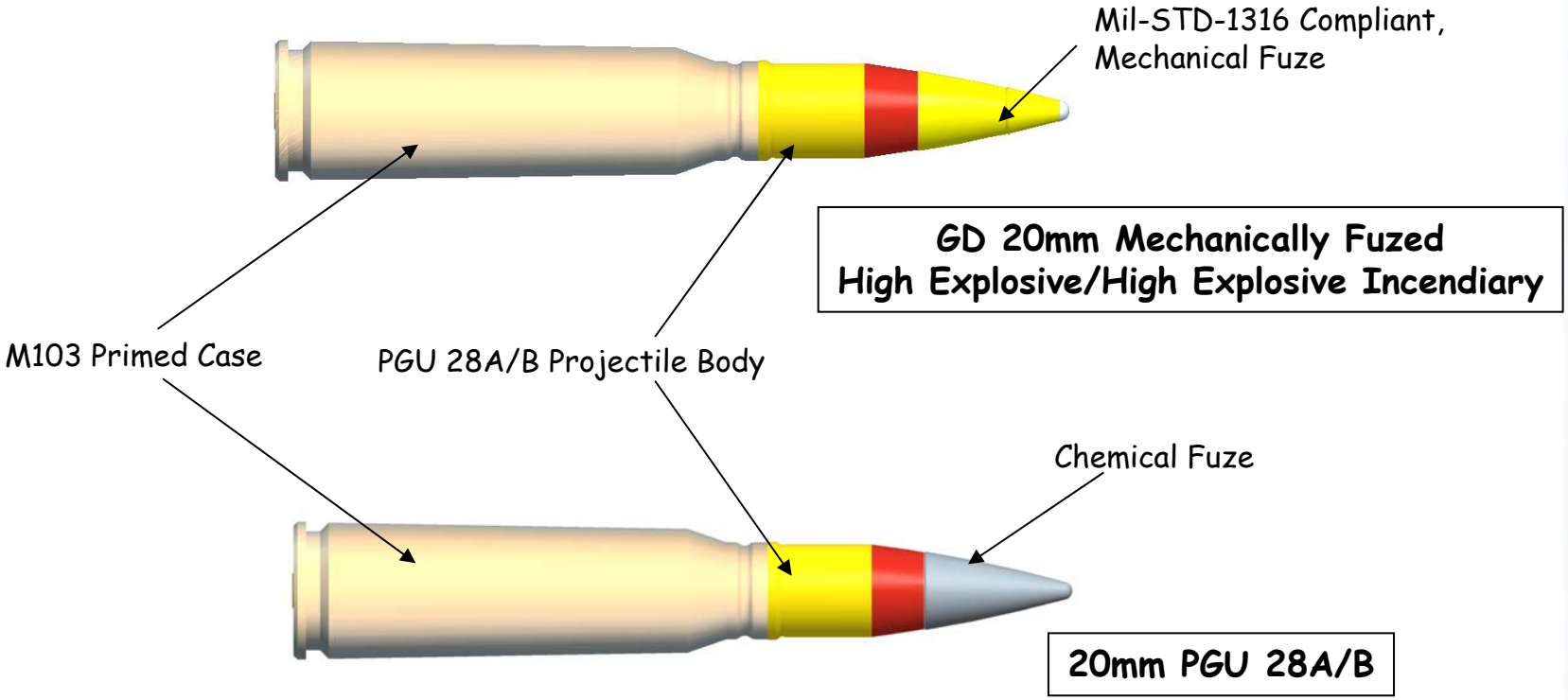
Cartridge Description



-Cartridges utilize same propellant and LAP facility.

