

AC-130J Ghostriider

Executive Summary

- U.S. Special Operations Command (USSOCOM) is developing AC-130J through the integration of a modular Precision Strike Package (PSP) onto existing MC-130J aircraft. An earlier version of the PSP was previously developed and tested on several AC-130W aircraft since 2009 and fielded in 2010.
- The 18th Flight Test Squadron conducted an Operational Utility Evaluation (OUE) of the Block 10 AC-130J from December 2015 to March 2016 to support Milestone C and an early fielding decision, but USSOCOM will not pursue early fielding of Block 10.
- The Block 10 PSP demonstrated system immaturity during the OUE that diminished the usability of the system. The AC-130J entered operational testing with numerous open deficiency reports (DRs), which required aircrews to use burdensome workarounds in order to conduct their missions. Almost none of the surveyed aircrew rated the system “usable” during the OUE.
- In single-weapon live-fire engagements during the OUE, the AC-130J successfully achieved nominal direct hits and effective kills against two static and two moving targets with Griffin missiles and four static targets with Small Diameter Bombs (SDBs) using two different target coordinate systems.
- The OUE discovered problems with the 30 mm gun control system that affected its accuracy. Preliminary results from an upgraded gun tuning software resident in Block 20 indicate both the 105 mm and 30 mm guns are performing within accuracy specifications.
 - Preliminary results from lethality analysis of the PGU-46/B 30 mm round against mannequin targets indicate that this round has limited effectiveness against personnel in the open on soft ground but is more effective against personnel on hard surfaces.
 - Data also indicate that lethality to personnel above a “soft” plywood roof is lower than predicted by existing models because the round detonated below the roof’s surface; mannequins above a concrete roof incurred more fragmentation damage than above a plywood roof.
- Cybersecurity testing of the Block 10 PSP found vulnerabilities that are described in the classified Cooperative Vulnerability and Penetration Assessment (CVPA) report. These vulnerabilities are addressed in Block 20 software modifications.
- Lockheed Martin delivered the first Block 20 AC-130J to USSOCOM in July 2016 to begin developmental testing of new capabilities, such as the 105 mm gun. As of the end of FY16, the program received eight donor MC-130J for modification and produced four AC-130J. The first AC-130J, which experienced a Class A mishap in FY15 rendering it



non-flyable, will become an Air Education and Training Command training asset.

- The 18th Flight Test Squadron will conduct IOT&E on a Block 20 aircraft from March through June 2017 to support a Full-Rate Production decision in 1QFY18.

System

- The AC-130J is a medium-sized, multi-engine, tactical aircraft with a variety of sensors and weapons for air-to-ground attack.
- USSOCOM is developing the AC-130J by integrating a modular PSP onto existing MC-130J aircraft, and replacing the MC-130J refueling pods with weapon racks. USSOCOM continues to develop new PSP capabilities on legacy AC-130W aircraft in parallel before they are introduced on the AC-130J in an evolutionary acquisition approach:
 - The Block 10 AC-130J PSP provides a weapons suite that includes an internal, pallet-mounted 30 mm side firing chain gun; wing-mounted, GPS-guided SDBs; and Griffin laser-guided missiles mounted internally and launched through the rear cargo door.
 - The PSP also provides two electro-optical/infrared sensor/laser designator pods and multiple video, data, and communication links.
 - A dual-console Mission Operator Pallet (MOP) in the cargo bay controls all PSP subsystems with remote displays and control panels (including master arm and consent switches and a gun trigger) on the flight deck. An interim, limited-functionality, carry-on flight deck workstation for a Combat Systems Officer has been added to the Block 10 AC-130J.
 - Block 20 AC-130J adds a 105 mm gun, laser-guided SDB, a side-mounted pilot tactical display, and Large Aircraft Infrared Countermeasures. The aircrew will increase

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from seven to nine. The first Block 20 configuration was delivered on aircraft number 4 in July 2016.

