

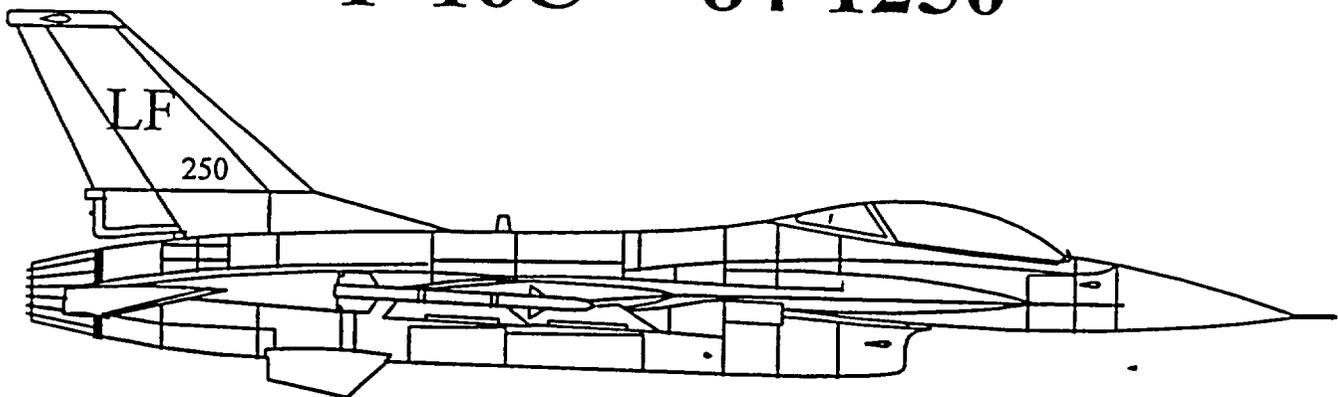
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OFFICE OF THE SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

**Air Education
and
Training Command
U.S. Air Force**

AFI 51-503

**Aircraft Accident
Investigation Report
F-16C 84-1250**



56TH FIGHTER WING

58257

LUKE AIR FORCE BASE, ARIZONA

Date of Mishap: 21 Dec 1995

PFS Exh. 183

Location: Winslow, Arizona

10 of 10

NUCLEAR REGULATORY COMMISSION

Docket No. _____ Official Ex. No. 183
In the matter of PPS
Staff _____ IDENTIFIED
Applicant
Intervenor _____
Cont'g Off'r _____ 2/1/02
Contractor _____
Other _____ 96
Reporter _____

EXECUTIVE SUMMARY

**Aircraft Investigation Report
F-16C (SN 84-1250)
Luke AFB, AZ
21 December 1995**

On the morning of 21 Dec 1995, an F-16 assigned to the 62nd Fighter Squadron, 56th Fighter Wing, Luke Air Force Base, Arizona, was preparing to rendezvous with a tanker in AR 658 as part of a BFM 4 TX syllabus sortie. At approximately 1007 MST and approximately 29 miles southwest of Winslow Arizona, at FL 190, the engine failed. The pilot ejected safely and the aircraft was destroyed upon impacting the ground in an unpopulated area on land belonging to the State of Arizona. There was neither property damage nor personal injury.

After witness interviews, review of maintenance documents, engine records, and other data, the Accident Investigating Officer found that the engine experienced a failure of the fan drive turbine. This caused the accident.

AFI 51-503 ACCIDENT INVESTIGATION REPORT

AUTHORITY. In a letter dated 12 Jan 1996, General Billy Boles, Commander Air Education and Training Command, appointed Colonel William O. Faucher, HQ AETC/XOS, Randolph AFB, TX, to conduct an investigation pursuant to Air Force Instruction (AFI) 51-503 into the circumstances surrounding an aircraft accident involving F-16C, tail number 84-1250, assigned to the 62nd Fighter Squadron, 56th Fighter Wing, Luke Air Force Base, Arizona. He also appointed Major Ronald E. Thompson, 550th Special Operations Squadron, 58th Special Operations Wing, Kirtland AFB, New Mexico, to act as the Aircraft Maintenance Technical Advisor and Major Dennis W. Yamrose Jr., 19 AF/DOV, to act as the Pilot Technical Advisor in letters dated 17 Jan 96. Captain James Meinders, Assistant Staff Judge Advocate, 56 FW/JA, Luke AFB, AZ, was appointed to act as Legal Advisor. (TAB Y).