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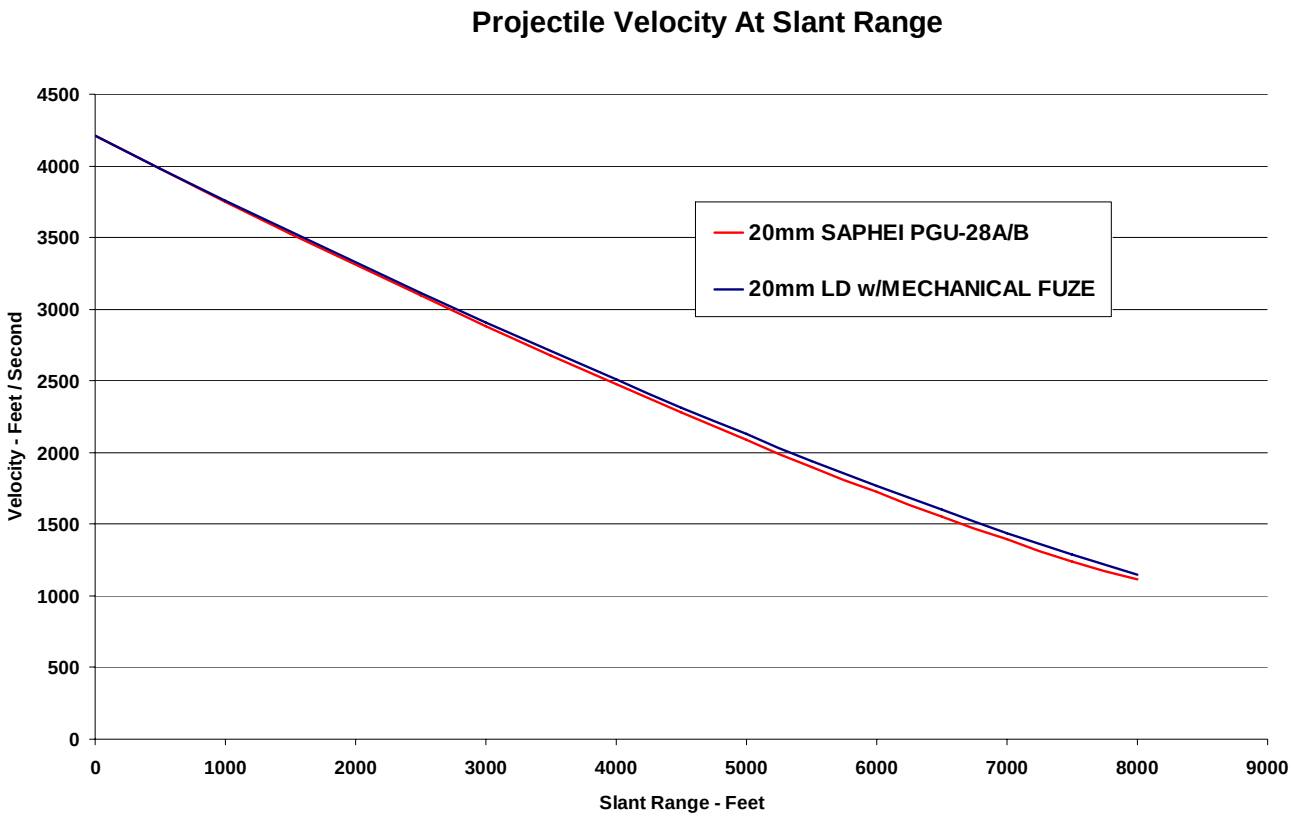
PGU-28A/B, 20mm Mechanically Fuzed Variant Trajectory Comparisons



Trajectory Conditions:

- **Aircraft Altitude: 6,000 ft ASL**
- **Aircraft Airspeed: 450 knots**
- **Muzzle Velocity: 3440 ft/sec**
- **Standard Atmospheric Conditions**