- Future updates are expected to include a permanent Combat Systems Officer station, wing-mounted HELLFIRE missiles, radio-frequency countermeasures (RFCM), all-weather engagement capability, and on a limited number of aircraft, a high-energy laser.
- The AC-130J retains all survivability enhancement features found on the MC-130J aircraft.
 - Susceptibility reduction features include the AN/ALR-56M radar warning receiver, the AN/AAR-47(V)2 missile warning system, and the AN/ALE 47 countermeasure dispensing system.
 - Vulnerability reduction features include fuel system protection (fuel tank foam to protect from ullage

explosion), redundant flight-critical components, and armor to protect the crew and the oxygen supply.

- The AC-130J will replace legacy AC-130H/U aircraft.

Mission

The Joint Task Force or Combatant Commander will employ units equipped with the AC-130J to provide close air support and air interdiction using battlespace wide area surveillance, target geolocation, and precision munition application.

Major Contractor

Lockheed Martin – Bethesda, Maryland

Activity

- The 18th Flight Test Squadron conducted an OUE in accordance with the DOT&E-approved test plan of the Block 10 AC-130J from December 2015 to March 2016 to support an early fielding decision. USSOCOM has subsequently decided not to pursue early fielding of Block 10. Testing consisted of 18 sorties and 74 flight hours during the dedicated OUE period and accomplished approximately half of the operational test designs for the Griffin missile and the SDB. The remainder of the Griffin and SDB tests will occur in IOT&E.
- The OUE included cooperative cybersecurity testing of most of the PSP, but precision-guided munition subsystems and aircraft avionics and support systems were not part of the test, and DOT&E did not approve the cybersecurity test plan. The Block 20 AC-130J will undergo a full-aircraft CVPA and an Adversarial Assessment during IOT&E.
- Live fire tests during the OUE and follow-on developmental testing comprised the first phase of AC-130J weapons effectiveness testing. The 780th Test Squadron collected live fire data against operationally representative mannequin and vehicle targets to support lethality evaluation of the 30 mm gun and the Griffin missile. Block 20 testing will include additional Griffin engagements and characterization of the 105 mm gun.
- Lockheed Martin delivered the first Block 20 AC-130J to USSOCOM in July 2016 to begin developmental testing of new capabilities, such as the 105 mm gun. As of the end of FY16, the program received eight donor MC-130J for modification and produced four AC 130J. The first Block 10 AC 130J, which experienced a Class A mishap in FY15 rendering it non-flyable, will become an Air Education and Training Command training asset.
- Block 20 developmental testing began in July and includes additional flying and handling qualities tests to verify flight characteristics of the modified aircraft are consistent with technical data. The program expects to complete developmental testing in December 2016.
- Through a Memorandum of Agreement, USSOCOM Program Executive Office-Fixed Wing, Air Force Special Operations Air Warfare Center, 96th Test Wing, and 1st Special Operations Wing formed a Special Operations Combined Test Force to conduct AC-130J developmental testing in lieu of the traditional Air Force Materiel Command framework. Test team members and aircrew will come from 1st Special Operations Wing (1st Special Operations Group Detachment 2), 96th Test Wing (413th Flight Test Squadron), and Air Force Special Operations Air Warfare Center (18th Flight Test Squadron), depending on the nature of the test sortie.
- The Program Office submitted, and DOT&E approved, an updated Test and Evaluation Master Plan (TEMP) in July to support a Milestone C decision in September. The program updated the TEMP to include full-aircraft cybersecurity testing and phase two lethality testing of the Griffin missile and 105 mm gun as part of developmental and operational testing of the Block 20 AC-130J.
- The 18th Flight Test Squadron will conduct IOT&E on a Block 20 aircraft from March through June 2017 to support a Full-Rate Production decision in 1QFY18. IOT&E will complete the Griffin and SDB tests, add 105 mm gun and Laser Small Diameter Bomb (LSDB) testing, and repeat much of the 30 mm gun testing due to problems discovered in the OUE.
- The 780th Test Squadron, in coordination with DOT&E, has submitted the phase two weapons lethality test plan for the Griffin missile and 105 mm gun to the Combined Test Force for approval and execution. The plan includes four more Griffin missile engagements against static ground and maneuvering boat targets and 105 mm gun engagements against structures, personnel, technical vehicles, and lightly armored air defense vehicles.
- USSOCOM is developing an RFCM system for MC-130J and AC-130J under a separate Acquisition Category II program. A recent change in program strategy will implement and test

