Advancements in Lightweight .50 Caliber Ammunition

Presented By:

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• **Background**
  
  
  – Transitioned to a Title III program to develop a domestic production capability for lightweight polymer based ammunition.
  
  – Title III contract awarded to MAC, LLC, located in Bay St. Louis, MS on 18 September 2008
    
    ➢ Focus was on the development, production, and qualification of lightweight .50 caliber ammunition
.50 Caliber Polymer Case

- **MK 323 MOD 0**
- **Cartridge Design**
  - Hybrid cartridge case
    - Brass base cap
    - Polymer caselet
  - M33 projectile
  - WC 869 Propellant
  - No. 35 Primer
- **Packed 100 linked cartridges per M2A1 ammunition can**
Cartridge Performance

- Meet or exceed the ballistic requirements of M33 per specification MIL-DTL-10190F
  - Chamber Pressure
  - Muzzle Velocity
  - Action Time
  - Accuracy

- Function in all fielded weapon systems (i.e. M2HB, GAU 21/A, etc.)
• Benefit
  – 25% weight savings over conventional brass cased ammunition
  – Given the large number of platforms and missions, operational benefits of lightweight ammunition vary
  – Biggest payoffs in weight-critical scenarios:
    ➢ Increase effectiveness, due to larger quantity of rounds carried
      – Fewer reloads
    ➢ Operational flexibility – carry more equipment
    ➢ Increased operational range
    ➢ Reduced fuel consumption
    ➢ Less fatigue to personnel
- Cartridge Development and Challenges
  - Initial development work conducted exclusively with the M2HB
  - As a drop-in replacement for M33, the MK 323 had to be functional in all .50 caliber platforms
  - XM218 and GAU 21/A were introduced
    - Initial testing revealed the cartridge could not endure the higher rate of fire aircraft weapons
      - Projectile setback in cartridge case
      - Case separation at the joint between the brass cap and polymer caselet.
        - Case separation caused by combustion gases entering the interface between the polymer cartridge caselet and the brass base.
    - Issue was corrected by a change to the internal geometry of the case to completely seal the interface.
Program Status

- Cartridge design has been frozen
- Test and Evaluation Master Plan (TEMP) in process
  - TEMP includes performance testing and required safety qualification testing for future fielding.
  - 90% complete with the initial performance testing against the baseline M33 ball round.
  - Safety qualification testing anticipated start of July 2012
Initial Performance Testing

- MK 323 Lot: BYS12B264S-001
- M33 Lot: LC-10D406-994
- Chamber Pressure, Muzzle Velocity, and Action Time

  Conducted in accordance with SCATP-7.62mm

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Pressure Mean (psi)</th>
<th>Velocity Mean (fps)</th>
<th>Std Dev</th>
<th>Action Time Mean (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 70F</td>
<td>53,359</td>
<td>2,881</td>
<td>15</td>
<td>1.471</td>
</tr>
<tr>
<td>- 25F</td>
<td>47,150</td>
<td>2,720</td>
<td>24</td>
<td>1.581</td>
</tr>
<tr>
<td>+ 145F</td>
<td>57,220</td>
<td>2,996</td>
<td>16</td>
<td>1.431</td>
</tr>
</tbody>
</table>

MK 323 provides greater temperature stability in the two lots compared

Distribution Statement A – Approved For Public Release
• Initial performance testing (continued)
  – Accuracy and Ballistic Match
    ➢ Testing conducted at 600 yards
    ➢ 5 - 10 round groups out of two 36” accuracy test barrels

<table>
<thead>
<tr>
<th></th>
<th>100 Round Mean</th>
<th>M33</th>
<th>MK 323</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Spread (in)</td>
<td>22.2</td>
<td>19.0</td>
<td></td>
</tr>
<tr>
<td>Standard Deviation (in)</td>
<td>5.9</td>
<td>4.9</td>
<td></td>
</tr>
<tr>
<td>Mean Radius (in)</td>
<td>7.2</td>
<td>5.9</td>
<td></td>
</tr>
</tbody>
</table>

➢ Mean Point of Impact (MPI) taken from each 10 round group
➢ 6.8 inch average disparity in vertical MPI across both barrels
• Initial performance testing (continued)
  – Function and casualty

<table>
<thead>
<tr>
<th>Function &amp; Casualty</th>
<th>Test Weapon</th>
<th>Mount</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M2 Heavy Barrel #1</td>
<td>MK 93</td>
<td>-25°F - 5°F</td>
</tr>
<tr>
<td></td>
<td>M2 Heavy Barrel #2</td>
<td>MK 93</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>XM218, GAU 16/A #1</td>
<td>Aircraft</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>XM218, GAU 16/A #2</td>
<td>Aircraft</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>GAU 21/A #1</td>
<td>Aircraft</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>GAU 21/A #2</td>
<td>Aircraft</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>GAU 21/A #3</td>
<td>Aircraft</td>
<td>600</td>
</tr>
</tbody>
</table>

- All testing through the M2HB has been completed.
- Remaining weapons still to be completed
- Three cartridges at -25 F had a mid case split resulting in a weapon stoppage
  - Root cause has been identified and corrective action being taken
.50 Caliber Polymer Case

- Function and casualty M2HB
.50 Caliber Polymer Case

- Function and casualty GAU 21/A
Initial performance testing (continued)

- Hot gun cook-off
  - 400 cartridges of M33 were fired in rapid succession through a M2HB to bring barrel temp to 600°F
  - MK 323 cartridge was chambered and allowed to soak for 5 minutes
  - If no cook-off occurred, round was fired.
  - A total of 5, MK 323 rounds were tested with no cook-offs occurring
• Future Events
  – Conclude baseline performance testing
  – Environmental series testing and post test firings
  – Hazard Classification Testing
  – Pending successful completion of testing, WSESRRB review and other associated full qualification activities
• **Path forward**
  
  – Load alternative projectiles e.g., Tracer, AP, and API, SLAP, etc.)
  
  – Alternative calibers could be developed from the technology such as 5.56mm, 7.62mm, .300 Win Mag, and .338 Lapua Mag
  
  – Testing has indicated potential improvements in precision fire capability over brass case cartridges
Questions?