

M109A7 Family of Vehicles (FoV) Paladin Integrated Management (PIM)

Executive Summary

- The Army continued multiple phases of the M109 Family of Vehicles (FoV) Paladin Integrated Management (PIM) developmental testing at Yuma Proving Ground, Arizona, that included live firing performance, automotive performance, and reliability.
- The Army continued with live fire testing of the underbody IED protection kit, validation live fire testing of modified armored areas, and simulated damage testing of the electrical system at Aberdeen Proving Ground, Maryland.
- The Army began the M109 FoV PIM IOT&E in October 2016 at Fort Hood, Texas, but suspended it due to safety concerns. DOT&E will submit an IOT&E report in 2QFY17. A second IOT&E will be rescheduled for FY18 once corrective actions are complete.



System

- The M109 FoV PIM consists of two vehicles: the Self-Propelled Howitzer (SPH) and Carrier Ammunition Tracked (CAT) resupply vehicle.
 - The M109A7 SPH is a tracked, self-propelled 155 mm howitzer designed to improve sustainability over the legacy M109A6 howitzer fleet. The production howitzers have a modified M109A6 turret with a high-voltage electrical system and a modified Bradley Fighting Vehicle chassis, power train, and suspension. The M109A7 does not include upgrades to the cannon. A crew of four soldiers operates the SPH and can use it to engage targets at ranges of 22 km using standard projectiles and 30 km using rocket-assisted projectiles.
 - The M992A3 CAT supplies the SPH with ammunition. The full-rate production ammunition carriers have a chassis similar to the SPH. The ammunition carriers are designed to carry 12,000 pounds or 98 rounds of ammunition in various configurations. A crew of four soldiers operates the CAT.
- The Army will equip the SPH and CAT with two armor configurations to meet two threshold requirements for force protection and survivability – Threshold 1 (T1) and Threshold 2 (T2).
 - The base T1 armor configuration is integral to the SPH and CAT. The Army intends the T2 configuration to meet protection requirements beyond the T1 threshold with add-on armor kits.
 - The Army plans to employ PIM vehicles in the T1 configuration during normal operations and will equip the SPH and CAT with T2 add-on armor kits during combat operations.
- The Army designed an underbody kit to determine the potential protection an SPH and CAT could provide against IEDs similar to those encountered in Iraq and Afghanistan. The Army purchased five underbelly kits for test purposes. At this time, the Army does not intend to equip the SPH or CAT with the underbody kit.
- The Army intends to employ the M109 FoV as part of a Fires Battalion in the Armored Brigade Combat Team and Artillery Fires Brigades to support any Brigade Combat Team.
- The Army plans to field up to 557 sets of the M109 FoV with full-rate production planned for FY17.

Mission

Commanders employ field artillery units equipped with the M109 FoV to destroy, defeat, or disrupt the enemy by providing integrated, massed, and precision indirect fire effects in support of maneuver units conducting unified land operations.

Major Contractor

BAE Systems – York, Pennsylvania

FY16 ARMY PROGRAMS

Activity

- In FY16, the Army received 16 low-rate initial production (LRIP) SPH and CAT vehicles and conducted Production Qualification Testing (PQT) on the CAT and SPH at Yuma Proving Ground, Arizona:
 - PQT of LRIP vehicles included Cold Regions testing, performance live firing and automotive testing, characterization testing with T2 armor and underbelly kit, testing with the Crew Remote Operated Weapon System, and the Logistics Demonstration to validate operator and maintainer technical manuals and work packages.
 - The program began replacement of the steel cannon tubes with chrome-lined tubes to address tube wear and corrosion issues caused by use of the Modular Artillery Charge System (MACS).
 - In concert with the Program Executive Office Ammunition, the PIM program will use a redesigned M82 primer in IOT&E to better withstand pressures introduced by the higher zones (4&5) of the MACS propellant charges.
- The Army continued the execution of the LFT&E program at Aberdeen Proving Ground, Maryland, in accordance with DOT&E-approved test plans:
 - Exploitation testing on the CAT to validate armor modifications. Additional exploitation testing will be conducted on the SPH to complete validation of modifications to the T1 and T2 armor systems, made to address vulnerable areas identified in early testing.
 - Controlled damage experimentation on the high voltage electrical system to determine the consequences of ballistic damage.
 - The Army conducted all LFT&E in accordance with DOT&E-approved test plans.
 - The Army began full-up system-level testing of the M109 SPH and CAT resupply vehicle in 1QFY16.
- The Army began the M109 FoV PIM IOT&E in October 2016 at Fort Hood, Texas, but suspended testing after one of three test vignettes to determine the root cause of the toxic fumes coming into the cab of the howitzer. That effort continues. DOT&E will submit an IOT&E report in 2QFY17. A second IOT&E will be rescheduled for FY18 once corrective actions are complete.

Assessment

- Over the course of the Developmental Performance, Automotive, and LFT&E program, the Program Office has taken considerable action to correct deficiencies identified in early testing and to validate associated fixes.
 - During armor exploitation testing, most of the modified armored areas demonstrated that they provide protection against Key Performance Parameter threats.

- Changes to the crew compartment Automatic Fire Extinguisher System (AFES) in the CAT mitigate the deficiency identified in early testing and reduce the CAT's vulnerability to fires.
- The crew compartment AFES in the SPH was designed to protect a small, localized area in the crew compartment. Live fire testing demonstrated that the system is deficient in providing adequate fire survivability. The Program Office is developing courses of action to redesign this system and improve SPH survivability to fires. While not yet optimized, the M109A7 provides improved crew fire safety compared to the currently fielded M109A6 because:
 - The M109A7 has crew compartment AFES capability while the M109A6 has none.
 - The M109A7 has reduced fire hazards compared to the M109A6 because of the replacement of hydraulic systems, found on the M109A6, with electric drives.
- The Army verified that the base SPH has the potential to provide underbody IED protection against the requirement blast threat and the objective level threat when equipped with the underbody blast kit.
- Reliability issues found on both the CAT and the SPH have been addressed in a comprehensive test-fix-test cycle throughout the PQT phase.
- Legacy system (parts common to the current M109A6) failures involving breech componentry and primer failures continue to arise in live fire testing and will not be addressed until follow-on developmental work is completed. Engine component failures in both the CAT and the SPH have been initially traced to transmission oil cooler design discrepancies. An interim design change has mitigated further failures and additional testing is ongoing. A final design change will occur during full-rate production.

Recommendations

- Status of Previous Recommendations. In FY15, the Army made design changes to mitigate the deficiencies in the CAT's crew compartment AFES and validated those changes in test. The Army has not yet incorporated changes to address the deficiencies in the SPH's crew compartment AFES but has developed and is reviewing several courses of action to address this issue.
- FY16 Recommendations. The Army should:
 1. Continue development of breech component upgrades and verify corrections for both the breech and engine deficiencies in testing.
 2. Correct the deficiencies in the SPH's crew compartment AFES and validate those fixes in test.