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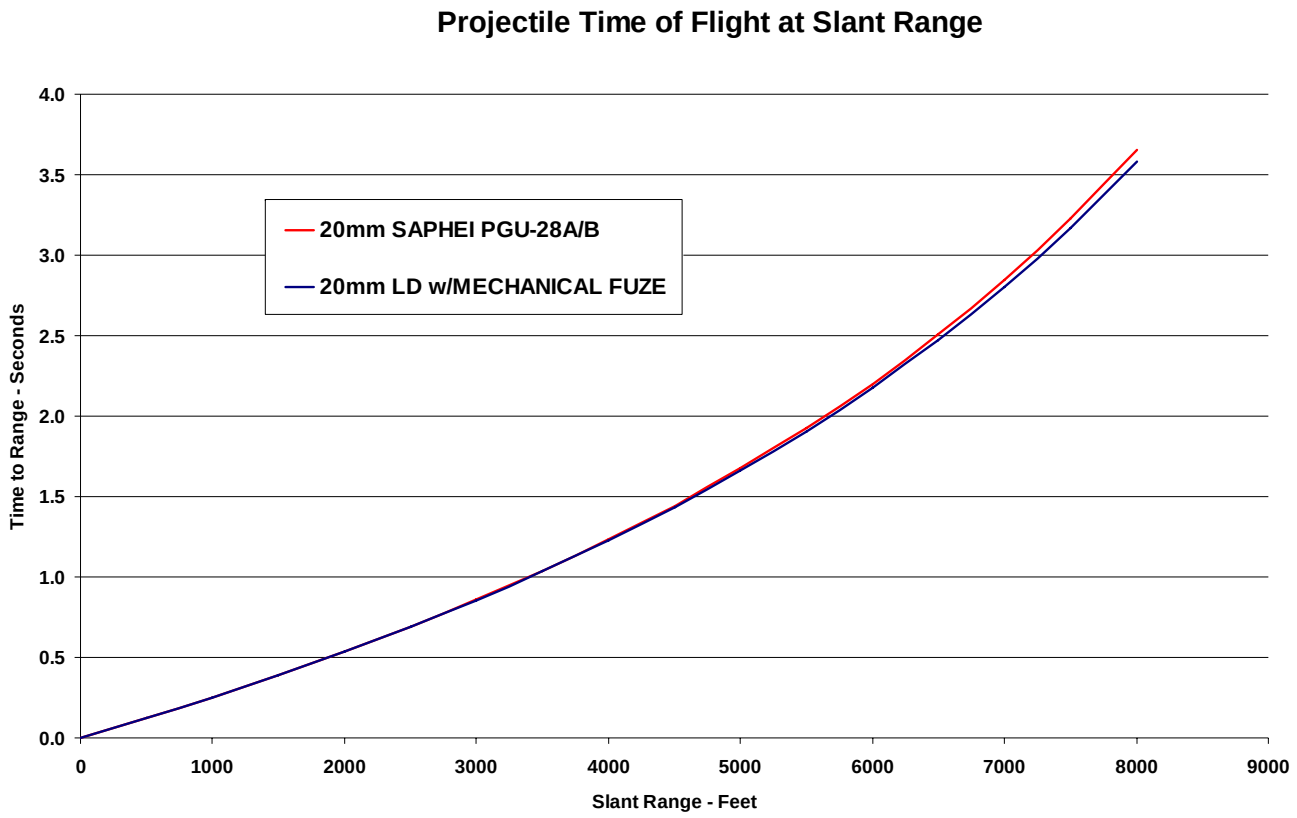