PURPOSE. To preserve evidence for claims, litigation, disciplinary, and adverse actions, and for all other purposes.

SUMMARY OF FACTS

1. HISTORY OF FLIGHT:

On 21 December 1995, an upgrading pilot (MP), his instructor pilot (FL 1A), and an upgrading instructor pilot (FL 1B) were scheduled for a two ship Basic Fighter Maneuvers (BFM) 4 mission for the upgrading pilot. FL 1B was to receive an upgrade from the rear cockpit in air refueling and landings. Their call sign, Hagar 1, originated at Luke Air Force Base, Arizona, and was scheduled to Air Refueling Track AR 658, followed by BFM in an air-to-air training area (Gladden Military Operating Area (MOA)) that is located approximately 60 miles northwest of Phoenix, Arizona. (TAB K-2). Ground operations, takeoff at 0950 Mountain Standard Time, and flight to the air refueling area were uneventful. While preparing to rendezvous with the tanker (Call sign Copper 7), Hagar 2's aircraft experienced heavy vibrations and the engine failed. The MP correctly performed the critical action procedures for engine failure, but was unable to gain a restart after several attempts (TABS J-11, V-2). The MP then initiated a controlled ejection and landed safely via parachute. The aircraft crashed on property belonging to the State of Arizona. There was no damage to private property (TAB P). There were no deaths or injuries. The mishap occurred at 1011 MST (TABS A, N-3, V-2).

The 56 FW Public Affairs sent out a news release at 1100 (TAB AA-4). This resulted in video and print media inquiries from local and national news organizations. Local news media attempted to interview the MP at the Winslow Hospital but the MP did not comment (TAB V-2).

The MP was Lieutenant Colonel Joseph A. Abbott, Student Pilot, 62nd Fighter Squadron, Luke AFB, Arizona.

2. MISSION:

The mishap aircraft (MA) was number two in a two ship BFM training sortie. This sortie is designed to teach offensive BFM maneuvers from set positions against another aircraft. This mission also included the opportunity to practice air refueling for both the student and an upgrading instructor pilot in the rear cockpit of Hagar 1. FL 1A, in the lead aircraft, was performing instructor duties for the MP in the mishap aircraft as well as for FL 1B in the rear of his aircraft (TABS K-2, V-4). This mission was a syllabus sortie for the mishap pilot.

3. BRIEFING AND PREFLIGHT:

Crew rest was not a factor. The MP flew the day prior in the morning, followed by academics in the afternoon from 1430 to 1630. He had no other official duties after 1630. Scheduled brief time on 21 Dec was 0735. This is 15 hours from one scheduled function to the next which is greater than the mandatory 12 hour minimum needed for crew rest. Flight briefing began on time and all appropriate items were briefed. Significant to this briefing was the mandatory emergency procedure to be briefed as a part of this mission--engine failure during flight. A significant portion of the briefing was devoted to this topic (TABS V-2, 5). Ground Operations proceeded smoothly without incident.

4. FLIGHT ACTIVITY:

Hagar 1 Flight took off on time as scheduled at 0950 MST from Luke AFB, Arizona, on an Instrument Flight Rules flight plan to Air Refueling Track AR-658. Takeoff, departure, and flight enroute to the air refueling were uneventful.

