

Joint Air-to-Ground Missile (JAGM)

Executive Summary

- The Army conducted a Joint Air-to-Ground Missile (JAGM) IOT&E in conjunction with the Version 6 AH-64E Apache Attack helicopter FOT&E II in 3QFY19. The Marine Corps will conduct an additional IOT&E in 2QFY20 to assess performance with Marine Corps attack helicopters.
- JAGM meets the Key Performance Parameter for probability of hit and meets the inflight reliability requirement when launched from the AH-64E.
- AH-64E aircrews demonstrated effective employment of JAGM in force-on-force missions against realistic targets in the IOT&E. The AH-64E pilot vehicle interface enables efficient employment of all JAGM modes, giving aircrews increased effectiveness in degraded visibility, against threat countermeasures, against multiple targets, and against targets in realistic operational terrain.
- JAGM maintains the lethality of the legacy HELLFIRE Romeo against target-representative light and heavy-armored ground combat vehicles, trucks, and boats; personnel in the open; and behind brick over block and adobe walls while adding a fire and forget capability.

System

- JAGM is an air-to-ground, precision-guided missile with two new seekers that replicate and combine capabilities of the existing laser-guided HELLFIRE Romeo and radar-guided Longbow HELLFIRE missiles.
- The JAGM design combines two sensor technologies – semi-active laser and millimeter wave (MMW) radar – into a single seeker and guidance system and mated it to the HELLFIRE Romeo warhead, motor, and flight control systems. The dual-seeker engagement modes optimize missile performance while minimizing aircraft exposure to enemy observation and fire by:
 - Destroying targets obscured by countermeasures or obscurants
 - Providing target location updates to an inflight missile



- Avoiding alerting enemy vehicles of imminent attack and unwanted collateral damage
- Engaging multiple targets quickly
- The HELLFIRE Romeo warhead Integrated Blast and Fragmentation Sleeve (IBFS) detonates with a programmable delay fuse and a Height-of-Burst (HOB) feature. This updated warhead blast provides a capability to engage armored vehicles, while the IBFS and HOB feature is designed to engage personnel in the open. The programmable delay allows time for the warhead to penetrate deep into a building, bunker, or lightly armored vehicle before detonating to incapacitate the personnel and destroy the equipment inside.

Mission

Army and Marine Corps commanders employ JAGM from rotary-wing and unmanned aircraft to engage enemy combatants in stationary and moving armored and unarmored vehicles, within complex building and bunker structures, in small boats, and in the open.

Major Contractor

Lockheed Martin Corporation, Missiles and Fire Control Division – Grand Prairie, Texas

Activity

- The Army conducted all operational and live fire testing in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plans. JAGM has not been tested in an active electronic warfare environment or against threats equipped with Active Protection Systems.
- The JAGM Program Office is continuing to test models utilizing a high-fidelity, all-digital simulation model to complement the test program and estimate hit performance throughout the engagement envelope. The Integrated Flight

- Simulation (IFS) testing device used for developmental model testing includes: a six degree-of-freedom missile model, tactical flight software, scene generation models for laser and MMW scenes, target models, clutter models, aircraft models, atmospheric models, and countermeasure models.
- The Army conducted cybersecurity testing of JAGM at Redstone Arsenal, Alabama, in conjunction with the Adversarial Assessment of the Version 6 AH-64E in 3QFY19. The Threat Systems Management Office conducted the

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assessment in an aircraft hangar with a JAGM and missile launcher attached to an AH-64E.

- The JAGM Program Office has completed integrated developmental/operational test shots of 70 missiles as of September 2019. The missile shots spanned the engagement envelope for target type, speed, range, and obscuration. Targets were located in realistic battlefield terrain and aircrews employed tactical maneuvers and procedures.
- The Army Test and Evaluation Command conducted an IOT&E in April through May 2019 at Fort Hood, Texas, and Eglin AFB, Florida. During the IOT&E, operational pilots fired six missiles in all JAGM engagement modes against stationary and moving, maritime and land targets in daytime conditions. During IOT&E, two maritime JAGM shots using a new maritime trajectory hit their targets, but did not produce the desired lethal effects. The program manager has suspended further maritime testing to analyze those results and refine missile software for maritime engagements.
- During all phases of the live missile testing, 13 of the armored targets were obscured or covered by threat countermeasures (smoke, dust, radar reflectors, and/or camouflage netting). Missile testing in FY19 featured shots against targets in realistic operational terrain and against multiple simultaneous moving targets.
- Live fire testing in FY19 included shots against an up-armored T-72, a BMP infantry fighting vehicle, personnel in the open, and behind brick over block and adobe walls.

Assessment

- In preliminary testing to date, JAGM met hit performance and reliability requirements when launched by Version 4.5 and Version 6 AH-64E software. JAGM demonstrated performance requirements for probability of hit, even though many of the targets were obscured by countermeasures or dust. The IFS provided valid hit-point estimates for 49 pre-Milestone C shots. The validated IFS model confirms that JAGM maintains lethality of the HELLFIRE Romeo missile. JAGM demonstrated its inflight and overall reliability requirements with the live missile shots.
- JAGM has been fired in all dual-seeker modes during early Army testing. JAGM destroyed targets aircrews would frequently bypass when armed with HELLFIRE due to tactical considerations. The fire-and-forget capability of the dual-seeking JAGM allowed aircrews the flexibility to engage

air defense systems with minimal aircraft exposure. Battlefield obscurants did not reduce observed accuracy during JAGM engagements.

- FY19 JAGM testing has demonstrated lethality against the up-armored T-72 and improved lethality against light-armored vehicles compared to past JAGM and HELLFIRE Romeo live fire tests using a new delayed fusing capability to delay warhead detonation until after missile penetration. Testing demonstrated improved lethality against personnel behind brick over block and adobe walls versus tests performed in FY18 by optimizing fuse delay timing, equaling HELLFIRE Romeo performance against these targets. The presence of nearby vehicles can increase the expected height of burst when attacking personnel in the open, a consideration that will be addressed in future testing and operational planning.
- The workload and usability scores for the dual-seeker JAGM are similar to the legacy single-seeker HELLFIRE. JAGM met all mission requirements with minimal workload demands during engagements.
- JAGM will require the Army to develop new tactics, techniques, and procedures due to technical differences with the HELLFIRE. The Army must develop a JAGM training device to support differences in training.
- The Army discovered no critical cybersecurity vulnerabilities during the AH-64E JAGM Adversarial Assessment. The Marine Corps will conduct additional cybersecurity testing of JAGM and its shipping container in conjunction with the Marine Corps IOT&E in 2QFY20.
- JAGM has not been tested in an active electronic warfare environment or against threats equipped with Active Protection Systems. These emerging threat capabilities may limit JAGM performance and the Army intends to evaluate this in future testing.

Recommendations

The Army should:

1. Develop, test, and field a JAGM training missile to train pilots on effective employment of JAGM.
2. Evaluate JAGM in an operational electronic warfare environment.
3. Plan and conduct appropriate test and evaluation of new JAGM capabilities as they are developed.
4. Plan and conduct testing of the effectiveness of JAGM against emerging threat armor Active Protection Systems.