

## Joint Air-to-Ground Missile (JAGM)

### Executive Summary

- The Joint Air-to-Ground Missile (JAGM) IOT&E I and LFT&E were adequate to assess the operational effectiveness, operational suitability, lethality, and cybersecurity of JAGM when employed by an AH-64E Apache.
- JAGM exceeded hit performance in 87 test shots, which included safety of flight, developmental, integration, and operational testing against a variety of targets. The missile successfully engaged and disabled heavy and light armor, structures, personnel in the open, maritime targets, and classified counterinsurgency targets.
- JAGM allowed pilots to engage targets beyond the capability of HELLFIRE Romeo. The dual guidance section allows the missile to mitigate the effects of battlefield obscurants such as smoke, dust, and foliage that limit the performance of laser designation needed for HELLFIRE Romeo.
- JAGM exceeded reliability requirements. This assessment includes prelaunch and inflight reliability. The program is continuing to improve environmental protection to ensure it is available in all operational environments.
- JAGM did not meet interoperability requirements for its second threshold platform. The Marine Corps AH-1Z was not able to enter JAGM operational testing due to software errors on the aircraft discovered during developmental and integration testing.

### System

- JAGM is an air-to-ground, precision-guided missile with two new seekers that replicate and combine the 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 while leveraging 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 concealed by countermeasures or obscurants



- Providing target location updates to an inflight missile
- Minimizing alerts to enemy vehicles of imminent attack and unwanted collateral damage
- Rapid engagement of multiple targets
- The integrated blast and fragmentation sleeve warhead detonates with a programmable delay fuse and a height of burst feature. This flexibility allows JAGM to destroy heavy armored vehicles while effectively targeting personnel in the open. The programmable fuse enables complete penetration into buildings, bunkers, or lightly armored vehicles prior to detonation.

### 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 – Orlando, Florida

### Activity

- The Army conducted operational and live fire testing in accordance with the DOT&E-approved Test and Evaluation Master Plan, LFT&E Strategy, and test plans.
- The JAGM program has experienced no operational testing or milestone decision delays due to the effects of the coronavirus

- (COVID-19) pandemic. Some developmental and integration test events have shifted, but the program remains on schedule.
- The JAGM program completed 87 test shots, which included safety of flight, developmental, integration, and operational testing against a variety of targets. JAGM has successfully

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engaged and disabled heavy and light armor, structures, personnel in the open, maritime targets, and classified counterinsurgency targets such as truck and motorcycles.

- The Army Test and Evaluation Command conducted an IOT&E I from March 25 through May 10, 2019, at Fort Hood, Texas, and Eglin AFB, Florida, using an AH-64E. Operational pilots fired six missiles in all JAGM engagement modes against stationary and moving maritime and land targets in daytime conditions demonstrating that suboptimal terminal trajectory can degrade lethality against maritime targets. The Army subsequently updated the software, adjusted the terminal trajectory angle, and conducted additional maritime testing in 1QFY20 and 2QFY20 demonstrating improved JAGM lethality against maritime targets.
- In December 2019, the Navy began integration testing with JAGM and the AH-1Z Viper in preparation for an IOT&E scheduled for 2QFY20. Integration testing revealed that the software for the AH-1Z and the aircraft's Target Sight System (TSS) were not ready for the upcoming IOT&E.
- In February 2020, the Navy decided to delay operational testing using the AH-1Z to focus on developing a new TSS software build. The Navy projects to have an effective TSS software build to support further JAGM integration testing in 1QFY21.
- In 4QFY21, using the AH-1Z, the Navy completed JAGM live fire testing against a multi-story structure, a multi-room structure, and against personnel behind a triple brick wall.
- The inability for the Navy to validate the AH-1Z as a threshold platform led to an Army decision in July 2020 to delay the JAGM Full-Rate Production decision to 4QFY21, following the completion of a Navy IOT&E using the AH-1Z. In the interim, the Army will continue with low-rate initial production of JAGM.

## Assessment

- The Army testing was adequate to assess the operational effectiveness, operational suitability, lethality, and cybersecurity of JAGM when employed from an AH-64E.
- JAGM did not meet interoperability requirements with its second threshold platform. The Marine Corps AH-1Z was not able to progress to the planned JAGM IOT&E due to software errors on the aircraft discovered during developmental and integration testing.
- The Navy is focused on resolving the software concerns with the AH-1Z and intends to complete JAGM IOT&E II with the AH-1Z threshold platform in 3QFY21.

## Operational Effectiveness

- The Army developed an effective and efficient pilot-vehicle interface that was intuitive for operational pilots.
- Aircrews can employ JAGM in multiple engagement modes depending on the tactical situation. This flexibility increases options for aircrews in the evolving operational environment in combat.
- JAGM allows pilots to engage targets not possible using HELLFIRE Romeo. The dual guidance capability mitigates the effects of battlefield obscurants such as smoke, dust,

and foliage that limit the performance of legacy semi-active laser HELLFIRE missiles.

- JAGM affords improvements over the legacy Longbow HELLFIRE by providing a regret avoidance capability. This feature allows a missile using millimeter wave radar to be redirected in flight. Regret avoidance allows the aircrew control of a missile throughout its flight to avoid fratricide or collateral damage.
- JAGM has exceeded required hit performance in operationally realistic testing against a variety of targets.

## Operational Suitability

- JAGM exceeds prelaunch and inflight reliability requirements. The program is using lot acceptance inspections to assess continuing environmental protection improvements to ensure JAGM is reliable in all operational environments.
- JAGM has completed environmental testing in a chamber but has not been flight tested in extreme cold environments. Flight missile testing in an operationally representative arctic environment, such as Alaska, may present performance limitations not possible in a static chamber environment.
- JAGM does not have a captive aircrew training missile. This training device is needed to ensure aircrews are prepared to employ JAGM.

## Lethality

- JAGM demonstrated adequate lethality against heavy and light armor, structures, personnel in the open, maritime targets, and classified counterinsurgency targets. The height of burst is higher than expected when engaging personnel in the open and appears unrelated to surrounding objects or vehicles.
- The new terminal trajectory angle resulted in improved hit point selection and lethality against maritime targets.
- Preliminary assessment indicates JAGM lethality as fired from AH-1Z against multi-room structures is comparable to legacy HELLFIRE. The Navy did not demonstrate lethality against personnel behind a triple-brick wall due to a problem with fuse delay timing. Correction of the timing should result in JAGM lethality at least equal to that of HELLFIRE. The Navy did not demonstrate lethality against the multi-story building due to a warhead failure that is currently under investigation by the Program Office.

## Cybersecurity

- The cybersecurity of JAGM has been assessed against insider and nearsider threats. Details are available in the classified JAGM IOT&E report published in August 2020.
- The Army has not assessed JAGM cybersecurity of the supply chain or against an outside threat.

## Recommendations

- The Navy should:
  1. Complete the interoperability and cybersecurity testing of the JAGM employed from the AH-1Z.
  2. Address the failures encountered in live fire testing.

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- The Program Office should:
  1. Investigate the cybersecurity of the JAGM supply chain.
  2. Correct issues with the height of burst sensor and adjust tactics, techniques, and procedures to ensure lethality against personnel in the open.
  3. Demonstrate JAGM lethality against emerging threats.
  4. Continue to improve reliability through lot acceptance and reliability testing.
- 5. Conduct missile flight testing in the arctic to assess the effects of sustained extreme cold temperatures.
- The Army should:
  1. Develop, test, and field a captive aircrew training missile with appropriate supporting training materials.

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