After entering the refueling track at FL 190 and at approximately 350K, shortly after obtaining a radar contact on the tanker, the MP felt strong vibrations in his aircraft followed by a decrease in engine RPM and Fan Turbine Inlet Temperature (FTIT). Recognizing these signs as engine failure, he radioed "Mayday" and stated he had lost his engine. At the same time he began emergency procedures to try to restart the engine. FL 1B looked at the MA and noticed a 10-15 feet dirty yellow flame coming out the rear of the MP's aircraft. FL 1A then repositioned his aircraft to the right side of the MA as he directed the MP to turn toward Winslow Arizona, 28 miles away. The intent was to land at Winslow if the engine could not be restarted. FL 1A established radio contact with Winslow tower and told them of the emergency. The MP tried several airstarts, but none were successful. He did not have sufficient altitude to glide to Winslow, so at approximately 1011 MST, he pulled the nose of his aircraft up and ejected from the aircraft approximately 1500 - 2000 feet above the ground (AGL) (TABS V-2, V-4).

5. IMPACT:

The aircraft impacted land owned by the State of Arizona about 10 nautical miles southwest of Winslow, AZ (Coordinates 34 degrees 57.8 minutes north, 110 degrees 55.1 minutes West), on 21 Dec 95, 1011 (L) MST in an upright attitude, with a shallow dive angle, and 200 - 300 KIAS. No structures were nearby. The aircraft was destroyed upon impact. There was no private property damaged and minimal damage to Arizona State owned property (TABS J, M-1, P, R, S-1)

6. EGRESS SYSTEMS:

The MP initiated ejection at the following estimated parameters:

- less than or equal to 1500 - 2000 AGL (6900 - 7400 feet MSL)
- less than or equal to 200 KIAS
- 10 degrees nose up pitch attitude

The ejection was initiated within the performance envelope of the egress system. No deficiencies with the egress system were identified, however, the MP encountered twisted parachute risers post ejection and was unable to resolve this problem prior to the parachute landing fall (PLF) (TAB V-2).

7. PERSONAL AND SURVIVAL EQUIPMENT:

The Radio Beacon, survival radio, signal mirror, and day flare were used. All personnel and survival equipment inspections were up to date. No difficulties were encountered in using the equipment (TAB V-2). The survival blanket was noted as missing from the survival kit and was never recovered.

8. RESCUE:

The time of the crash was 1011 (L) MST on 21 December 1995. The Flight Lead, HAGAR 1 monitored the ejection and aircraft impact. HAGAR 1 coordinated with Winslow municipal (Muni) tower, Copper 7 (a KC-135 Tanker established in AR-658), and with ORCA 1 (an F-16 established in formation with Copper 7). ORCA 1 relayed pertinent information to the Luke AFB Supervisor of Flying (SOF). The SOF scrambled the Arizona Department of Public Safety Helicopter (DPS). Winslow Muni notified Local Winslow Law Enforcement and emergency authorities. HAGAR 1 orbited the crash site and over the mishap pilot until reaching a preplanned fuel state at which time he exchanged roles with ORCA 1, and went back to the tanker for more gas. ORCA 1 flew in a box pattern and attempted radio contact with the MP. Communications were established, ORCA 1 exchanged roles with HAGAR 1 after HAGAR 1 refueled, then returned to Luke AFB AZ. HAGAR 1 monitored the arrival of local law enforcement and emergency vehicles and ensured that they extracted the MP, and then returned to Luke AFB.

First on the scene was a local sheriff, who parked his car and walked toward the MP. The MP gathered his equipment and went with the sheriff to the car and waited for the ambulance. The MP transferred to the ambulance and rode a short distance when the DPS helicopter arrived. MP transferred to the DPS helicopter which took him to Winslow AZ Hospital.

9. CRASH RESPONSE:

Local Law Enforcement responded first to the scene, assisted the MP, and secured the crash site (TAB V-2).

