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I. STATEMENT OF AUTHORITY AND PURPOSE

OFFICE OF THE SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

A. By order of the Commander, Headquarters Seventeenth Air Force, Lieutenant Colonel Thomas F. Twohig, HQ USAFE/DOTO, Ramstein Air Base, Germany, was appointed by Special Order M-1, dated 1 February 1995, to conduct an investigation into the crash of a F-16D aircraft. This accident occurred on 13 January 1995, with the flight originating from Spangdahlem Air Base, Germany. Captain Tishlyn Taylor, 86th Airlift Wing, Office of the Staff Judge Advocate, Ramstein Air Base, Germany, was detailed by the same order as the Legal Advisor to accompany Lieutenant Colonel Twohig throughout the course of the investigation. Master Sergeant Steven J. Herdler, 52nd Fighter Wing, Spangdahlem Air Base, Germany, was detailed as the Technical Advisor by Special Order M-2, dated 8 February 1995. (Tabs Y1 and Y2)

II. MATTER INVESTIGATED

A. This was an investigation of a Class A aircraft accident involving an F-16D [Serial Number (SN) 90-0849] assigned to the 52nd Fighter Wing, Spangdahlem Air Base, Germany. The Aircraft crashed at 1041 hours, Central European Time (CET) 13 Jan 1995, onto the Five Nations Golf Course, near the town Durbuy, Belgium, 55 nautical miles west of Spangdahlem Air Base, Germany. The F-16's fuel tanks fell in a farmer's field approximately 9 nautical miles east of the golf course near Rome, Belgium. The pilot and passenger ejected safely from their aircraft. The pilot and passenger were uninjured. The objective of the investigation was to obtain and preserve all available relevant facts and evidence pertaining to the accident, and to investigate the circumstances leading to the accident for use in claims adjudication and evaluation, litigation, disciplinary action, adverse administrative proceedings, or other purposes deemed appropriate by competent authority. Lt Col Twohig conducted the investigation under the authority of AFI 51-503.

III. SUMMARY OF FACTS

A. History of Flight Activity

1. On 13 January, F-16C SN 90-0849, callsign Spur 02, departed Spangdahlem Air Base, Germany at 1031 CET as number 2 of a 2-ship F-16D orientation flight to Belgium. Capt Thomas J. Smith, the mishap pilot (MP), and A1C Jason Fowler (passenger) were the crew of the mishap aircraft (MA). The MA experienced an engine failure and subsequent dual-sequenced ejection. Both the mishap pilot (MP) and passenger were recovered safely. The MA crashed and was destroyed at 1041 CET on the first hole of the Five Nations golf course near Durbuy, Belgium. Jettisoned 370 gallon fuel tanks,

NUCLEAR REGULATORY COMMISSION

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ocket No _____ Official Ex. No. PPS

In the matter of _____

Staff _____ IDENTIFIED

Applicant RECEIVED

Intervenor _____ REJECTED _____

Cont'g Of _____ DATE 7/1/02

Contractor _____ Witness _____

Other _____ all

Reporter _____

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crashed in an open farmer's field approximately 9 nautical miles east of the aircraft crash site, near Rome, Belgium.

2. No significant flight activity led up to the accident. All went as planned and in accordance with (IAW) applicable directives.

3. The 52 Fighter Wing Public Affairs Office handled all questions about the accident. News media involvement was limited to Armed Forces Network and the Stars and Stripes.

B. Mission

1. The mission was planned as a 2-ship surface attack mission using TGM-65D Maverick training missiles from Germany into Belgium. The mission was also planned, briefed, and flown as an orientation flight. Ingress and egress to and from the target area were planned at 1,000 feet above ground level (AGL). The attack was a split Maverick attack with a 2-ship egress and return to base (RTB) at Spangdahlem.

C. Briefing and Pre-Flight

1. Pre-flight activities for the orientation flight started on 12 Jan 95, when both incentive fliers in Spur flight received life support training and medical clearances to participate in the following day's mission. Detailed mission planning was accomplished for this surface attack ride. An area target for the Maverick missile was selected and appropriate cockpit materials were constructed to accomplish this mission.

2. On the morning of the flight, Spur 01 flight lead Capt Brett D. Hansen briefed the mission in the 22FS "A" Flight Commander's office due to no available briefing rooms. Flight and crew coordination briefs were given IAW USAFER 55-116 and were very thorough, covering all phases of ground and flight operations. All procedures were normal, to include: stepping to fly, aircraft pre-flight, aircrew strap-in-in, engine start, and taxi to takeoff (ref Tab V).

