

M829E4 Armor Piercing, Fin Stabilized, Discarding Sabot – Tracer (APFSDS-T)

Executive Summary

- The M829E4 120 mm cartridge is a line-of-sight kinetic energy cartridge designed for the Abrams main battle tank.
- During Integrated Test and Evaluation (IT&E), in-bore structural failures (IBSFs) occurred in the ambient zone temperature range (60-86 degrees Fahrenheit). The program manager stopped testing and conducted a formal failure analysis.
- Preliminary testing indicates the M829E4 cartridge is demonstrating an overall reliability of 94 percent as a result of IBSFs. The reliability requirement is 98 percent.
- The failure analysis identified reliability problems with the production process of the cartridge. The program has implemented production process changes to address reliability deficiencies and is in the process of conducting additional testing to verify the effectiveness of the changes.
- On June 30, 2014, the Program Executive Officer Ammunition approved the M829E4 cartridge for Milestone C with provisions.
- The Milestone Decision Authority authorized 910 M829E4 cartridges for low-rate initial production (LRIP) on June 30, 2014.

System

- The M829E4 120 mm cartridge is a line-of-sight kinetic energy cartridge designed for the Abrams main battle tank. It is the materiel solution for the Abrams' lethality capability gap against threat vehicles equipped with 3rd Generation Explosive Reactive Armor.
- The M829E4 cartridge is an Armor-Piercing, Fin-Stabilized, Discarding Sabot, with Tracer cartridge consisting of a depleted uranium long-rod penetrator with a three-petal composite sabot.
- The flight projectile includes a low-drag fin with a tracer, windshield, and tip assembly.
- The propulsion system of the M829E4 cartridge is a combustible cartridge case similar to that of the currently fielded suite of Abrams' 120 mm tank cartridges.
- The M829E4 has comparable characteristics to its predecessor, the M829A3, in length, weight, and center of gravity.

Ammunition Data Link (ADL) interface rings on base of the M829E4



The visible difference between the two cartridges is the Ammunition Data Link (ADL) interface rings on the base of the M829E4. The rings serve as the interface between the Abrams' fire control system and the M829E4. The ADL enables the Abrams' fire control system to send information to the M829E4.

Mission

Armored Brigade Combat Teams equipped with the M829E4 120 mm cartridge will have the ability to defeat current and projected threat main battle tanks equipped with third generation explosive reactive armor and active protection systems. The Army intends the M829E4 to provide enhanced lethality beyond its predecessor, the M829A3, and will enhance the Joint Forces Commander's capability to conduct decisive operations during Unified Land Operations.

Major Contractor

Alliant Techsystems Inc. (ATK) – Plymouth, Minnesota

Activity

- ATEC conducted a Design Engineering Test consisting of 50 M829E4 cartridges at Yuma Test Center, Arizona, from June through November 2013.
- ATEC conducted two phases of IT&E at Yuma Test Center; Redstone Test Center, Alabama; and Aberdeen Test Center, Maryland, from December 2013 through mid-June 2014.