10. MAINTENANCE DOCUMENTATION:

Aircraft documentation was difficult to glean information from, however, all information was present. There were no deficiencies related to the accident against either aircraft or the engine recorded in the aircraft Form 781 series (TAB H-2). There were no overdue Time Compliance Technical Orders (TCTO) (TABS H-12, H-13) Scheduled aircraft maintenance inspection in the AFTO Form 781 series reflected no overdue inspections (TAB H) The automated planning requirement for aircraft (PRA) reflected two overdue inspections: Aircraft bead blast and aircraft full paint. The unscheduled maintenance performed on the aircraft was not related to the mishap. There were six delayed discrepancies: "Aft transparency is opaque cannot see through it"; "RALT bus Fail PFL cleared OK "CARA INOP"; "broken nut plate under PNL 4301"; "Oxy Connector Storage bracket broken"; "no real world video"; "Info: SMS MFLS 001-004-005 no systems degrade". The next scheduled inspection was a 25 hour borescope of the fourth-stage blade root 4 Jan 96, and a 50 hour inspection of bulkhead FS 479 55 vertical stab attach pad. All workable aircraft TCTOs were complied with (TAB H-12).

The engine was current in all time compliance technical orders (received and workable) except for TCTO 2J-1F100 (III)-555 which had just been received 21 Dec 95. There were no trends evident throughout the engine history. The engine was installed in Aircraft 84-1250 on 27 Jun 95. The last inspection of the engine was a 25 hour borescope of the fourth stage blade root IAW 1F-16C-6, on 5 Dec 95 (TAB J-18). No deficiencies were noted during the inspection.

Oil analysis reflects no adverse trends or abnormalities.

11. MAINTENANCE PERSONNEL AND SUPERVISION:

A review of individual training records (AF Form 623, STS 797) indicated that maintenance personnel had been trained in the tasks they were required to accomplish. Personnel using the flexible borescope were trained and current in the task. Squadron manning is providing proper supervision for shift coverage. No maintenance practices or procedures were a factor in the accident.

12. ENGINE, FUEL, HYDRAULIC, AND OIL INSPECTION ANALYSIS:

All fluid sampling to include Liquid Oxygen (LOX) samples, were well within the established standard (TAB D-1).

13. AIRFRAME SYSTEMS:

The engine was found to have no overdue inspections. However, safety Time Compliance Technical Order 2J-F100 (III)-555, subject: Inspection of 3rd and 4th stage turbine blades, F100-PW-220/-220c fan drive turbine modules, F-100-PW-220/220E engines, F-16/F-15E series aircraft had been received 21 Dec 95. Jet engine intermediate maintenance (JEIM) Engine record and data was superbly maintained and reflected appropriate parameters for the engine operation during operational checks (TABS H-14, U-2)

Engine Analysis: San Antonio Air Logistics Center (SA-ALC) determined a fan drive turbine (FDT) failure due to a fourth stage turbine blade that was liberated because of a fatigue crack in the attachment area of the blade (TAB J-20) All other damage to the engine was secondary to the blade liberation or to the crash impact. The cause of the blade failure is being further investigated at Pratt and Whitney, West Palm Beach, Florida (TABS J-20, AA-17). The following is a chronological account of the failure:

- A fatigue crack in the attachment area of a fourth stage blade grew over time to the point that the remaining material could not support normal operation stresses. The blade fractured in overstress (TAB J-11).
- The liberated blade platform/air foil was thrown outward into the fourth stage Basic Outer Air Seal (BOAS), puncturing the BOAS and denting the turbine exhaust case (TAB J-11).
- Neighboring blades rotated into the liberated blade, breaking off their tip shroud and portions of their air foil (TAB J-11).
- The loss of airfoils in the area of the fractured blades caused the rotor to have a "heavy" side. The imbalance overcame the clamping ability of the W-support inner bolts, pulling them out of the bearing inner race support and allowing the rotor to "wobble" (TAB J-11).
- Centrifugal loads pulled the rotor toward the heavy side, allowing the FDT to rotate non-concentrically with the engine case. The FDT corresponding to the heavy side of the fourth stage disk rubbed heavily against the inner surface of the HPT nut and the rear compressor drive shaft. Rotating knife-edge seals rubbed through their matrix honeycomb abradable and into the metal backing plates, flattening the seals on the heavy side of the rotor. The third and fourth stage blade tip shrouds rubbed heavily into the BOAS segment. The tip shrouds fractured from the increase load (TAB J-11).
- The heavy rub patterns on the Fan Drive Turbine (FDT) shaft and the airseals indicate the FDT was operating with a significant imbalance. The orientation of the rub marks indicate the