3. No problems or misunderstandings occurred that hampered anyone's ability to be fully prepared for the planned mission. Maintenance ground crew procedures and actions were carried out normally (ref Tab V).

D. Flight Activity

1. The flight plan (DD Form 1801) for Spur 01 flight was a local area 19 (LA 19) which allowed an IFR departure and recovery with a planned VFR delay for the

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planned mission (ref Tab K). Although the LA 19 flight planned VFR delay is for inside Germany only, Spur flight contacted Belga Radar to in-flight re-file for clearance into Belgian VFR airspace. They were given clearance, as requested, to proceed.

2. Communication between Spur 01 and Spur 02, during the emergency, was minimal and consisted of Spur 02 informing Spur 01 of his engine problem and, finally, his decision to eject. The first time Spur 01 knew of Spur 02's engine problem was at 1039 CET. Spur 02 ejected at 1040 CET. The flight lead, Spur 01, was talking to Belga Radar at the time of occurrence and concentrated on getting a snap vector to the nearest airfield, while allowing the MP to handle the emergency (ref Tabs N and V).

3. Communication between Spur 01 and Belga Radar was normal (on UHF frequency 250.25 MHz) until the emergency was declared. Belga Radar was confused by the emergency call, but only for twenty seconds (ref Tabs N and V). After this time, Belga tried to vector Spur flight to Sint-Truiden while Spur 01 was assessing the distance to Florennes. Spur 01 had to interrupt Belga for a moment to inform them of the ejection and impending crash. Some confusion occurred between Spur 01 and Belga but communication was good considering the short period of time and the catastrophic nature of the emergency. Belga Radar initiated Belgian rescue efforts within four minutes of the ejection (at approximately 1044 CET).

4. Spur 01 also notified the Spangdahlem Supervisor-of-Flying (SOF) of the mishap at 1059 CET (ref Tab N). Communications between the SOF, Spur 01, Repo [flight of 2 Spangdahlem A-10 aircraft (diverted by the SOF) to fly a rescue combat air patrol (RESCAP)], and Belga Radar on Spangdahlem SOF frequency 369.37 UHF, was excellent. All parties passed vital information on the search and rescue operation and corrected then confirmed contradictory survivor locations. Spur 01 was able to lead Repo flight to the site where the MP and passenger had landed. The SOF passed all home base and weather information and assisted Spur 01 with his recovery to Spangdahlem Air Base.

5. There were no known navigational, terrain, or similar difficulties involved in this accident. Weather was a factor, in that, Spur flight had to climb to between 5 and 7,000 feet mean sea level (MSL) prior to the target area, to avoid low clouds not forecasted for that time period. This resulted in Spur 02's emergency occurring at a safer altitude of approximately 4,000 feet above ground level (AGL) versus 1,000 feet AGL. The pilot's decision to eject was reinforced by the weather because the pilot made sure he and his passenger ejected prior to entering the undercast (ref Tabs V and W).

6. Flight sequence of events (ref Tabs A,C,I,N,O, and V):

10.31'00" CET - Spur 02 took off from Spangdahlem Air Base, Germany.

10.39'24" CET - Spur 02's engine recorded the first indication of an engine problem. The MP and passenger felt and heard a loud "thump" that almost

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knocked their feet off the floor of the cockpit. Engine RPM decreased from 100 percent to below 40 percent in less than five seconds.

The first stage fan, number 8 blade failed and was ingested by the F-110-GE-129 engine. Ingestion of the fan blade created a massive titanium fire in the high pressure compressor (HPC) section of the engine resulting in an unrecoverable engine failure. The MA was not in a position or at an altitude where it could be recovered by an emergency flameout approach and landing.

10.39'29" CET - the secondary engine control (SEC) caution light was illuminated and the MP placed the engine throttle in idle.

10.39'31" CET - the MP initiated a zoom from the current altitude of approximately 5000 ft MSL and placed the throttle in off, then midrange (between idle and full military power) trying to initiate an airstart.

10.39'41" CET - the MP placed the throttle momentarily to afterburner trying to ensure he had the throttle out of off.

10.39'47" CET - the MP jettisoned both 370 gallon external fuel tanks. The fuel tanks impacted in an open farmer's field near Rome, Belgium, approximately 9 nautical miles east of the Five Nations Golf Course (the aircraft crash site).

10.39'49" CET - the MP again placed the throttle to off and then back to midrange. Capt Smith stated he was not sure he had really initiated the first airstart because everything had happened so quickly. The engine was not responding to the first airstart attempt, in any case.