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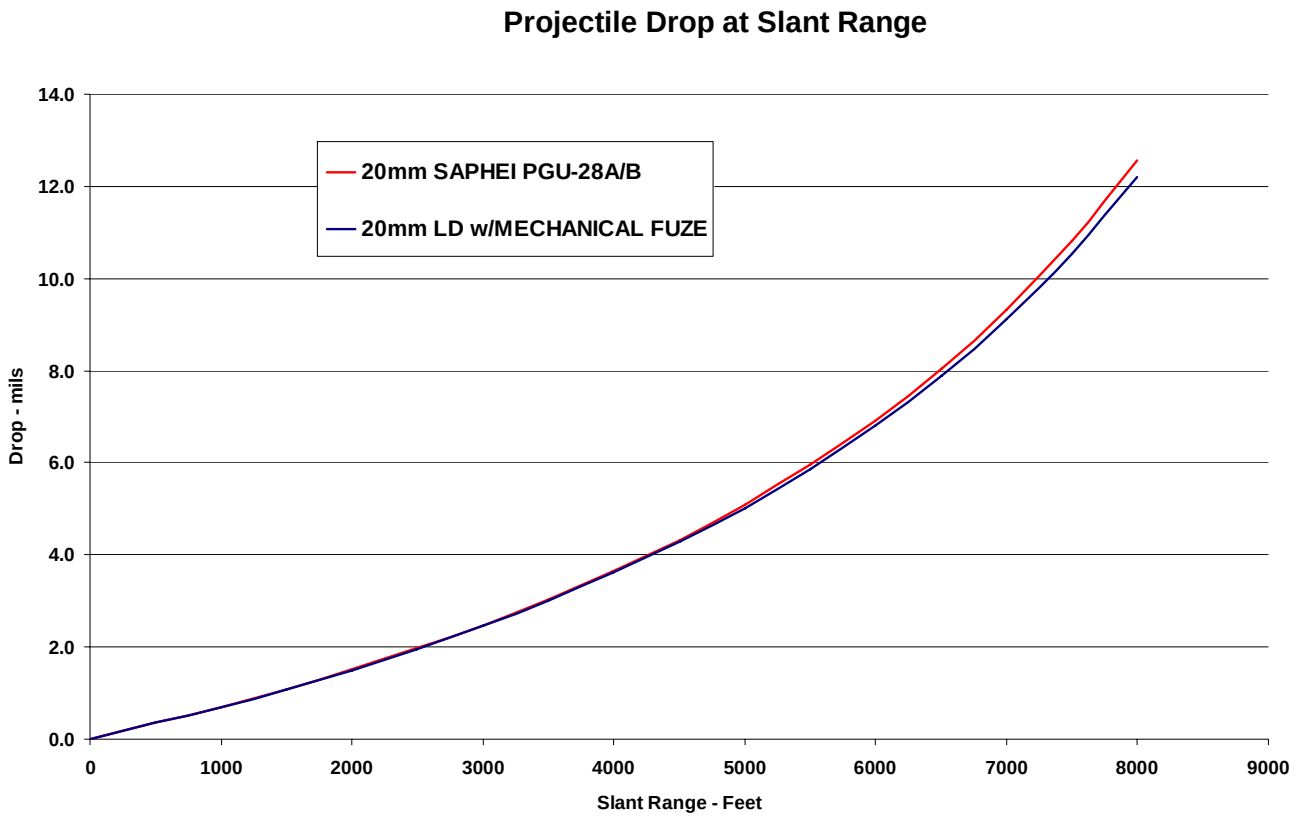

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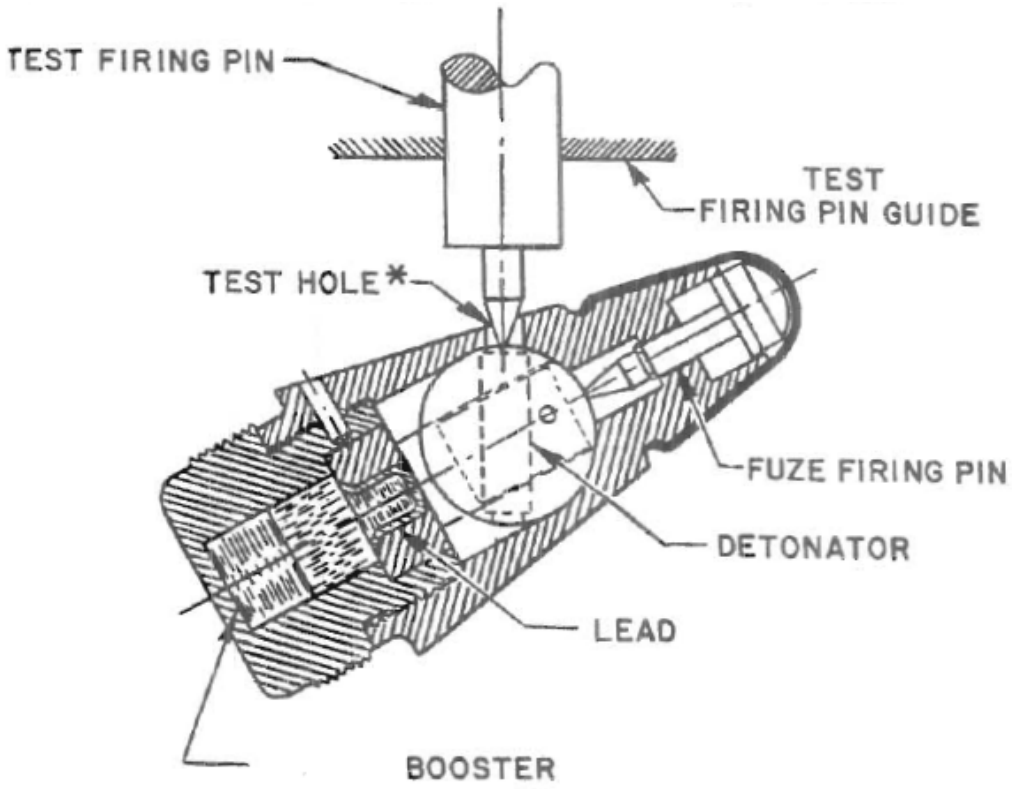
Hand Safety Testing



