120 mm Tank Ammunition
Advanced Case System (ACS)

Presented At
The National Defense Industrial Association’s Joint Armaments Conference, Exhibition, & Firing Demonstration

19 May 2010

Jeff Berg
Principal Engineer
120mm Training Ammunition
ATK

Approved for public release 22 CFR 125.4(b)(13) applicable. PAO Log# 503-10
120 mm Tank Ammunition Advanced Case System (ACS)

- Background
- Program Summary
- ACS Design Options
- Double Wall Joint vs. Skive Joint
- Technical Challenges – Bond Joints
- Analysis and Solutions
- Conclusion
M1002 Cartridge (current case design)

- Case Base & Seal
- Cartridge Case
- Bond Joint
- Case Adapter
- Projectile Assembly
Background

Advanced Case System (ACS)

• Program:
  • Product Manager Large Caliber Ammunition: Program Management and Guidance
  • Joint Munitions Command (JMC): Executes and Manages the 120mm Multi-Year contracts

• Members: PM-MAS, PM-LC, JMC, ARDEC, ATK, GD-OTS, Esterline Defense Group, American Ordnance

• Objective: Provide a re-designed cartridge solution to eliminate a contributing cause of damaged rounds during training.
  • Relocate the cartridge bond joint
  • Qualify the modified cartridge design
  • Transition into production with qualified design
ACS Design

- Joint: Double Wall, Skive, Single Wall
- Adhesive: Green two-part epoxy or Red NC based adhesive
- Propellant Bag: Tailored or Tied
ACS Design Options – Cartridge Joint

- Live NC composition
- Inert composition

Current cartridge case and case adapter

Aft Skive ACS cartridge case and base sleeve

Transition (live & inert)

Double Wall ACS cartridge case and base sleeve
## Double Wall vs. Aft Skive Joint

<table>
<thead>
<tr>
<th></th>
<th>Double Wall Joint</th>
<th>Aft Skive Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
<td>• Manufacturing process simpler.</td>
<td>• Producibility – similar to current design.</td>
</tr>
<tr>
<td></td>
<td>• Joint is more robust</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Joint has better protection</td>
<td></td>
</tr>
<tr>
<td><strong>Cons</strong></td>
<td>• Ballistic concerns:</td>
<td>• Component manufacturing more complex (same as current design).</td>
</tr>
<tr>
<td></td>
<td>• Increased risk for residue</td>
<td>• Cartridge bonding process more difficult.</td>
</tr>
<tr>
<td></td>
<td>• Restricts seal performance (joint too strong).</td>
<td>• Joint is more exposed.</td>
</tr>
<tr>
<td></td>
<td>• Diametric repeatability risk (adhesive).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Trimmed end of case difficult to paint.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Component manufacturing more complex (same as current design).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Cartridge bonding process more difficult.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Joint is more exposed.</td>
<td></td>
</tr>
</tbody>
</table>
Aft Skive Joint:

- Cartridge alignment (straightness): joint location allows for misalignment.
  - Early concern that has since been resolved.
- Aft skive joint is more exposed than double wall.
  - Preliminary qualification results demonstrate aft skive location is superior compared to the current design.
- Actual protection is quite good due to proximity to case base.
Double Wall Joint:

- Case base seal performance
  - Occasional gas leakage aft of case base seal.
  - Modeling was able to repeat the condition.
  - Design modifications investigated and modeled to correct.
  - Testing successfully validated the model results.
- Design Modifications lead to increase risk of energetic exposure
  - Continue to evaluate solutions.
- Objective – no more risk than current design
Comparative Analysis of ACS Double Wall and Current Case System

MODEL ASSUMPTIONS:
• Explicit dynamic analysis performed in ABAQUS.

• Axi-symmetric analysis performed.

• Up to 200 psi uniform pressure applied on the inside of the case.
Comparative Analysis

A premier aerospace and defense company

Current Case System

- Standard Case
- Case base & seal assembly

ACS Double Wall

- Cartridge casing
- Adhesive
- Case resting on rubber seal
- Base Sleeve

Approved for public release 22 CFR 125.4(b)(13) applicable. PAO Log# 503-10
Current Case vs ACS Double Wall

30 psi uniform pressure on case

Current Case System

Case material beginning to fail

ACS Double Wall

Approved for public release 22 CFR 125.4(b)(13) applicable. PAO Log# 503-10
Improved Double wall with 6.25 mm gap

Approved for public release 22 CFR 125.4(b)(13) applicable. PAO Log# 503-10
30 psi uniform pressure on case

Current Case System

Case beginning to fail

ACS

Case in contact with chamber.

Bending of case eliminated with smaller axial gap. No case failure.

Approved for public release 22 CFR 125.4(b)(13) applicable. PAO Log# 503-10
Model Conclusions

- Model of improved double wall with 6.25 mm axial gap showed good sealing.
  - Seal performance was comparable to the current case system.
  - Of all ACS double wall designs models, the 6.25 mm gap had the best results.
- Ballistic testing completed to validate results.
- ACS qualification program proceeding with both the ACS double wall and skive joints.
- Down-select to a single joint anticipated upon completion of qualification tests.
QUESTIONS???

Jeff Berg
Principal Engineer – 120mm Tank Training Ammunition
Alliant Techsystems – Advanced Weapons Division
763-744-5523
jeff.berg@atk.com