heavy side was 180 degrees from the blade with the below-the-platform fatigue fracture, consistent with a primary failure of that blade (TAB J-11).

- The damage progressed to the point the FDT could no longer extract sufficient energy from the hot gas stream to drive the fan. The engine then stalled and likely stagnated, with almost no chance of a successful restart (TAB J-11).

The mishap engine, PWOE 703068 was installed in aircraft 84-1250 on 14 Sep 95 (TABS J-17, 18). There were two "Info" engine delay discrepancies; Engine MFL 065 (FTIT Adv) may occur and NDI not required for Engine 50 hr inspection (TAB H-10). The last 25 hour inspection was accomplished on 5 Dec 95. During this inspection the fourth stage blade roots were examined in accordance with TO 1F-16C-6. No discrepancy were noted (TAB J-18).

Engine History:

30 Mar 93 - Engine was upgraded to -220E. The FDT was installed in PWOE 703068 at this time (TAB J-18).

01 Feb 94 - Engine received at Luke AFB from 180 Fighter Group Toledo, Ohio installed in aircraft 84-1250.

18 Oct 94 - Engine removed for third stage fan disk lug insp. Fourth stage turbine blade - 6 inspection.

20 Oct 94 - Installed in aircraft 84-1247.

06 Mar 94 - Removed for third stage for disk lug inspection.

19 Apr 95 - Installed aircraft 84-1241.

22 Jun 95 - Removed for fan module third stage disk lug inspection. While removed, removed and replaced 3 augmentor finger seals and #3 FTIT probe. Rigged RCVV feedback cable. Borescoped 13th stage spacer and 4th stage turbine blade roots. Main fuel manifold lugs clamp was also removed and replaced.

27 Jun 95 - Installed aircraft 84-1250.

30 Aug 95 - Removed for augmentor time change and fan module upgrade.

08 Sep 95 - Fan module upgrade, TCTO 2J-F100 (III)-547 was complied with. Borescoped 13th spacer 2nd vanes, 3rd turbine blade section and 4th stage turbine blade roots.

14 Sep 95 - Reinstalled aircraft 84-1250.

14 Oct 95 - 4th stage blade root inspection (25 hr).

05 Dec 95 - 4th stage blade root inspection (25 hr).

(TABS J-17, J-18)

14. OPERATIONS PERSONNEL AND SUPERVISION:

The mission was properly authorized by the Assistant Operations Officer. The Flight briefing officer, Hagar 1, was a squadron supervisor and instructor for the mission IAW governing directives, and covered all aspects of the mission. There is no evidence that anyone in the operations and supervisory chain performed their duties in other than a thorough, responsible manner on the day and time of the mishap. There is no evidence that any operational directives were violated in the course of the mishap flight.

15. CREW QUALIFICATIONS:

The instructor pilot (FL 1A), Lt Col Grosshans was current and qualified to perform the mission he was assigned on 21 December 1995.

The student pilot, the MP, Lt Col Abbott, was making satisfactory progress in his program. He had completed all prerequisites and was well prepared for the mission he was assigned on 21 December 1995. The MP had completed F-16 Transition Phase training, including a satisfactory Instrument/Qualification evaluation and five air-to-air sorties in the air-to-air phase of training. There were no significant deficiencies in training noted. The MP had flown previous to the mishap as follows:

LAST 30 DAYS	LAST 60 DAYS	LAST 90 DAYS
Sorties/Hours	Sorties/Hours	Sorties/Hours
10/14.0	12/21.4	18/35.2

(TABS G, T).

