



**INSPECTOR GENERAL  
DEPARTMENT OF DEFENSE  
400 ARMY NAVY DRIVE  
ARLINGTON, VIRGINIA 22202-2884**

May 21, 1991

MEMORANDUM FOR ASSISTANT SECRETARY OF DEFENSE (PRODUCTION  
AND LOGISTICS)  
ASSISTANT SECRETARY OF THE ARMY (FINANCIAL  
MANAGEMENT)

SUBJECT: Report on the Audit of Performance and Reliability of  
Cobra Helicopter Rotor Blades (Report No. 91-082)

Introduction

We are providing this final report for your information and use. The audit was made from January to March 1991. The audit objective was to evaluate the performance, maintenance, and reliability of the Cobra Helicopter K747 Main Rotor Blade. We also evaluated the effectiveness of the applicable internal controls. The audit was made in response to concerns raised by personnel at the Sharpe Army Depot about the K747 blade's performance, maintenance, and reliability.

Summary of Audit Results

The concerns about the performance and reliability of the K747 blade were legitimate. The blade has had performance and reliability problems; however, the problems have been identified and corrected. After a defect was discovered the Army took corrective action to fix the problem. The inventory of blades was upgraded to accommodate the redesigns and each of the follow-on acquisitions of the blade included the revised specifications. Also, the blade appeared to have no unusual maintenance problems, was not being refurbished or discarded frequently, was not causing large numbers of mishaps, and had been adequately tested. Furthermore, cracks and voids discovered by Sharpe Army Depot personnel were evaluated and determined to be in a noncritical area of the blade and to pose no problem. There is no evidence that the cracks and voids will shorten the blade's life or affect safety. The Army Aviation Systems Command's evaluation of Sharpe Army Depot's Quality Deficiency Reports relating to the cracks and voids appeared to be thorough and complete.

Scope of Audit

We reviewed Army and contractor records for FY 1985 through FY 1990 relating to performance, maintenance, reliability, and testing procedures for the K747 blade. Engineering specialists from the Office of the Inspector General, DoD, assisted the auditors in evaluating the testing procedures. We also reviewed

the Army's mishap reports relating to the K747 blade for the past 14 years. Activities visited are listed in Enclosure 2.

This economy and efficiency audit was conducted in accordance with auditing standards issued by the Comptroller General of the United States as implemented by the Inspector General, DoD, and accordingly included such tests of internal controls as were considered necessary.

### Internal Controls

We evaluated the internal controls over the K747 blade by determining if controls existed to ensure the adequacy of the performance, maintenance, and reliability of the blade. This included an evaluation of the adequacy of the Army's internal controls for ensuring that the blade manufacturer met the performance and reliability requirements of the Defense and Federal Acquisition Regulations. It also included an evaluation of the adequacy of the Army's internal controls for ensuring the maintenance requirements of Army Regulation 750-1, "Army Material Maintenance Policy," and Department of the Army Pamphlet 738-750, "The Army Maintenance Management System," were met. The internal controls were deemed to be effective in that no material deficiencies were disclosed by the audit.

### Background

This audit was initiated as a result of concerns raised about the performance, maintenance, and reliability of the K747 blade by personnel at the Sharpe Army Depot during our Audit of Aircraft Depot Maintenance Programs (Project No. OLB-0058). Specifically, we were informed that K747 blades were being refurbished repeatedly and many were being discarded before achieving their expected useful life. Sharpe personnel also stated that the K747 blade's life may be reduced because of cracks and voids they found during nondestructive examinations of the blades.

The K747 blade is an all composite structure consisting of fiberglass, kevlar, graphite, and metallic components. The composite blade was designed in 1975 under the Army Aviation System Command's Product Improvement Program as a replacement for the then current metal blade. The composite blade was developed to increase radar avoidance, lower life cycle cost, and reduce the weight of the blade, thereby allowing the helicopter to carry more weight. The K747 blade was first produced in 1977, and the Army's AH-1 Cobra Helicopter fleet was completely outfitted with the blade during FY's 1988 and 1989 at a cost of about \$100 million.

### Prior Audit Coverage

We did not identify any prior audits during the past 5 years that specifically addressed the performance, maintenance, and reliability of the K747 blade.

### Discussion

The K747 blade that is used as the main rotor blade on the AH-1 Cobra Helicopter has had performance and reliability problems. The blade's most serious performance and reliability problems included cracking in the root end fitting and erosion of the blade's leading edge (see Enclosure 1). However, the Government and the blade's manufacturer identified and corrected the problems. The actions appeared to be complete and satisfactory.