Primary Component
Safety Test Set Up from
Mil-Std-331

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Hand Safety Testing

Final Configuration

Design passes the D1 "Out of Line" safety test per Mil-STD-331

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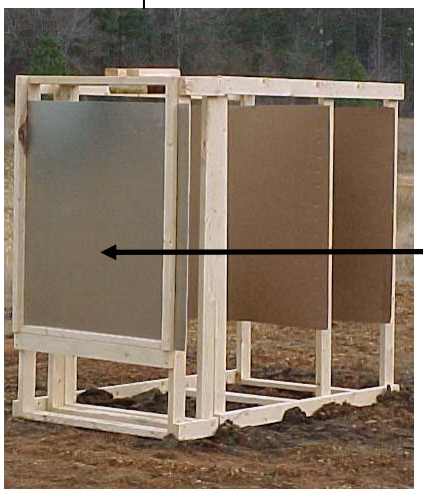
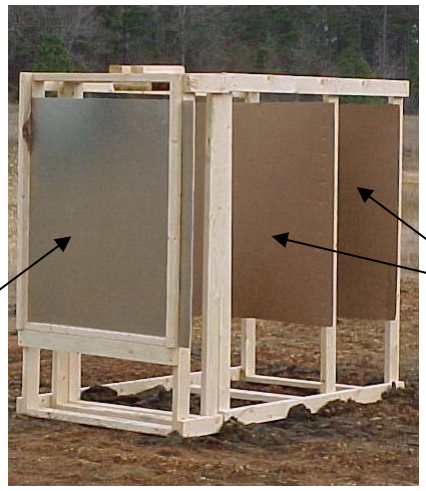
Detonation Delay/Point Detonating Test Set-Up Description