10.40'00" CET - the MA reached its peak altitude of 7,000 ft MSL in the zoom. MA speed was approximately 230 knots calibrated air speed (KCAS). The MP started a gradual descent to maintain a proper airstart airspeed.

10.40'29" CET - the MP commanded and initiated a dual sequenced ejection of himself and the passenger.

10.41'08" CET - aircraft F-16D, SN # 90-0849, impacted on the first fairway of the Five Nations Golf Course, near Durbuy, Belgium.

E. Impact

1. On 13 Jan 1995, at approximately 10.41'08" CET, the MA impacted the green-side bunker and fairway of the first hole of the Five Nations Golf Course (N5021.1 E00521.0) at an airspeed of approximately 325 KCAS, 1,200 ft MSL, and 3.5 degrees angle-of-attack. The impact course was approximately 220 degrees magnetic and crash debris extended 377 meters from the point of impact (ref Tabs O and R).

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Jettisoned 370 gallon fuel tanks impacted an open farmer's field near Rome, Belgium. This impact area is approximately 9 NM east of the MA crash site (ref Tab P).

F. Egress System

1.. A dual sequenced ejection was initiated well within the performance envelope of the ACES II ejection system. No deficiencies were noted with either cockpit ejection system.

G. Personal and Survival Equipment

1. All personal and survival equipment inspections were up to date. The MP performed all appropriate post ejection procedures, except for releasing his survival kit and life raft prior to entering the trees. The passenger was unable to perform the four-line jettison of the canopy because the four-line jettison loops were recessed into the rear parachute risers. His inexperience in this area prevented him from identifying the proper area on the risers and pulling out these loops.

2. The MP and passenger were unable to use their survival equipment due to the landing site. They both landed in a heavily wooded area and unstrapped from their harnesses to climb down from their final positions in the trees. So neither MP or passenger contacted rescue aircraft because their survival radios were stuck in the trees with the rest of their equipment. No other difficulties were experienced.

H. Rescue

1. The crash occurred at approximately 1041 CET. The first call for rescue came from Spur 01 at 10.41'26" CET to Belga Radar. Belgian rescue were alerted but were too distant to be a factor (ref Tabs N and V). Local civilians and gendarmerie located and transported the MP and passenger, within minutes of the crash, to the police station in Durbuy. The MP was checked for a sore jaw but he and the passenger suffered no injuries.

2. Repo flight, two A-10 aircraft from Spangdahlem (81FS, 52FW), were diverted to the crash area to take over RESCAP responsibilities from Spur 01.

3. Rescue aircraft did not recover the aircrew.

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I. Crash Response

1. Belga Radar alerted Belgian rescue of the crash at approximately 1044 CET (ref Tab N). Spangdahlem SOF diverted Repo, flight of two A-10 aircraft, at 1105 CET to assume RESCAP duties. No delays were encountered in launching and diverting rescue aircraft.

2. Difficulties encountered were the trees the MP and passenger came down in and the loss of their survival radios (ref Tab V). They were unable to contact airborne RESCAP aircraft to notify them they were unhurt. Local civilians and gendarmerie were instrumental in recovering the MP and passenger.

J. Maintenance Documentation

1. The aircraft 781 series forms were reviewed. Although minor irregularities existed in documentation, none were related or contributed to the accident. There were no overdue time compliance technical orders (TCTO) or one time inspections (OTI) for the mishap aircraft (MA) or mishap engine. With the exceptions of 781K entries, "Rt main landing gear strut affected by OTI L940010", and "Fuel Inert system shall be returned to OP status for deployment to cont. operation", which are not considered to be related to the accident, there were no outstanding TCTO or OTI maintenance actions annotated in the MA 781 maintenance forms.

2. The MA had flown 56.8 hours since the last scheduled airframe (phase) inspection. The MA 400 hour, #2 phase inspection was completed on 17 November 1994, without the mishap engine installed due to cannibalization. Upon completion of the #2 phase inspection, the mishap engine (F110-GE-129, SN 538197) was installed in the MA and operational checks were completed.

3. Engine oil analysis was accomplished on the mishap engine three consecutive days prior to the mishap, with no irregularities noted in the samples. A review of the oil analysis records from October 1994 revealed no evidence which would suggest oil contamination or warning of the imminent failure of an oil wetted component (ref Tab U).

4. Post-accident tear down work of the mishap engine and a report of findings were accomplished at Spangdahlem Air Base, Germany by Fred T. Engle, F110-GE-129 Project Engineer, Propulsion Development System Office, Wright-Patterson AFB, OH 45433 (ref. Tab J). Although foreign object damage is considered to be the cause of the first stage fan, number 8 blade separation and subsequent engine failure and resulting accident, no evidence was found identifying a specific foreign object or its origin.

