

Audit



Report

OFFICE OF THE INSPECTOR GENERAL

**QUALITY ASSURANCE PRACTICES FOR THE
AV-8B HARRIER II AIRCRAFT WING SKINS**

Report No. 94-099

May 13, 1994

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Department of Defense

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

May 13, 1994

**MEMORANDUM FOR ASSISTANT SECRETARY OF THE NAVY (FINANCIAL
MANAGEMENT)
DIRECTOR, DEFENSE LOGISTICS AGENCY**

**SUBJECT: Report on Quality Assurance Practices for the AV-8B Harrier II Aircraft
Wing Skins (Report No. 94-099)**

Introduction

We are providing this report for your review. We performed the audit in response to a referral from the Defense Criminal Investigative Service concerning allegations about improper quality assurance practices for the AV-8B Harrier II aircraft (AV-8B) wing skins. The complainant alleged that, during 1990, the following occurred:

- o The McDonnell Aircraft Company (McAIR), now a part of McDonnell Douglas Aerospace East (McDonnell Douglas), produced a number of potentially nonconforming AV-8B upper and lower composite wing skins. The alleged nonconformance affected part of the wing skin area near the aircraft center line, which is a high-stress area. Nonconforming wing skins would have nearly zero strength due to folding of some of the inner plies of the composite material.

- o Potentially weakened wing skins were installed on Marine Corps aircraft with the approval of the Navy.

- o Some of the AV-8B wings produced by the contractor were sold to British Aerospace, Limited (British Aerospace), for use by the United Kingdom. British Aerospace refused to accept aircraft with the potentially weakened wings, and Navy officials then directed that the potentially weakened wings only be installed on aircraft destined for the Marine Corps.

Audit Results

We did not substantiate the allegations. We determined that McAIR initially produced nonconforming composite lower wing skins for the AV-8B that had folded inner plies. However, McAIR subsequently strengthened the nonconforming AV-8B wings with an external titanium strap to compensate for any loss of strength in the completed wing assembly. We further determined that neither the contractor nor the Navy directed the installation of 17 nonconforming lower wing skins only on Marine Corps aircraft. By the time McAir identified the problem as wrinkled inner composite plies, McAir had

produced 17 nonconforming lower wing skins. Of the 17 wing skins, 10 were installed on wing frames. The wing skins could not be repaired; therefore, all 10 wings were strengthened as necessary. Of these 10 completed wings, the Marine Corps received 7 and British Aerospace received 3. McAir scrapped the 7 remaining wing skins not installed on wing frames at the time of problem identification.

Objective

The announced objective of the audit was to evaluate contract administration practices for the AV-8B wing skins. Considering the nature of the allegations, our audit objective was narrowed to focus only on the quality assurance practices.

Scope and Methodology

We performed the audit at the organizations listed in Enclosure 1. We reviewed FY 1989 McAIR Material Review Board records for the 17 nonconforming lower wing skins and FY 1989 Navy Plant Representative Office (now Defense Plant Representative Office) records at McDonnell Douglas. We interviewed quality assurance and engineering personnel at the contractor's location and at the Defense Plant Representative Office, McDonnell Douglas. In addition, we reviewed 1989 documentation and interviewed officials at the Naval Air Systems Command, Arlington, Virginia, and we reviewed maintenance logs as of February 1994 at the Naval Aviation Depot, Marine Corps Air Station, Cherry Point, North Carolina.

This economy and efficiency audit was made in January and February 1994 in accordance with auditing standards issued by the Comptroller General of the United States as implemented by the Inspector General, DoD. We did not use computer-processed data or statistical sampling procedures to perform the audit.

Internal Controls

We did not attempt to evaluate the effectiveness of the internal controls that were applicable to the then-Navy Plant Representative Office, McAir, because the allegation dealt with events that transpired in 1989. The Navy's internal controls were replaced in 1991 when Military Department plant representative offices were consolidated, and the Defense Contract Management Command assumed management responsibility for the Navy Plant Representative Office, McAir. Similarly, we did not evaluate the Navy's implementation of the DoD Internal Management Control Program.

Prior Audits and Other Reviews

No audits addressed this specific topic in the last 5 years.

Background

The AV-8B is a vertical/short take-off and landing attack aircraft that was placed in service in April 1984. The first operational AV-8B squadron was commissioned at Marine Corps Air Station, Cherry Point.

Wing Manufacturing Process. McDonnell Douglas manufactures the wings and some of the other major components of the AV-8B and assembles the U.S. version of the AV-8B at its manufacturing facilities in St. Louis, Missouri. McDonnell Douglas manufactures complete wings for the United Kingdom version of the AV-8B, which are then shipped to British Aerospace in England for installation on British-built AV-8Bs.

Upper and lower wing skins for the AV-8B are built in one piece from laid-up plies of composite materials. After the complete wing skins are cured, the skins and the wing assembly to which the wing skins are attached are drilled simultaneously. The drilled wing skins are not interchangeable between wing assemblies.

