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OFFICE OF THE SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

AUTHORITY AND PURPOSE

The Commander of Air Force Logistics Command appointed Colonel David A. Dietsch, on 22 March 1990, to conduct an investigation in accordance with AFR 110-14, of a major aircraft accident involving F-16A, serial number 82-0937, which occurred on 16 March 1990, at 0919 MST, four (4) miles northeast of Wendover, Utah.

The purpose of the accident investigation is to obtain and preserve all available evidence for use in claims, litigation, disciplinary and administrative actions, and for all other purposes, except purposes of safety investigation under AFR 127-4.

SUMMARY OF FACTS

History of Flight:

The pilot, Captain Daniel A. West, flew the aircraft, call sign Phantom 18, on a functional check flight (FCF). The flight was authorized by the Commander, 2872 Test Squadron, as a routine part of final testing associated with programmed Depot maintenance on the aircraft. Approximately 19 minutes into the flight, the aircraft developed an engine malfunction, which required Captain West to shut down the engine. Captain West diverted the aircraft for an emergency landing at the closest available field, Wendover Airport, Utah. After at least two unsuccessful attempts to restart the engine, Captain West determined he could not make a landing at Wendover, pointed the aircraft toward an uninhabited area of the desert, and successfully ejected. The aircraft impacted in the desert some four miles northeast of Wendover, Utah, and was destroyed.

Mission:

Captain West's mission was to fly a functional check flight on this aircraft to determine correction of previous discrepancies with the aircraft's ultra high frequency radio, inertial navigation system, radar, and flight control systems. He was also to act as a simulated target for Captain David M. Whittemore, who was piloting another F-16A, call sign Phantom 16. (Captain Whittemore was checking the performance of the aircraft weapons control systems after his aircraft had been modified to the air defense fighter configuration.) This was the third functional check flight on Captain West's aircraft; the other two were flown on 8 March 1990 and 12 March 1990.

Briefing and Preflight:

Captain West's physical condition prior to flight, including rest and nutrition, are unknown. The planning and briefing for the mission were normal and unremarkable (Tab V-7) according to the squadron Supervisor of Flying (SOF). Aircraft servicing procedures and ground crew preflight were normal (Tab V-11, 13). Engine start, end-of-runway checks and aircraft launch were also normal, and the ground crew did not notice anything out of the ordinary (Tab V-18).

Flight:

Captain West's takeoff was recorded at 0855 MST; and Captain Whittemore, took off three minutes later. Both pilots flew to the military operating area designated R-6404, near Wendover, Utah, to conduct their respective missions. Because Captain Whittemore's aircraft had just received the air defense fighter modification, the two pilots spent a short time mutually assisting each other in checking the operation of the modified weapon systems. They then separated to conduct the remainder of their respective missions. In Captain West's case, this would have been to determine whether his UHF radio, inertial navigation system, radar, and flight controls were functioning properly (Tab V-7).

Approximately 19 minutes into his flight (time approximated based on aircraft flight data recorder (Tab J), radio communication transcript (Tab N), and takeoff time from AF Form 711 (Tab A)), Captain West reported an engine problem to ground control over his UHF radio. He described the problem as an engine stagnation (loss of thrust accompanied by decreasing engine speed (RPM) and increasing temperature in the turbine). The cause of the stagnation is unknown. Captain West reacted as prescribed by the aircraft flight manual and shut down the engine (Tabs N and AA-1).

Stagnations are a result of the interruption of normal airflow through the engine. They are always preceded by an engine stall which is the momentary reversal of airflow through the engine. Stalls are accompanied by a loud bang or pop which is clearly audible in the cockpit and can often be felt through the cockpit floorboards. Stalls are most common during throttle movement in the afterburner range, and most often occur in flight regimes designated in the aircraft flight manual as regions 2 and 3. Region 2 is defined as circumstances in which the aircraft is above 20,000 feet above mean sea level (MSL) and has an indicated airspeed below 250 knots. Region 3 is defined as circumstances above 30,000 feet MSL and below 180 knots. The aircraft flight manual states that stalls may occur in Region 2 during throttle

movement in the afterburner range. The aircraft flight manual also states that, in Region 3, steady state afterburner operation, or afterburner cancellation are the only advisable afterburner throttle operations, and stalls may occur even under these conditions. In Region 1, stalls should not occur if the engine is operating normally (Tab AA-1).

The recovery procedure for an engine stall in afterburner is to snap the throttle out of the afterburner range to military power. At military power, the engine stall recovery logic which regulates fuel flow and airflow is most effective and provides the best protection from engine stagnation. However, stagnation still may occur if the fuel control is malfunctioning, and in some cases, stall recovery logic is not fast enough to prevent a stagnation even when the engine and fuel control are functioning normally (Tab AA-1).

~~Examination of recovered engine components from aircraft~~ 82-0937 did not reveal any abnormal conditions as indicated later in this summary. However, during Captain West's mission, the aircraft flight data recorder recorded an abnormal event at 18 minutes 52 seconds into the flight. At this time, the airspeed was 90 knots, the aircraft angle of attack was +23.02 degrees, and the altitude was 26,978 feet (Tab J). These circumstances put the aircraft in Region 2. Throttle activity at this time is unknown. It is also unknown why Captain West placed the aircraft in this situation. The only discrepancy noted on the 12 March functional check flight which might have necessitated such an extreme maneuver, was a previous caution light on the pitch channel of the flight control system indicating possible failure of the automatic pitch controls. Appropriate checkout procedure for this discrepancy is to place the aircraft in the identical attitude and circumstances under which the light originally occurred. The exact circumstances surrounding the previous discrepancy on 12 March 1990, a test flight also flown by Captain West, are also unknown. However, the AFTO Form 781A from the 12 March 1990 test flight indicates that Captain West maneuvered the aircraft in the pitch axis as a part of troubleshooting the pitch channel light (Tab U-1).