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5. There were five significant maintenance actions performed on the mishap engine just prior to and since its installation in the MA: 1. replacement of the first stage fan blades (32 each) was accomplished in accordance with TCTO 2J-F110-549 on 20 Nov 94 by the 52d CRS Propulsion Flight; the remaining maintenance actions were accomplished on the installed engine by maintenance personnel of the 22d Fighter Squadron, 2. first stage blades 12 and 16 had nicks blended on 28 Nov 94, 3. CDN bore scope inspection and engine run for TCTO 2J-F110-552, Main Engine Control inspection on 19 Dec 94, 4. First stage blades 3, 4, and 8 had nicks blended on 22 Dec 94, 5. Lube and scavenge pump filter change and engine run on 6 Jan 95. Training records were reviewed and interviews conducted with the maintenance personnel involved in these maintenance actions. No evidence has been found that would connect these actions to the accident. In addition, the personnel involved in the accomplishment of these actions are adequately trained and certified to complete these tasks.

K. Maintenance Personnel and Supervision

1. Training records were reviewed and interviews were conducted with maintenance personnel who accomplished the last Basic Post-flight and Pre-flight inspections, pre-flight servicing, and launch of the MA. All three maintenance personnel (APG) are E-5s with 7-level RED X orders and are certified to accomplish the aforementioned tasks. They all possessed the training, knowledge, experience, and skills required to complete those tasks.

L. Engine, Fuel, Hydraulic, and Oil Inspection Analysis

1. Due to the post accident condition of the mishap engine, an oil sample could not be obtained through normal procedures. However, two post accident engine oil samples were taken, one from the engine scavenger pump and one from the oil heat exchanger. Analysis of oil samples revealed contamination thought to be the result of the HPC titanium fire and impact with the ground. Analysis of the post accident fuel sample showed normal. No post accident hydraulic fluid sample could be obtained.

M. Airframe and Aircraft Systems

1. Review of the hydraulic, electrical, avionics, and mechanical systems of the MA were not considered practical due to the magnitude of damage sustained on impact. The power plant system (engine) was recovered, as was the Crash Survivable Memory Unit (CSMU). The CSMU was sent to Lockheed, Ft. Worth, Texas for analysis. Data from the mishap flight was successfully retrieved (ref. Tab O). Review of this data indicated the engine was operating normally prior to the mishap.

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2. The mishap engine tear down was accomplished at Spangdahlem Air Base, Germany. The recovered portion of the suspect first stage fan, number 8 blade was sent to GE Aircraft Engines Engineering Materials Technology Lab at Evendale, Ohio for further evaluation. The evaluation revealed a fatigue crack initiated from an impact site located on the leading edge of the blade. The fatigue crack propagated for a distance of 1.37 inches before final separation by tensile overload.

3. An energy dispersive spectroscopy (EDS) was used on the blade to analyze the deposits in the impact area and revealed that the majority of the spectra are representative of the material Inconel 718. EDS analysis of the second impact area (not related to the origin of the fatigue crack) revealed the metallic deposits to be representative of 17-4 Ph steel.

N. Operations Personnel and Supervision

1. Lt Col John K. Roll, Operations Officer, 22 Fighter Squadron, authorized the mission (ref Tab V).

2. Capt Brett D. Hansen briefed the mission for the flight, Spur 01/02. Capt Thomas J. Smith briefed the passenger, A1C Jason Fowler. USAFER 55-116 contains the briefing guides used to conduct pre-flight briefings. No squadron supervisory personnel attended the briefing. Both the flight brief and crew coordination briefings were thorough and IAW USAFER 55-116 (ref Tab V).

O. Crew Qualifications

1. Captain Smith, the MP, is a highly qualified non-experienced (less than 500 hours F-16 flying time) wingman who was current and qualified for the planned mission.

2. Capt Smith had 987.5 total flying hours, 322.1 hours of F-16 time, and 63.3 combat hours by 13 Jan 95. His 30-60-90 day breakdown is as follows: 11.7 hours/7 days - 34.7 hours/20 days - 56.5 hours/ 33 days (ref Tab G).

3. Capt Smith completed F-16 training as follows (ref Tab T):

F-16 Formal RTU training

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- only noted deficiency was his grade of Q-3 (unqualified) on his Initial Qualification/Instrument Check for simulated flameout landings and precision approach final. Capt Smith had a re-check and passed with no discrepancies (Q-1).

