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30mm x 113mm (LW30) High Explosive Incendiary – Tracer (HEI-T)

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Outline

- Applications
- Design/Performance Objectives
- Initial Design/Development Phase
- Final Design and Testing
- Summary

Medium Caliber Cannon Rifling
Applications

LW30mm M230 Chain Gun®

- Currently on Apache helicopter

LW30mm M230LF (Link Fed) Chain Gun®

- Based on proven M230 gun
- Low-recoil design makes gun adaptable to many systems
- Being implemented for ground and shipboard applications

ATK System Application Examples for M230LF

- Invictus™
- Palletized Autonomous Weapon System (PAWS)
- Nobles Engineering Viper Gun System

Ground and Shipboard Applications Require Traced Ammo
Design/Performance Objectives

Design Objectives

• Percussion primed ignition system
• Utilize current LW30 components to expedite design and test
• Increased lethality
• Incendiary for increased collateral damage
• Traced
  – Trace distance to 2,000m
  – Daylight & infrared visible

Flight Characteristics

• Flight characteristics to current LW30 ammo
LW30 HEI-T Preliminary Designs Concepts

Design Considerations

- Projectile body materials
- Tracer metering disk vs. no metering disk
- Boomtail vs. no boomtail
- High explosive quantities

LW30 Common Components

- M759 Fuze
- PBXN-5 High Explosive
- Tracer & Igniter Composition (LW30 TP-T)

Option 1
Option 2
Option 3
LW30 HEI-T Initial Design (Mod 1)

<table>
<thead>
<tr>
<th></th>
<th>Muzzle Velocity (m/sec)</th>
<th>Pressure (Mpa)</th>
<th>Gyro Stability Factor</th>
<th>Muzzle Jump</th>
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</thead>
<tbody>
<tr>
<td>M789 HEDP</td>
<td>802</td>
<td>285</td>
<td>2.42</td>
<td>0.027</td>
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<tr>
<td>Mod 1</td>
<td>749.5 (est.)</td>
<td>274 (est.)</td>
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"Optimal" range for Gyro Stability Factor = 2 - 3 (Known good at 2 or above for air-based systems)
Minimum for margin of safety for Gyro Stability Factor (for ground-based systems) = 1.2
Unstable below 1.0
**LW30 HEI-T Initial Design (Mod 2)**

Common Igniter & Tracer

One-Piece Projectile Body

PBXN-5

Zirconium Sponge

M759 Fuze

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<td>Mod 2</td>
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<td>266 (est.)</td>
<td>1.53 (est.)</td>
<td>0.03 (est.)</td>
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"Optimal" range for Gyro Stability Factor = 2 - 3 (Known good at 2 or above for air-based systems)
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Unstable below 1.0
**ANSYS FEA Analysis**

### Axial Displacement [m]
- **Baseline**: 0.0
- **Modification 5**: 2.0
- **FINAL**: 1.8

### Equivalent Stress [Mpa]
- **Max Stress**: 1010 Mpa

### Max Principal Stress [Mpa]
- **Max Stress**: 216 Mpa

### Plastic Strain (Max Strain 0.5%)

<table>
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<tr>
<th>Model</th>
<th>Wall/Aft Reduction [mm]</th>
<th>Mass Reduction [gram]</th>
<th>MOS-Yield</th>
<th>Max Strain [%]</th>
<th>MOS-Ultimate</th>
<th>Comment</th>
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<tr>
<td>Baseline</td>
<td>0.0</td>
<td>0.00</td>
<td>0.0</td>
<td>0.7</td>
<td>4.5</td>
<td>Adequate Projectile Body</td>
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<tr>
<td>Modification 5</td>
<td>2.0</td>
<td>2.34</td>
<td>0.0</td>
<td>0.9</td>
<td>3.7</td>
<td>Adequate Projectile Body</td>
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<tr>
<td>FINAL</td>
<td>1.8</td>
<td>2.07</td>
<td>0.0</td>
<td>0.5</td>
<td>4.4</td>
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Design Changes:

- Optimized projectile body design to minimize weight and increase ease of manufacture based on ANSYS analysis
- HE loading iteration trials to determine consistent/safe loading assembly process

Projectile Design:

- Common Tracer & Igniter
- Hardened Steel Body
- PBXN-5 High Explosive
- M759 Fuze
- Zirconium Sponge
LW30 HEI-T Test Plan

Test Plan

- Charge Establishment - Complete
- Charge Verification @ 500m Outdoor Range – Complete
  - Including target effects data
- PVAT, Dispersion, Yaw, Mann Barrel Function & Casualty
- Max Range Tracer & Radar
- Autogun Function & Casualty

LW30 HEI-T Projectile & Projectile Body
LW30 Target Effects (1/2” Plywood @ 500m)

Standard LW30 M789
~11.75” Diameter Hole

LW30 HEI-T
~16” Diameter Hole
LW30 HEI-T Target Effects (Multi-Plate Array @ 500m)

Impact Plate (4’ x 4’)
0.063” Aluminum

2nd Plate
(8” Behind Impact Plate)
0.040” Aluminum

3rd Plate
(16” Behind Impact Plate)
0.040” Aluminum

4th Plate
(24” Behind Impact Plate)
0.040” Aluminum
Summary

Initial Two Designs

- Did not meet ballistic match and flight objectives
- Had producibility and assembly concerns

Final Design

- Simulations and initial testing indicate this will meet ballistic and flight requirements
- Anticipate that the additional tracer mix will provide reliable tracer burn to 2,000m
- Structurally robust design (demonstrated in the CE and CV testing)
- Improved producibility and cost savings

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<tr>
<td>LW30 HEI-T (M230LF)</td>
<td>801</td>
<td>246</td>
<td>1.68*</td>
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* Gyro stability factor for ground based systems considered stable between 1 and 2
Questions?
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