630 ft



Target Array

Gun and Mount



Aluminum Trigger Plate

Witness Panels 4' and 6' Behind Trigger Plate

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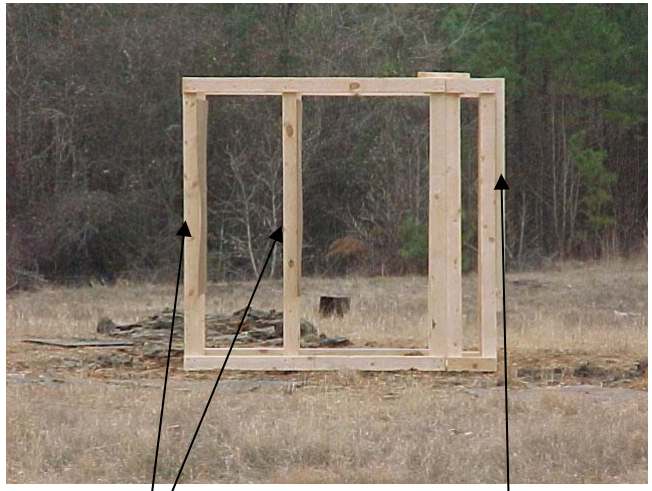
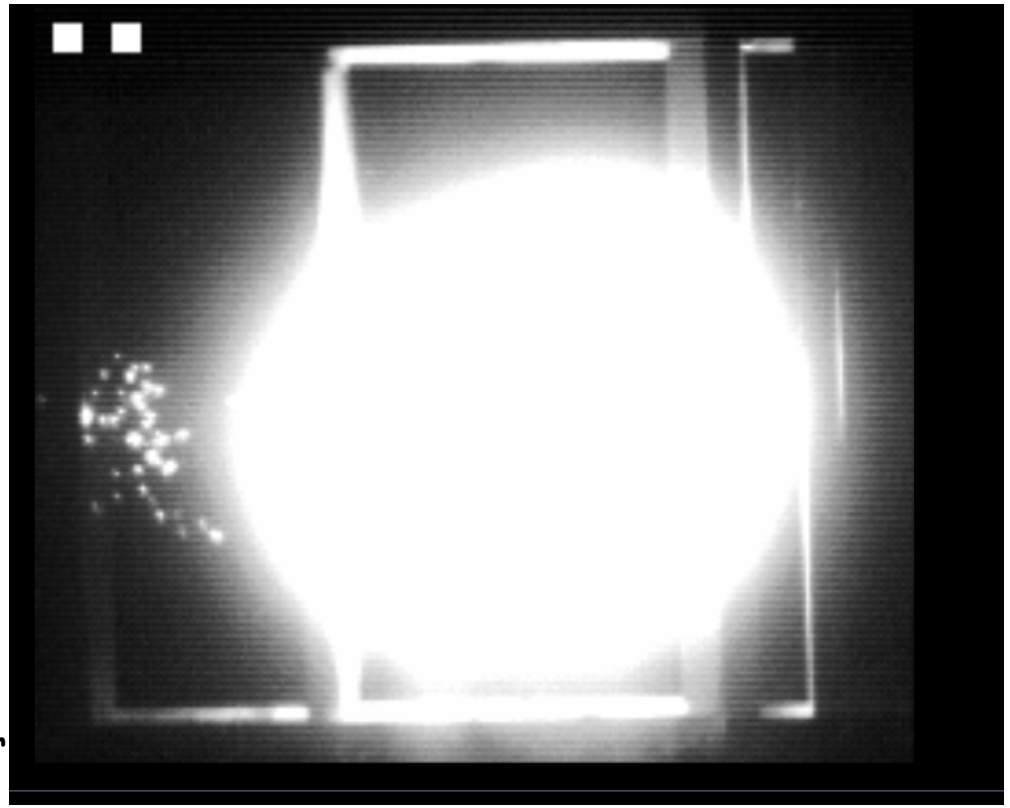
Pictures from Demonstration Testing



