

CH-47F (Chinook) – Improved Cargo Helicopter

Executive Summary

- DOT&E published a combined OT&E/LFT&E report in June 2007 and found that the CH-47F is operationally effective, suitable, and survivable.
- As of September 2013, Boeing has delivered 256 of the planned 464 CH-47F aircraft.
- Commanders in combat and homeland support report that the CH-47F is much more capable than the CH-47D.
- The Army continues to improve the CH-47F by incorporating product improvements to address operational test findings and respond to emerging operational needs. Key product improvements since 2007 have enhanced mission capabilities and increased aircraft survivability.
- Issues identified during testing in 2012 and 2013 that require resolution:
 - The CH-47F Cargo On-Off Loading System (COOLS) enhances the operational effectiveness of CH-47F-equipped units and is an improvement over the legacy cargo handling system for supporting combat operations. Ramp rollers do not provide adequate clearance to accommodate the forklift tines on the Army's primary tactical forklift and unrestrained cargo movement poses a danger to crews. The Army should modify the COOLS design or installation to provide sufficient ramp clearance for forklift tines and reinforce the need to heed published warnings to avoid crewmember injury and equipment damage when operating the system.
 - The COOLS under-floor Ballistic Protection System (BPS) provides some ballistic protection to the crew and passengers, but not to the same level expected from earlier qualification testing. The Army should conduct additional ballistic testing of the BPS to understand the varying performance noted in testing and determine if the new version of the BPS meets the Army's requirements.

System

- The CH-47F is a twin-turbine, tandem-rotor, heavy-lift transport helicopter that enables the Army to support the rapid response capability necessary for forcible and early entry contingency missions, as well as linear and nonlinear, and simultaneous or sequential operations.
- The CH-47F is used in General Support Aviation Battalions assigned to Combat Aviation Brigades. Each Battalion has 12 CH-47F helicopters authorized.
- The CH-47F is designed to transport artillery and light equipment, up to 16,000 pounds, or 31 combat troops.
- The CH-47F aircraft capability improvements include:
 - A CAAS cockpit to increase crew situational awareness and increase cockpit commonality with other Army aircraft



- A Digital Automatic Flight Control System to improve handling qualities and decrease pilot workload
- Engine upgrades for increased power
- Fuselage stiffening, corrosion protection, and a new monolithic airframe structure to reduce cockpit vibration and increase airframe durability
- The Common Missile Warning System, an Infrared Suppression System, and an Advanced Tactical Infrared Countermeasures system for increased aircraft survivability
- The Army acquisition objective is to procure 464 CH-47F aircraft.

Mission

The General Support Aviation Battalion assigned to the Combat Aviation Brigade employs the CH-47F to conduct the following types of missions:

- Air Assault operations to transport ground forces and equipment
- Air Movement operations to move passengers, fuel, ammunition, and equipment
- Casualty evacuation operations
- Disaster relief, fire-fighting, and rescue operations

Major Contractors

- Aircraft: The Boeing Helicopter Company – Ridley Park, Pennsylvania
- Engine: Honeywell – Phoenix, Arizona
- Software development: Rockwell Collins – Cedar Rapids, Iowa

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Activity

- As of September 2013, Boeing has delivered 256 of the planned 464 CH-47F aircraft.
- The Army completed testing, fielding, and deployment of the following product improvements between 2007 and 2012:
 - Enhanced coupled flight director to reduce pilot workload in the cruise/en-route flight mode (functionality that links flight plan/navigation guidance to the flight control system allowing it to generate corresponding flight control inputs)
 - Integrated communications system upgrade to enhance voice, data, and navigation capabilities
 - Additional Common Missile Warning System sensor to increase missile warning effectiveness
 - Infrared Suppression System to reduce aircraft infrared signature
 - Advanced Tactical Infrared Countermeasure with an active infrared jammer for missile defense
- The Army completed integrated testing of the CH-47F COOLS from November through December 2012 where operational crews completed four end-to-end internal cargo missions using a COOLS-equipped CH-47F. Aircrews loaded and unloaded 20 cargo pallets, and on 2 missions reconfigured the COOLS in flight; this was a task that crews could not have completed using the legacy Helicopter Internal Cargo Handling System (HICHS).
- The Army Research Laboratory/Survivability/Lethality Analysis Directorate (ARL/SLAD) conducted live fire testing from May through June 2013 to evaluate the ballistic performance of the under-floor BPS against a variety of expected small-arms projectiles. Production representative panels were installed in the same configuration for the test as they are on the aircraft. ARL/SLAD also performed a force protection analysis to assess the level of protection afforded to the crew and passengers.
- The Army conducted integrated testing and live fire testing of the COOLS in accordance with the DOT&E-approved test plans.
- The Army conducted flight testing of CAAS v9.2 from August 2011 to February 2012. The CAAS v9.2 is designed to improve situational awareness, expand Identification Friend or Foe Mode 5 capability, update the flight performance modules, and provide the highest level of navigation certification: Required Navigational Performance/Area Navigation.
- DOT&E published the CH-47F COOLS Integrated Test report in July 2013 and the CH-47F COOLS BPS LF&E report in August 2013.