16. MEDICAL:

- a. The MP was medically qualified to perform flight duty at the time of the mishap (TAB X-3).
- b. Toxicology studies performed on the MP after the mishap were reviewed and found to be negative. He did sustain contusions and abrasions as a result of the accident (TAB X-2).

17. NAVAIDS AND FACILITIES:

Navigation aids and airfield facilities were not a factor in this accident. There were no significant published notices to airman (NOTAM) for the date of the accident that affected the flight.

18. WEATHER:

The forecast weather for the refueling track and the Gladden Military Operating Area (MOA) was 6000 scattered, 10,000 scattered, 25,000 scattered, 30,000 scattered and seven (7) miles visibility. The forecast weather for Luke AFB was 6000 scattered, 20 miles visibility and winds 360 at 3 knots. Reported weather at Winslow Arizona Municipal Airport as reported by Prescott Flight Service at 1056(L) was 4900 feet overcast with 10+ miles visibility and calm winds. Testimony confirms thin overcast conditions at 8000 to 10,000 feet MSL and is consistent with the Prescott Flight Service report (TAB K). Weather was not a factor.

19. GOVERNING DIRECTIVES AND PUBLICATIONS. The following publications were applicable to the mission:

OPERATIONS:

- 1) AFI 11-205: Aircraft Cockpit and Formation Flight Signals (formerly AFR 60-15)
- 2) AFI 11-206: General Flight Rules (formerly AFR 60-16)
 - AETC SUP 1
 - HQ AETC MSG
 - LUKE SUP 1
- 3) AFI 11-214: Aircrew and Weapons Director Procedures Air Operations (formerly AFR 55-79)
 - AETC SUP 1
- 4) AFI 11-215: Flight Manuals Program (FMP) (formerly AFR 60-9)
 - AETC Sup 1
- 5) AFI 11-218: Aircraft Operation and Movement on the Ground (formerly AFR 60-11)
- 6) AFI 11-410: Flight Management (formerly AFR 60-1)
 - AETC Sup 1
 - LUKE Sup 1
- 7) AFPAM 11-404: G-Awareness for Aircrews (formerly TACP 51-17)
- 8) AFI 11-404: Centrifuge Training for High-G Aircrews (new regulation)
- 9) MCM 3-3 Vol 5: Combat Aircraft (formerly MCM 3-3 Vol 5, 01 Jul 91)
- 10) MCI 11-F-16 Vol 1: Pilot Training F-16 (formerly MCR 51-50, Vol 8)
- 11) MCI 11-F-16 Vol 3, Chap 8: Pilot Training Procedures F-16 Luke Sup 1 (formerly MCR 55-116, Vol 1)
- 12) AETCI 11-405: Flying Training Supervision (formerly AETCR 51-5)
 - LUKE Sup 1
- 13) MCR 60-2, Vol 3, CH 1: Aircrew Standardization/Evaluation Program, Aircrew Flight Evaluation Criteria--Tactical

