

Development and Fielding of the Guided Multiple Launch Rocket System (GMLRS) Unitary Warhead

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GENERAL DYNAMICS
Ordnance and Tactical Systems

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GMLRS Unitary Team



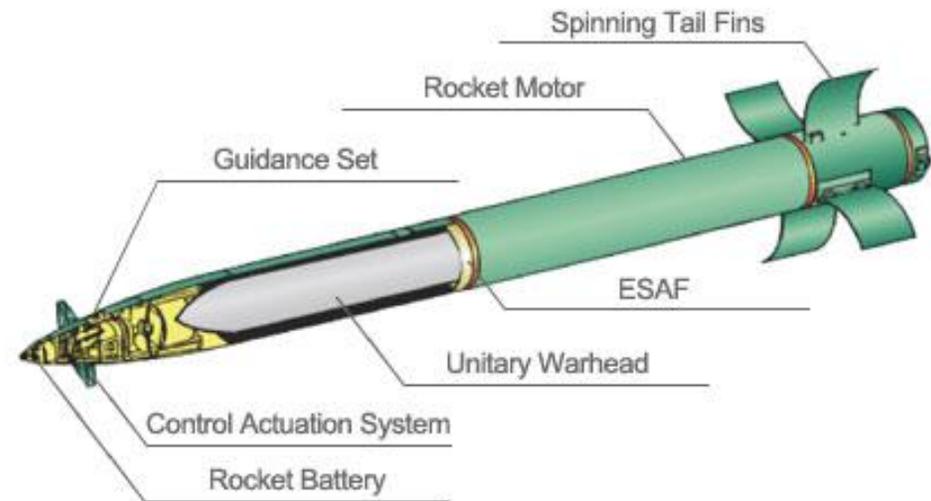
- Prime Contractor – Lockheed Martin Missiles & Fire Control
- General Dynamics – Ordnance & Tactical Systems
- Aviation & Missile Research, Development, & Engineering Center
- Program Executive Office – Missiles & Space
- Precision Fires Rocket & Missile Systems Project Office



GMLRS Unitary System Description



- Joint Expeditionary
- All Weather, Precision Guided Rocket
- 70km Range
- 196 lb Unitary Warhead
- Tri-Mode Fuze
- Low Collateral Damage
- Target Sets
 - ↗ Buildings
 - ↗ Soft Targets
 - ↗ Urban Structures
 - ↗ Air Defense Surface Targets





GMLRS in Theatre

- As of 17 February 2009, 1109 Rockets Fired in Theater
- 100% Mission Success
- “70 Kilometer Sniper Rifle”



GMLRS Unitary in Iraq





Past, Present & Future

| | Basic Rocket (M26) | Extended Range Rocket (M26A1 / A2) | Guided Rocket DPICM (M30) | Guided Unitary Rocket-UMR (XM31) | Guided Unitary Rocket (XM31E1) |
|--------------------------|---|---|---|---|---|
| |  |  |  |  |  |
| | 1980 | | 1998 | 2004 | 2005 |
| | | EVOLUTIONARY | | REVOLUTIONARY | |
| User Requirements | | | | | |
| • Range | 32 km | 45 km | 70 km | 70 km | 70 km |
| • Precision / Accuracy | Free Flight Rocket | No Load Detent | Inertial Measurement Unit (IMU) / Global Positioning System (GPS) Aided | IMU / GPS Aided | IMU / GPS Aided |
| • Flexibility | — | Deeper Targets Farther Laterally "General Support (GS)" Mission | Deeper Targets Farther Laterally "GS-Reinforcing" Mission | Deeper Targets Farther Laterally "GS-Reinforcing" Mission | Deeper Targets Farther Laterally "GS-Reinforcing" Mission |
| • Payload | 644 Dual Purpose Improved Conventional Munition (DPICM) M77 Grenades | 518 DPICM M77 Grenades | 404 DPICM M101 Grenades | Unitary with Dual Mode Fuze | Unitary with Multi-Option (Tri-Mode) Fuze |
| • Maneuver Safety | 5% Dud Rate | 4% Dud Rate / < 1% with M101 | Threshold: < 2 / 4% Dud Rate Objective: 0% Dud Rate | NA | NA |
| • Targets | Soft | Soft | Soft | Hard Stationary Point Targets Collateral Damage Sensitive Soft Area Targets | Hard Stationary Point Targets Collateral Damage Sensitive Soft Area Targets |



Warhead

- Evolved from 6-inch to 3-inch Fuze Design
- Internal Scored Case to Control Fragmentation to Minimize Collateral Damage
- Warhead Weight – 196 lbs
- Approximately 50 lbs of High Explosive
- Won Competition in 2006 for Follow-on Production Contract





Modeling & Simulation

- OTI*HULL – GD-OTS Proprietary Hydrocode Software
 - Simulates Weapon Problems from Target Interaction through Functioning
- Also use Hydrocode to Predict Insensitive Munitions (IM) Results
 - Bullet Impact, Fragment Impact, Sympathetic Detonation



Environmental Qualification

- Warhead Passed Environmental Qualification
- Tests:
 - ↗ Vibration
 - Transportation, Tactical, Flight
 - ↗ Temperature Shock
 - ↗ Rail Impact Shock
 - ↗ Handling Drop Shock
 - ↗ Launch Shock
 - ↗ Long-Term Storage