At the time of our audit, the K747 blade did not require any extensive maintenance and, except for the performance and reliability problems mentioned above, there was no evidence that the blade had prior maintenance problems. Future maintenance requirements for the blades are expected to be minimal.

The K747 blades were not being completely refurbished. However, the blade did require modifications to perform as required by the Army. From June 1978 through January 1989 the blade's configuration was changed nine times to achieve the desired performance and reliability.

We did not find an excessive number of blades being discarded. Of the 3,420 blades procured by the Army as of February 11, 1991, only 119 (3 percent) had been scrapped at the time of the audit. The blades were scrapped for a number of reasons including manufacturing defects and mishaps. As a result, the majority (97 percent) of the blades manufactured as of the date of our audit were still in service.

The cracks and voids in the blade discovered by Sharpe personnel did not appear to be a problem. Sharpe Army Depot's Nondestructive Evaluation Team discovered cracks and voids in the blade drag strut attaching point (see Enclosure 1) by X-ray imaging in February 1989. Sharpe submitted six Quality Deficiency Reports addressing the deficiencies to the Army Aviation Systems Command. The Army Aviation Systems Command's engineering department replied to Sharpe's deficiency reports in February 1990 stating that the cracks and voids that Sharpe identified were located within the filler block of the blade and that cracks and voids in this area were acceptable. The Army Aviation Systems Command's conclusion was based on an engineering evaluation that the contractor performed and the Government's plant representative monitored. Additionally, in June 1990, the Army Materiel Command informally requested that engineering

personnel from the National Aeronautics and Space Administration evaluate the cracks and voids in the filler material. Those engineering personnel informed the Army Materiel Command that the cracks and voids posed no performance or reliability problems.

We reviewed mishap records covering the past 14 years at the Army Safety Center at Fort Rucker, Alabama, to determine if cracks or voids in the K747 blade drag strut area had resulted in accidents. We found that there were 15 accidents attributable to the K747 blade during those 14 years. Ten (67 percent) of the failures were caused by problems with the leading edge erosion guard, which was corrected by a configuration change. None of the incidents were caused by cracks or voids in the drag strut attaching area.

During one mishap involving a Cobra Helicopter (the mishap was not caused by the blade) the K747 blade demonstrated its ability to withstand extreme abuse without cracking. The K747 blade repeatedly struck a 9-inch diameter pine tree and cut it into several segments. The helicopter landed safely, in part, because the blade assembly stayed together and continued to operate. The drag strut attaching area of the blade was examined after the accident and showed no external stress.

Engineering personnel on the staff of the Inspector General, DoD, assisted us in evaluating the adequacy of tests the contractor performed on the blade. We concluded that the blade has been thoroughly tested and its useful life is expected to far exceed the platform it will serve. Fatigue life testing reports produced by the contractor showed that the blade has a fatigue life of 10,000 hours.

#### Management Comments

We provided a draft of this report to the addressees on April 12, 1991. Because there were no recommendations, no comments were required of management, and none were received. Therefore, we are publishing this report in final form. Any comments on this final report should be provided by June 20, 1991.

We appreciate the courtesies and cooperation extended to the audit staff. If you have any questions on this audit please contact Mr. Dennis Payne, Program Director, at (703) 614-6227 (DSN 224-6227) or Mr. James Kornides, Project Manager, at (703) 614-6223 (DSN 224-6223). A list of the Audit Team Members is in Enclosure 3. Copies of this report are being provided to the activities listed in Enclosure 4.