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<u>22 FS Mission Qualification Training (MOT)</u> - no deficiencies	20 Apr 1994
<u>22 FS Low Level Step Down Training</u> - no deficiencies	18 Mar 1994
<u>22 FS Maverick Training</u> - no deficiencies	11 Jul 1994

P. Medical

1. Both MP and passenger were medically cleared for flight. Post flight toxicology tests results for both were negative. No injuries resulted from ejection or landing.

Q. Nav aids and Facilities

1. Nav aids and facilities were not a factor in this accident.

R. Weather

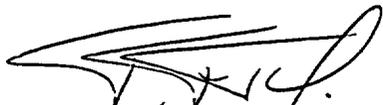
1. Weather was a minor factor in this accident (ref Tabs V and W). Low altitude clouds in the target area forced Spur 01 flight to route abort to 5,000' MSL giving the MP more altitude and time to assess the situation, attempt an airstart, and determine the proper course of action. The low altitude undercast also reinforced the MP's decision to eject above the recommended minimum altitude of 2,000' AGL. The weather, in other words, was a positive factor in this accident.

S. Governing Directives and Publications

1. AFR 60-1, Flight Management; USAFE Sup 1 to AFR 60-1
2. AFR 60-2, Aircrew Standardization/Evaluation Program
3. AFR 60-16, General Flight Rules
4. AFM 51-37, Flying Training Instrument Flying
5. AFI 11-214, Aircrew and Weapons Director Procedures for Air Operations
6. USAFER 51-1, Vol IV, Aircrew Ground Training

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7. USAFEM 51-50, Vols I and VIII, Tactical Fighter and F-16 Aircrew Training
8. USAFER 55-44, Life Support Program
9. AFI 11-301, Air Force Life Support Systems Program
10. USAFER 55-116, F-16 Pilot Operational Procedures; Spangdahlem AB Chapter 8 to USAFER 55-116
11. USAFER 66-5, Combat Oriented Maintenance Organization
12. DoD Flight Information Publication, General Planning
13. DoD Flight Information Publication, Area Planning, Special Use Airspace, Europe-Africa-Middle East
14. 52 FW In-flight Guide
15. 1F-16CJ-1, F-16C/D Flight Manual
16. 1F-16CJ-1CL-1, F-16C/D Checklist
17. 1F-16CJ-6WC-1-11, Combined Preflight/Postflight, End of Runway, Thruflight, Launch and Recovery, Quick Turnaround, Basic Postflight, and Walkaround Before First Flight Of The Day Inspections
18. 1F-16CJ-2-10JG-00-1, Aircraft Ground Safety Guide
19. 1F-16CJ-2-12JG-00-1, Aircraft Ground Servicing Guide
20. 1F-16CJ-34-1-1, Avionics and Non-nuclear Weapons Delivery Flight Manual
21. 1F-16CJ-34-1-1CL-1, Checklist Avionics and Non-nuclear Weapons Delivery Flight Crew Procedures
22. 1F-16CJ-2-70FI-00-1, Fault Isolation, Power Plant, F110-GE-129
23. 1F-16CJ-6-11, Scheduled Inspections and Maintenance Requirements

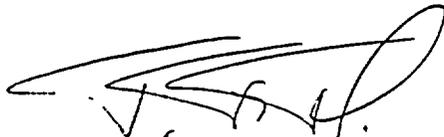


THOMAS F. TWOHIG, Lt Col, USAF
Accident Investigation Officer

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.

The aircraft accident that occurred on 13 Jan 1995 to F-16D, SN 90-0849 from the 52 Fighter Wing, Spangdahlem Air base, Germany, was caused by failure of the first stage fan, number 8 blade in the aircraft's General Electric F110-GE-129 afterburning turbofan engine. A low stress, high frequency loading crack propagation had occurred from the leading edge of the failed blade. The fatigue crack initiated from an impact site located on the leading edge of the blade. This impact site was caused by ingestion of a foreign object determined to be composed of the material Inconel 718. This fatigue crack propagated for 1.37 inches before tensile overload caused fan blade separation. Ingestion of this blade fragment caused a titanium fire in the high pressure compressor section of the engine. Unrecoverable engine failure resulted. The aircraft was not in a position or at an altitude where it could be recovered by an emergency flameout landing. The mishap pilot and passenger ejected safely and the aircraft crashed on the first fairway of the Five Nations Golf Course, near Durbuy, Belgium.



THOMAS F. TWOHIG, Lt Col, USAF
Accident Investigation Officer