Fighter/Attack/Trainer/FAC

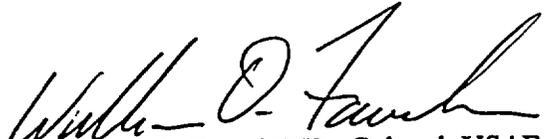
- 14) LAFBR 55-2, Vol 2: Local Operating Procedures
 - Chg 1
 - Chg 2
 - Vol 2
 - Chg 1
- 15) #FALCON FACTS: F-16 Pilot Aid
 - FCIF 95-33
 - FCIF 95-41
 - Chg 1
- 16) F16COTXOPL: USAF Transition/Requal Training Course
 - Chg 1
- 17) F16COIOOPL: USAF Instructor Pilot Upgrade Training Course
- 18) #T.O. 1F-16C-1, 27 FEB 95
 - CH-1, 15 MAY 95
 - ISS-171, 29 AUG 95
- 19) #T.O. 1F-16C-1CL-1, 27 FEB 95
 - FCIF 94-20, 14 JUN 94
 - Chg 1, 15 MAY 95
 - ISS-171, 29 AUG 95
- 20) T.O. 1F-16C-1-1, 14 NOV 94
 - Chg1, 03 APR 95
 - *Chg2, 09 OCT 95
- 21) T.O. 1F-16C-1-2, 01 OCT 94
 - 2S-13, 03 MAR 95
 - Chg-1, 01 APR 95
 - 2S-15, 20 JUN 95
 - *2S-17, 17 DEC 95
- 22) #T.O. 1F-16C-34-1-1, 07 SEP 95
 - CH-1, 23 AUG 95
- 23) #T.O. 1F-16C-34-1-1CL-1, 07 SEP 94
 - Chg1, 23 AUG 95
- 24) T.O. 1-1C-1, 15 APR 94: Basic Flight Crew Air Refueling Manual
- 25) T.O. 1-1C-1-30, 01 May 78: F-16 Flight Crew Air Refueling Procedure Inclusive Reprint
 - C7, 01 JAN 86
 - C8, 01 JAN 87
 - CH9, 15 NOV 87
 - CH10, 04 AUG 89
 - CH11, 15 JUN 91
 - S-4 (F), 20 AUG 94
- 26) T.O. 1-1C-1-30CL-1, 01 JAN 87: F-16 Pilot Air Refueling Checklist
 - CH1, 15 NOV 87
 - CH2, 04 AUG 89

MAINTENANCE:

- 1) 1F-16C-6: Inspection Requirements
- 2) 1F-16C-2-70FI-00-21: Fault Isolation Power Plant
- 3) 1F-16C-6WC-1: Combined Preflight/Postflight, End-of-Runway thru flights, Launch and Recovery, Quick Turnaround Basic Postflight, and Walkaround before first flight of the day inspections work cards

There are no known or suspected deviations from governing directives or publications by aircrew members or others involved in the mission.

25 January 1996


WILLIAM O. FAUCHER, Colonel, USAF
Accident Investigation Officer

STATEMENT OF OPINION

UNDER 10 U.S.C. 2254(D), ANY OPINION OF THE ACCIDENT INVESTIGATORS AS TO THE CAUSE OR CAUSES OF, OR THE FACTORS CONTRIBUTING TO, THE ACCIDENT SET FORTH IN THE ACCIDENT INVESTIGATION REPORT MAY NOT BE CONSIDERED AS EVIDENCE IN ANY CIVIL OR CRIMINAL PROCEEDING ARISING FROM AN AIRCRAFT ACCIDENT, NOR MAY SUCH INFORMATION BE CONSIDERED AN ADMISSION OF LIABILITY BY THE UNITED STATES OR BY ANY PERSON REFERRED TO IN THOSE CONCLUSIONS OR STATEMENTS.

1. In my opinion, this accident was caused by a mechanical malfunction. It was determined by Logistics Center analysts that the engine experienced a failure of the fan drive turbine (TAB J-11). The engine failed without possibility of restart. There is no evidence that any action by the individual operating the aircraft or supervising the operation contributed to this mishap. The pilot's decision to eject was correct.
2. The cause for the failure of the Fan Drive Turbine was the liberation of a blade from the 4th stage of the turbine. The blade was transferred to Pratt and Whitney for analysis. As a result, no opinion is issued as to the cause of the blade failure.
3. In summary, it is my opinion that the accident was caused by a mechanical failure of the fan drive turbine which occurred in a manner that was not preventable by operations or maintenance supervision.

25 January 1995


WILLIAM O. FAUCHER, Colonel, USAF
Accident Investigation Officer