Wing Skin Nondestructive Test Results. In 1989, McAIR reported that nondestructive testing of a wing skin showed high porosity at the center line of a lower wing skin. The wing skin was rejected and cut up, revealing that the problem was not porosity but wrinkling of the inner plies of the wing skin. McAIR then identified other nonconforming wing skins. McAIR determined that 17 wing skins were manufactured with nonconforming wrinkles in the inner plies.

Discussion

Although McAIR produced nonconforming wing skins during 1989, all wings, Marine Corps and British Aerospace, were strengthened as necessary to compensate for the weakness. Once a wing skin was installed on a wing frame, it was not possible to divert Marine Corps wings to British Aerospace or to divert British Aerospace Wings to the Marine Corps.

Allegations. The complainant alleged that McAIR produced nonconforming wing skins that resulted in potentially weakened wings for use on AV-8Bs. British Aerospace refused to accept the potentially weakened wings and Navy officials then directed that potentially weakened AV-8B wings only be installed on aircraft destined for the Marine Corps.

Audit Response. We did not substantiate the allegations. During 1989, McAIR produced 17 AV-8Bs lower wing skins that were nonconforming due to wrinkled inner plies in the center line of the composite wing skin. McAIR performed nondestructive testing on all composite wing skins McAIR manufactured. However, McAIR misinterpreted the high rate of failure from nondestructive test results as "porosity," a condition that does not affect wing skin strength.

In August 1989, McAIR cut up a rejected wing skin that showed heavy porosity and found that inner plies at the center line of the wing skin were wrinkled. McAIR then located a total of 17 wing skins that showed high porosity and determined that 10 skins were attached to wing structures and 7 were not yet attached. McAir scrapped the seven unattached wing skins because Naval Air Systems Command would not accept wings with wrinkles that were not already installed on wing assemblies.

Reinforced Wing Skins. Of the 10 wings that had wrinkles in the inner plies of the lower skin along the center line (7 Marine Corps and 3 British Aerospace), McAir reinforced 8 by attaching a titanium strap to the outer side of the lower wing. The titanium reinforcing strap is covered by the engine heat shield. The wrinkled plies on the remaining two Marine Corps wings were not severe enough to necessitate the titanium reinforcing strap. The seven Marine Corps AV-8Bs that McAir identified as having wrinkled inner plies are shown below.

Affected Marine Corps AV-8B Harrier II Aircraft		
<u>Aircraft Bureau Number</u>	<u>Wing Assembly Serial Number</u>	<u>Wing Skin Serial Number</u>
163855	A19-0201	7872Z059
163862	A19-0202	7872Z061
163865	A19-0205	7897Z145
163868	A19-0209	7847Z098
163869	A19-0210	7897Z146
163870	A19-0212	7872Z062
163872	A19-0213	7897Z144

Differences in Wing Skins. Completed wings are not interchangeable between the different versions of the aircraft because of differences in the configuration of completed wings for Marine Corps and United Kingdom AV-8Bs. During 1989, before installation on a wing assembly, lower wing skins for the AV-8B were universal, in that they could be used on any AV-8B wing. However, the method of manufacture of the wing assembly for the AV-8B precludes interchanging of wing skins after they are drilled for installation on wing. Therefore, the 10 lower wing skins, already installed on wing assemblies when the problem was discovered, could not be switched between British Aerospace and Marine Corps programs and contracts. McAir informed British Aerospace and the Navy of the repairs done to the wings, and each provisionally accepted the repaired wings.

Other Matters of Interest

The Naval Aviation Depot at the Marine Corps Air Station, Cherry Point, is the focal point for problem identification, maintenance, and repairs of Marine Corps AV-8Bs. As of February 16, 1994, the Naval Aviation Depot has not reported problems concerning the wrinkled lower wing skins for the seven AV-8Bs that are in service.

Management Comments

We provided a draft of this report to the addressees on April 6, 1994. Because this report contains no findings or recommendations, written comments were not required of management and none were received.

We appreciate the courtesies extended to the audit staff. If you have questions on this audit, please contact Mr. Salvatore D. Guli, Audit Program Director, at (703) 692-3025 (DSN 222-3025) or Mr. Charles J. Richardson, Audit Project Manager, at (703) 692-3220 (DSN 222-3220). The planned distribution of this report is listed in Enclosure 2. The audit team members are listed inside the back cover.



David K. Steensma
Deputy Assistant Inspector General
for Auditing

Enclosures

Organizations Visited or Contacted

Office of the Secretary of Defense

Defense Criminal Investigative Service, St. Louis, MO

Department of the Navy

Naval Air Systems Command, Arlington, VA
Marine Corps Air Station, Cherry Point, NC

Defense Organizations

Defense Logistics Agency, Alexandria, VA
Defense Contract Management Command, Alexandria, VA
Defense Contract Management District, Chicago, IL
Defense Plant Representative Office, McDonnell Douglas Aerospace East,
St. Louis, MO
Defense Contract Audit Agency Resident Office, McDonnell Douglas Aerospace East,
St. Louis, MO

Non-Government Organization

McDonnell Douglas Aerospace East, St. Louis, MO

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