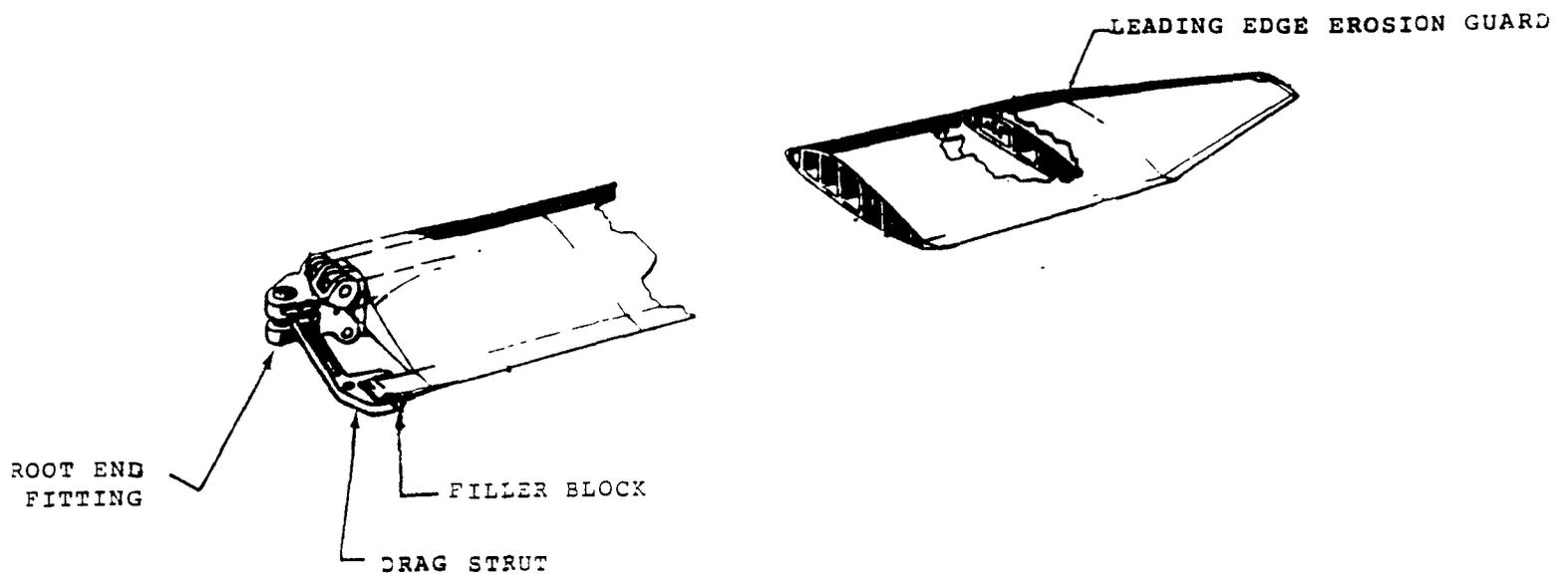
Edward R. Jones  
Deputy Assistant Inspector General  
for Auditing

Enclosures

cc:  
Secretary of the Army



COBRA HELICOPTER K747 MAIN ROTOR BLADE





ACTIVITIES VISITED OR CONTACTED

Office of the Secretary of Defense

Deputy Assistant Secretary of Defense (Logistics), Office of the  
Assistant Secretary of Defense (Production and Logistics),  
Washington, DC

Department of the Army

Chief of Staff for Logistics, Office of the Deputy Chief of Staff  
for Logistics, Washington, DC  
Army Aviation Center, Fort Rucker, AL  
Army Aviation Systems Command, St. Louis, MO  
Army Aviation Technical Test Activity, Fort Rucker, AL  
Army Materiel Command, Alexandria, VA  
Army Safety Center, Fort Rucker, AL  
Corpus Christi Army Depot, Corpus Christi, TX  
Sharpe Army Depot, Stockton, CA

Department Of the Navy

Naval Aviation Systems Command, Arlington, VA

Department of the Air Force

Sacramento Air Logistics Center, McClellan Air Force Base, CA

Defense Agencies

Defense Contract Administrative Service Plant Representative  
Office - Kaman Aerospace, Inc., Bloomfield, CT

Other Activities

National Aeronautics and Space Administration - Langley Research  
Center, Hampton, VA



**AUDIT TEAM MEMBERS**

Shelton R. Young, Director, Logistics Support Directorate  
Dennis E. Payne, Program Director  
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Assistant Secretary of Defense (Public Affairs)

### Department of the Army

Secretary of the Army  
Assistant Secretary of the Army (Financial Management)  
Chief of Staff for Logistics, Office of the Deputy Chief of Staff  
for Logistics  
Army Aviation Center  
Army Aviation Systems Command  
Army Aviation Technical Test Activity  
Army Materiel Command  
Army Safety Center  
Corpus Christi Army Depot  
Sharpe Army Depot

### Non-DoD Activities

Office of Management and Budget  
National Security Division, Special Projects Branch  
U.S. General Accounting Office  
NSIAD Technical Information Center

### Congressional Committees:

Senate Subcommittee on Defense, Committee on Appropriations  
Senate Committee on Armed Services  
Senate Committee on Government Affairs  
Senate Ranking Minority Member, Committee on Armed Services  
House Committee on Appropriations  
House Subcommittee on Defense, Committee on Appropriations  
House Ranking Minority Member, Committee on Appropriations  
House Committee on Armed Services  
House Committee on Government Operations  
House Subcommittee on Legislation and National Security,  
Committee on Government Operations