the system first on the AC-130J instead of the MC-130J, with RFCM IOT&E on an AC-130J scheduled for 4QFY18. The RFCM program plans a Milestone B decision and source selection in 1QFY17.

- The U.S. Air Force Combat Effectiveness and Vulnerability Analysis Branch expect to have completed the Ballistic Vulnerability Analysis, Anti-Aircraft Artillery Susceptibility Analysis, Proximity Burst Analysis, and Occupant Casualty Analysis by 2QFY17. These analyses are being conducted in accordance with the LFT&E Alternate Test Plan.

Assessment

- The Block 10 PSP demonstrated system immaturity during the OUE that diminished the usability of the system. The system entered operational testing with numerous open DRs, which required aircrews to use burdensome workarounds in order to conduct their missions. Almost none of the surveyed aircrew rated the system “usable” during the OUE.
 - The Block 10 AC-130J entered the OUE with 19 Category 1-Urgent and 60 Category 2-Urgent open DRs. Testing generated 10 additional Category 1-Urgent or Category 2-Urgent DRs. The program has since closed out 18 DRs, but only downgraded the severity of 6 Category 1-Urgent and 1 Category 2-Urgent DRs.
 - Nine Category 1-Urgent DRs remained open as of the OUE report covering the following problems:
 - MOP computers become overloaded and perform poorly or must be reset (two DRs).
 - Software does not update target coordinates frequently enough in some modes.
 - MOP hand controllers do not provide adequate control of the sensor or may allow accidental movement of the targeting sensor (two DRs).
 - Laser designator frequently does not fire, and settings may spontaneously change during editing (two DRs).
 - One of the aircraft radios interferes with the PSP GPS receiver.
 - Oxygen hoses are too short.
 - The Block 20 update is designed to address eight of the Category 1-Urgent DRs, which are currently under evaluation. The DR on GPS receiver interference remains open.
- The overall operating environment aboard the AC-130J also diminished PSP usability. Crews reported problems with night-vision goggle compatibility caused by MOP display screens, gun noise preventing hands-free communication on the intercom system, the temporary flight deck workstation laptop physically interfering with aircraft controls and displays, and a physically challenging aft-cabin environment due to the “roll-on” nature of the PSP creating multiple trip hazards and narrow passageways.
 - The test team submitted a Category 1-Urgent and a Category 2-Urgent DR regarding trip hazards in the cargo compartment where special mission aviators routinely carry high-explosive ammunition, but the material improvement project review board downgraded the Category 1-Urgent DR to Category 2-Urgent.
- Previously reported problems with the Block 10 PSP sensors appear to have been corrected as of the OUE and will be validated during IOT&E of Block 20. No un-commanded sensor movements occurred that were not attributable to allowing the sensor to pass through nadir.
- Block 10 flying and handling qualities testing showed no significant differences from basic C-130J performance as a result of the AC-130J modifications. An Air Force Materiel Command investigation into the Class A mishap on the first aircraft attributed the departure from controlled flight primarily to improper control inputs and test procedures.
- Although the OUE missions did not experience the same kind of complete shutdowns of MOP computers that crews observed during the operational assessment, operators still frequently reported software instability and poor computer performance during more complex tasks. Hardware and software upgrades on Block 20 MOP are intended to resolve these issues and will be evaluated during IOT&E.
- In single-weapon live-fire engagements during the OUE, the AC-130J successfully achieved nominal direct hits against two static and two moving targets with Griffin missiles and four static targets with SDBs using two different target coordinate systems.
 - Preliminary results from lethality analysis of the Griffin vehicle targets indicate mobility kills against a stationary truck and two moving trucks in both height-of-burst and point-detonate modes, which appear to correlate well with pre-test modeling and simulation; however, the level of incapacitation and effective distance of fragmentation against personnel appear to be lower than predicted by existing models.
- The OUE discovered problems with the 30 mm gun control system that affected its accuracy and are still under investigation. Preliminary results during Block 20 developmental testing indicate an upgraded gun tuning software has resolved the DR and both the 105 mm and 30 mm guns are performing within accuracy specifications.
 - Preliminary results from lethality analysis of the PGU-46/B 30 mm round against mannequin targets indicate that this round has limited effectiveness against personnel in the open on soft ground but is more effective against personnel on hard surfaces.
 - Data also indicate that lethality to personnel above a “soft” plywood roof is lower than predicted by existing models because the round detonated below the roof’s surface; mannequins above a concrete roof incur more fragmentation damage than above a plywood roof.
 - USSOCOM has indicated that it may change the standard operational round for the 30 mm gun from PGU-46/B to PGU-13D/B for production reasons. If the operational round changes, the program will need to repeat the phase one lethality testing with the new round to characterize