Performance Results - Effectiveness

- Five JMEM Arena Tests Conducted
 - Fragments Recovered & Weighed
 - Recovery Locations were Recorded
 - Fragment Velocities Calculated
- Warhead is Lethal Against Target Set





Performance Results - Penetration

- Earth & Timber Bunker Target
 - Successfully Penetrated Target During Development Tests



Earth & Timber Bunker Pre-Test Setup



Earth & Timber Bunker Post-Test

Performance Results – Insensitive Munitions



| Insensitive Munitions Verification and Investigations | MIL-STD-2105/STANAG Description | Achievable Results Given in STANAG Type Classification |
|---|--|--|
| Intermediate Cook-Off | Remote Fire Not in Direct Contact with Warhead: 50°F (10°C) per Hour Heating Rate | Type V (SDD Testing) Type III (Subsequent Testing) |
| Fast Cook-Off | Flames in Direct Contact with Warhead: Average Flame Temperature ≥ 1600° F (871°C) | Type IV (SDD Testing) Type IV (Subsequent Testing) |
| Bullet Impact | .50-Caliber Bullet Fired into Payload Section of Explosive | Type V (SDD Testing) Type V (Subsequent Testing) |
| Fragment Impact | Land-Attack Threats: 16.2 gram Steel Fragment Impacts Munition at 6000 ft/s | Type V (Subsequent Testing) |
| Sympathetic Detonation | Propagation of Detonation from One Payload Section to Another | Type I (Subsequent Testing) |



Intermediate Cook-Off Test

- Test Conducted IAW STANAG 4382 – Slow Heating Test for Munitions
- Enclosed in Oven Housing
- Ramp Rate 50°F/hr
- Blast Gauges and Witness Plates Showed no Evidence of Detonation





Fast Cook-Off Test

- Test Conducted IAW STANAG 4240 - Liquid Fuel Fire Tests for Munitions
- Approximately 1000 Gallons Kerosene in Fuel Pans
- Internal Warhead Components Expelled from Case

Requirements: (STANAG 4240)

- Reach 1020°F within 30 seconds
- Average flame temperature of at least 1600°F



Fuel Pans and Fuel

Test Stand



Thermocouple (flame temp)

Aft Warhead

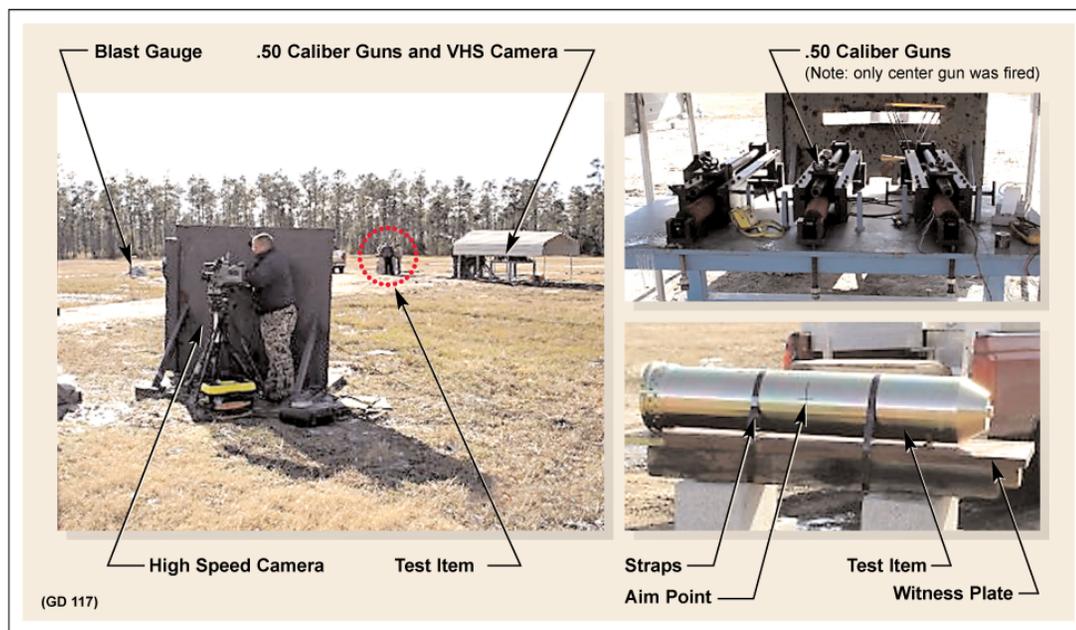
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IM Testing – Bullet Impact

- Test Conducted IAW STANAG 4241 – Bullet Attack Test for Munitions
- .50 Caliber Type M2 Armor Piercing Projectile
 - ↗ 2840 ft/sec
- Aim Point – Center of Warhead
- No Exit Bullet Hole
- Blast Gauges and Witness Plates Showed no Evidence of Detonation





GMLRS Warhead Performance

| Requirements | Performance |
|----------------------------|--|
| Effectiveness | Warhead Lethal Against Target Set |
| Penetration | Warhead Penetrates Earth & Timber Bunker Target |
| Insensitive Munitions (IM) | <ul style="list-style-type: none">● Type V – Bullet Impact● Type IV – Fast Cook-Off● Type III – Intermediate Cook-Off● Type I – Sympathetic Detonation● Type V – Fragment Impact |



Design Challenges

- Inensitive Munitions
 - Passing Fast and Slow Cook-Off Proved to be a Challenge
 - Pressure Built up in Warhead Nose
 - Warhead Case Structural Integrity did not Allow Venting in Nose



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