FY14 ARMY PROGRAMS

- During Phase 1, IBSFs occurred. The program manager stopped testing and conducted a formal failure investigation.
- The Army produced subsequent M829E4 cartridges that incorporated design configuration and production process changes to correct the IBSFs.
- During Phase 2 of IT&E, 100 M829E4 cartridges with the design configuration and production process changes were fired. IBSFs continued to occur. The program manager again stopped testing and conducted another formal failure investigation.
- ATEC conducted vulnerability live fire testing on the Abrams uploaded with M829E4 cartridges to ensure that stored cartridges do not pose a threat when an Abrams tank is engaged by enemy fire from March through June 2014.
- ATEC conducted DOT&E-approved live fire tests to support a lethality assessment from June 16 – 25, 2014.
 - Due to the IBSFs observed during Phase 2 of IT&E, the Army ceased live fire testing. The potential for an IBSF during a live fire test presented an unacceptable risk to the live fire facility.
 - The Army will resume live fire testing when the risk to the live fire test facility related to IBSFs is mitigated and production-representative rounds are available.
- The Army conducted the M829E4 User Excursion at Aberdeen Proving Ground, Maryland, in accordance with a DOT&E-approved Test and Evaluation Master Plan on May 22, 2014.
 - The User Excursion utilized an ADL-equipped Abrams tank and qualified Abrams tank crew, who performed select engagements of a Tank Table VI gunnery event.
 - The gunnery event involved eight M829E4 engagements against moving and stationary targets.
 - The User Excursion was designed to confirm M829E4 cartridge transparency of employment and provide supplemental data for accuracy, performance, and reliability.
- The Program Executive Officer Ammunition approved the M829E4 cartridge for Milestone C with provisions on June 30, 2014.
 - The provisions require that the Army investigate fixes to the failures identified in IT&E, and verify those fixes in ATEC-approved follow-on testing prior to the Full-Rate Production Decision Review/Material Release, per the Milestone C Acquisition Decision Memorandum.
- The Milestone Decision Authority authorized 910 M829E4 cartridges for LRIP on June 30, 2014.
 - The Acquisition Decision Memorandum directed additional reliability testing to validate that LRIP cartridges meet reliability requirements.
- The Army conducted another formal failure investigation into the failures experienced during the second phase of IT&E and identified potential production process and design configuration changes to correct the IBSFs from June through August 2014.
 - Results of the formal failure investigation led the Army to produce two configurations (Configuration A and Configuration B) M829E4 cartridges to correct IBSFs.
 - Configuration A incorporated four production process changes.
 - Configuration B incorporated two design configuration changes and the four Configuration A production process changes.
- The Army conducted testing (Verification #1) at Yuma Proving Ground, Arizona, involving Configuration A and B cartridges on October 27, 2014.
 - Thirty events employing Configuration A cartridges. All 30 Configuration A cartridges fired successfully.
 - Twenty-six events employing Configuration B cartridges. Two of the 26 Configuration B cartridges experienced IBSF, and 24 cartridges fired successfully.
- Based on Verification #1 test results, the Army approved the Configuration A cartridge for Verification #2 testing in February 2015.
 - After Verification #2 testing is complete and yields successful results, the Army will resume live fire testing, production, and First Article Acceptance Testing.

Assessment

- Preliminary testing indicates the M829E4 cartridge is demonstrating an overall reliability of 94 percent. The reliability requirement is 98 percent.
 - During IT&E testing, the cartridge experienced IBSFs in the ambient zone temperature range. The M829E4 cartridge reliability was assessed by firing the cartridge within three temperature zone conditions: cold (-25 to 19 degrees Fahrenheit), ambient (60 to 86 degrees Fahrenheit), and hot (120 to 145 degrees Fahrenheit).
 - In ambient zone temperatures, the cartridge demonstrated 91.6 percent reliability. In cold zone temperatures, the cartridge demonstrated 94.6 percent reliability, and in hot zone temperatures, the cartridge demonstrated 97.2 percent reliability. Overall reliability is 94 percent.
 - The program has proposed additional design configuration changes to address reliability deficiencies and is in the process of testing to verify the effectiveness of the changes.
- Effectiveness is based on the Single Shot Probability of Kill metric computed using the Passive Vehicle Target Model (PVTM). Cartridge reliability is an input to PVTM, along with accuracy and lethality. Because reliability is an input to the PVTM model, effectiveness is sensitive to reliability results.
- DOT&E will submit an evaluation after completion of the production process changes and additional testing.

FY14 ARMY PROGRAMS

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY14 Recommendations. The Army should:
 1. Conduct an FOT&E event for the M829E4 and Abrams' production-representative hardware and software as part of the FY16 Ammunition Data Link Qualification event at Aberdeen Proving Ground, Maryland.
 2. Conduct Verification #2 testing to demonstrate that production process changes enable the cartridge to meet reliability requirements in a DOT&E-approved test prior to the Full Material Release decision.
 3. Complete live fire tests specified in the live fire strategy. If major design changes occur to the M829E4 cartridge to correct IBSFs experienced during IT&E, the Army should conduct live fire tests germane to the cartridge's design changes.
 4. Update PVTM with results from Verification #2 testing and the remaining live fire tests, and use the updated effectiveness model to evaluate M829E4 lethality against relevant threat targets.

FY14 ARMY PROGRAMS