Assessment

- Reports from theater indicate that the CH-47F is much more capable than the CH-47D. Commanders in Afghanistan commend the CH-47F for its superior navigation, enhanced voice and digital communications, ability to operate in a high-altitude and hot-temperature environment, high-operational tempo, and overall system reliability.
- The Army continues to improve the CH-47F by incorporating product improvements to address operational test findings and respond to emerging operational needs. Key product improvements since 2007 have enhanced mission capabilities and increased aircraft survivability.
- CAAS v9.2 performed satisfactorily and the aircraft achieved the Required Navigation Performance/Area Navigation certification.
 - The handling qualities and flight characteristics of the CH-47F have not changed and the aircraft continues to be capable of performing its mission.
 - Identification Friend or Foe Mode 5 capability and flight performance modules performed satisfactorily.
 - Workload when using CAAS v9.2 was satisfactory.
- The COOLS enhances the operational effectiveness of CH-47F-equipped units and is an improvement over the legacy cargo handling system for supporting combat operations. Testing revealed problems with ramp roller clearance and the dangers of unrestrained cargo movement.
 - The COOLS is easily reconfigured for carrying troops or cargo, adds flexibility for CH-47F mission tasks, and increases cargo carrying capacity by 543 pounds when combat-configured. Soldiers can easily accomplish loading, handling, securing, and unloading palletized cargo with the COOLS at airfields and field sites.
 - The COOLS is not compatible with all fielded Army tactical forklifts. COOLS ramp rollers do not provide adequate clearance to accommodate the forklift tines on the Army's primary tactical forklift.
 - Unrestrained cargo movement on COOLS rollers is dangerous. The risk is mitigated through New Equipment Training and published notes, cautions, and warnings in operator and technical manuals.
- The COOLS under-floor BPS provides improved coverage over the legacy BPS. The COOLS BPS does not provide the level of ballistic protection expected from previous material qualification testing, requiring additional distance between the weapon and the aircraft to have equivalent protection. Live fire testing also revealed some anomalies indicating that the ballistic performance varies with impact angle.
 - The COOLS BPS is semi-permanently installed below the cabin floor and provides coverage for the entire cabin floor and ramp areas.
 - The legacy BPS cannot be reconfigured in flight to accommodate a change of mission from cargo to passenger transfer and also is significantly heavier, so the complete legacy BPS is often not used in theater.
 - The COOLS BPS, being lighter and stowed away, provides a greater area of coverage under a wider variety of missions.
- The results of the force protection analysis indicated that the level of protection offered by the COOLS BPS is moderate for one of the two projectiles analyzed, and relatively low for the other higher caliber projectile. The results presented were for impacts representative of the weapon's muzzle velocity and three additional velocities representative of typical

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increasingly greater combat standoff ranges (i.e., lower impact velocities for distances of 100, 200, and 300 meters).

Recommendations

- Status of Previous Recommendations. The Army addressed 9 of 10 FY07 recommendations. The Army should improve the APR-39 radar warning receiver performance to increase threat reporting accuracy for the aircrew or install a more accurate alternative radar warning receiver.
- FY13 Recommendations. The Army should:
 1. Modify the COOLS design or installation to provide sufficient ramp clearance for forklift tines.
 2. Reinforce in training the need to heed published warnings to avoid crewmember injury and equipment damage when operating the COOLS.
 3. Perform additional testing of the COOLS BPS armor to understand the varying performance with regard to angles of impact and determine if it still meets the Army's requirements.

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