Witness Panels

Aluminum Trigger Plate



Impact with .080"
Aluminum at 200 yards

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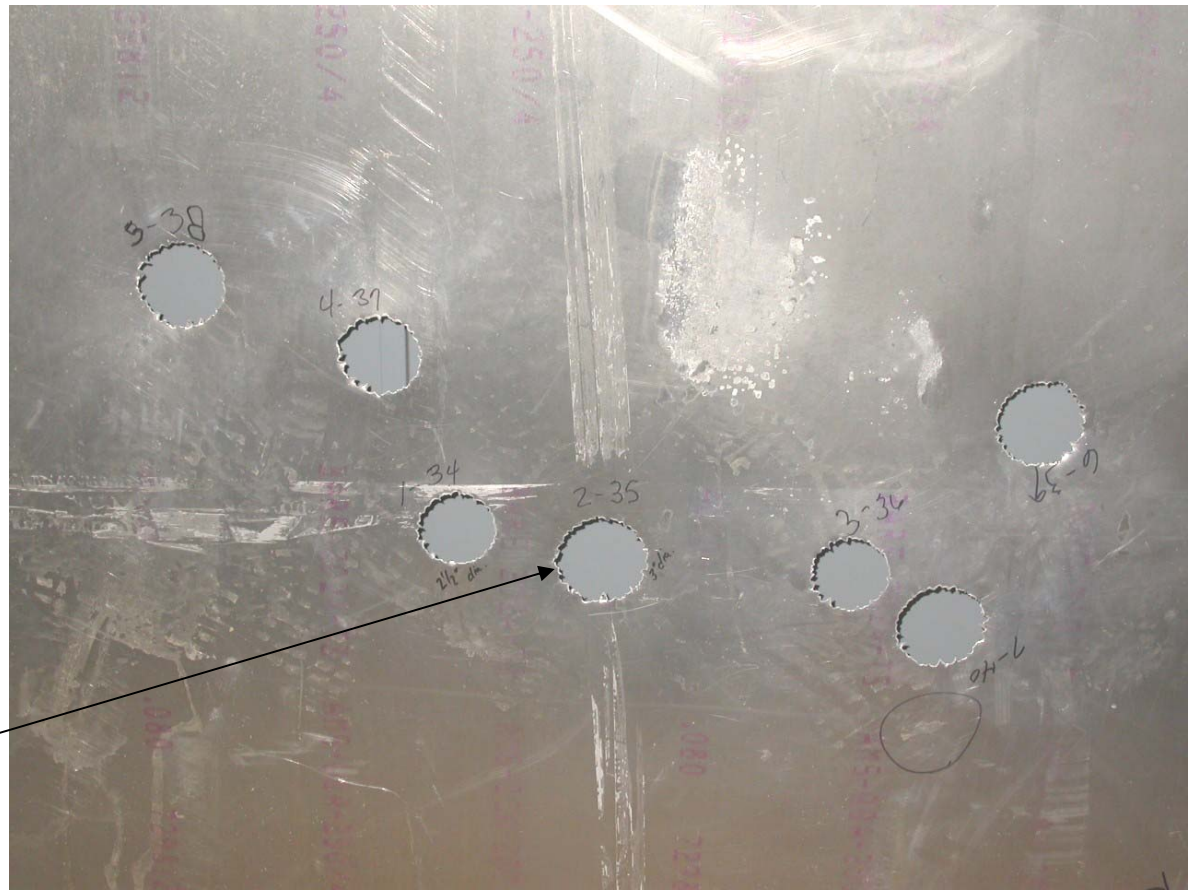
Pictures from Demonstration Testing

Ø of hole is approximately 60mm



.080" Aluminum trigger plate
for point detonating test

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Pictures from Demonstration Testing

.080" Aluminum Trigger plate (75 degrees)
for Graze Sensitivity Test, 100% Function

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Pictures from Demonstration Testing

Witness Panel 4' behind trigger plate for Graze Sensitivity Test

Summary of Results

Verification Tests	Delay Function	Point Detonating Function
Static Booster Testing	Complete	Complete
Booster Material Ballistic Evaluation	Complete	Complete
Low Drag Shape Concept	Complete	Complete
Explosive Train Development	Complete	Complete
Explosive Train Down Select	Complete	Complete
Detonation Delay	Demonstrated	N/A
Armor Penetration	Met Requirement	Expected to meet requirement per AS6120
Projectile Sensitivity	Demonstrated	Demonstrated
Point Detonating Function	N/A	Demonstrated
Fragmentation	Test Not Performed, witness panel comparison to PGU 28-A/B yields better fragmentation	Test Not Performed
Graze Sensitivity (75 Degrees)	Demonstrated	Demonstrated
Function and Casualty	Test Not Performed	Test Not Performed
Safety Tests	Passed Mil-Std-331 D1 Out-of-Line Safety Test @ Ambient, Tests at Hot Yet to be Conducted	Passed Mil-Std-331 D1 Out-of-Line Safety Test @ Ambient, Tests at Hot Yet to be Conducted
No-Arm (3 meters against .040" Al)	Passed	Passed

GD-OTS has performed testing against all of the key baseline performance requirements to ensure future success

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Summary

•GD-OTS has developed and successfully demonstrated a Mil-STD-1316 compliant, mechanically fuzed variant, both point detonating and delay, to the 20mm PGU 28 A/B Cartridge.

•Fuze has been proven to function across temperature extremes.

GD-OTS has completed significant testing and investment on a 20mm fuzed cartridge and is prepared to move forward.

Questions?