its effectiveness in the LFT&E report required for the Full-Rate Production decision.

- The OUE did not adequately support DOT&E evaluation of the suitability of crew compartment armor because the crews did not install it during test flights for weight and balance reasons that will be remedied by the addition of the 105 mm gun in the rear of the aircraft. However, a ground demonstration indicates that crew compartment armor hinders crew egress in an emergency.
- Cybersecurity testing of the Block 10 PSP found vulnerabilities that are described in the classified CVPA report. The program expects to test and verify remediation of these deficiencies in April 2017 as part of the Block 20 CVPA.
- The mission success-based measure of Weapon System Reliability exceeded the Capabilities Production Document requirement of 82 percent during the OUE, but the AC-130J experienced hardware and software failures that diminished system effectiveness and limit the system's inherent availability.
- The AC-130J still does not satisfy two Key System Attributes from the Capabilities Production Document:
 - The program has not implemented a solution to provide flight deck crew a geo-rectified tactical display superimposed on the field of view. A side-mounted heads-up display next to the pilot station is planned for Block 20 and is expected in early FY17, but it is not yet available for developmental testing to ensure its readiness for IOT&E.
 - The AC-130J does not have a sensor system that enables adverse weather engagements by detecting and tracking targets obscured by weather, smoke and haze, or obscurants. Earlier efforts to integrate an AN/ASQ-236 radar pod were unsuccessful.
- The current test schedule leaves only 29 days between delivery of the developmental test and evaluation report and the start of IOT&E, with an operational test readiness review 22 days before IOT&E instead of the recommended 45 days. This raises the risk that any problem discoveries in developmental testing may delay the start of IOT&E or adversely affect the evaluation of the AC-130J.

Recommendations

- Status of Previous Recommendations.
 1. The program included the recommended lethality testing in the TEMP update for Milestone C, has conducted phase one lethality testing of the Griffin and 30 mm gun, and plans to conduct phase two lethality testing prior to IOT&E. However, a change in ammunition for the 30 mm gun will require a repeat of that portion of testing.
 2. The program briefed an updated baseline for block capability development and fielding at the June 2016 program management review, but it is not reflected in the Milestone C TEMP, and the test strategy for the new capability increments is unclear.
- FY16 Recommendations. The Program Office should:
 1. Correct, close, and verify all Category 1-Urgent DRs and as many Category 2-Urgent DRs as possible prior to IOT&E.
 2. Conduct additional 30 mm lethality testing using PGU-13D/B in time to support the Full-Rate Production decision if that round is likely to be employed in combat.
 3. Include a clear test strategy for future testing of the new capability increment baseline in the TEMP update for the Full-Rate Production decision.