Hearing Captain West's report of his problem, Captain Whittemore in Phantom 16 requested a ground control vector to rejoin with Captain West in Phantom 18 and offer any assistance possible in handling the situation. It is unknown whether Captain West attempted a unified fuel control (UFC) airstart, as recommended by the aircraft flight manual, between the time he initially had the problem and the time at which Captain Whittemore

rejoined him. A UFC airstart is recommended by the flight manual. "Unless an airstart is obviously impossible (total lack of fuel, engine seizure, etc.) do not become tempted to establish a maximum range or maximum endurance glide. The first consideration should be given to an immediate airstart attempt even if the engine failed for no apparent reason" (Tab AA-2).

Upon rejoin, Captain West asked Captain Whittemore to "back me up on the checklist" (the emergency procedures checklist for engine stagnation) (Tab N). Captain Whittemore recalled the altitude at rejoin as "between 21,000 and 20,000" (feet) (Tab V-15). Phantom 16 (Whittemore) immediately told Captain West the direction and distance to Wendover Airport ("on your nose ... 25 miles") (Tab N). Thirty seconds later, once Captain West's course was set for the emergency field, Captain Whittemore asked Captain West whether he had the throttle in "off" position, and the jet fuel starter (JFS) switch in "Start 2" (Tab N). Captain West replied, "~~Throttle off. JFS won't start. It's in Start 2.~~" These are the proper positions for a jet fuel starter (JFS) airstart. As indicated by the flight manual (Tab AA-6), there are two types of airstarts. One relies on the force of air down the engine inlet generated by the movement of the aircraft. The other method is to use the JFS which is the method used to start the aircraft on the ground. The JFS is a gas turbine fueled by jet fuel from the aircraft's normal fuel system. When used, this turbine is engaged into the engine gearbox and used to turn the engine with sufficient RPM to obtain fuel and ignition for start.

The envelope in which such a start is expected to be successful is below 20,000 feet above mean sea level (MSL). The precise altitude at which Captain West attempted the start is unknown. However, Captain Whittemore's altitude recollection (Tab V-15) indicates that it was near the upper limits of the envelope. It cannot be precisely determined whether the aircraft was above or below 20,000 feet MSL. The aircraft flight manual prohibits jet fuel starter airstarts above 20,000 feet MSL, since the JFS is unlikely to operate, and the hydraulic accumulator which powers the JFS and the reserve aircraft brakes will be depleted (Tab AA-3).

Captain West also said, in the same transmission, "I've got zero rpm" (Tab N). The aircraft flight manual indicates that a minimum of 15 percent RPM is required for fuel and ignition for a UFC or backup fuel control (BUC) airstart (Tab AA-4), and 12 percent is required to maintain sufficient hydraulic pressure in the secondary engine driven hydraulic system to recharge the jet fuel starter and emergency brake accumulator (Tab AA-5).

Captain Whittemore then recommended "Maintain 210 knots" to Captain West, and that he return the JFS switch to "off." An airspeed of 210 knots is the appropriate airspeed for maximum glide (Tab AA-6). Returning the JFS switch to off is required prior to initiation of another attempted JFS airstart (Tab AA-7). However, the JFS accumulator will only recharge if sufficient engine RPM (12 percent) is available (Tab AA-5). Captain West replied that he was holding 210 knots and the JFS was off, and that he had switched to the backup engine fuel control (Tab N).

A minute and 30 seconds later, after passing through 8500 feet altitude, and approximately 10 miles from Wendover Airport, Captain Whittemore asked Captain West if he had made another attempt at a JFS airstart. Captain West replied that he had gone back to "start 2" on the JFS, but that the JFS still would not start (Tab N). Twenty-three seconds later, Captain Whittemore suggested to Captain West that he prepare for ejection (Tab N). Twelve seconds later, Captain Whittemore recommended that Captain West point the aircraft towards an unpopulated area if possible (Tab N). Thirty seconds later, Captain Whittemore called out 1,000 feet of altitude and Captain West announced, "One-eight, heading for ejection." Ground control notified Wendover Airport that the aircraft was four miles from the runway (Tab N). Six seconds later, Captain Whittemore recommended to Captain West that he turn a little north if he could. Captain West acknowledged that he was turning north and less than eight seconds later, Captain West ejected from his aircraft (Tab N).

Impact:

The aircraft impacted in an unpopulated area of desert four miles northeast of Wendover, Utah. Ejection was successful and Captain West was uninjured. The initial impact occurred in Township 1 South, Range 19 West, Section 1, on land belonging to the United States Bureau of Land Management. The aircraft skipped and came to rest in Township 1 South, Range 19 West, Section 2, on Utah State land. A fire resulted (Tab V-12), but because the land was unimproved, there was no permanent damage done to either federal or state land. The only damage from the crash was rutting which was later raked and graded by the Air Force (Tab P).

Ejection Seat:

Ejection sequence was initiated within the performance envelope of the system, and the equipment functioned correctly resulting in successful ejection.

Analysis of the flow rate of fuel through the recovered engine fuel nozzles indicated a slight variance from prescribed technical data flow rates on some nozzles (Tab J).

Fuel contamination tests were run on the refueling vehicle which serviced the aircraft, and the fuel tested within prescribed limits (Tab U-7). Spectrometric oil analysis records for the engine indicate no unusual metal wear (Tab U-6), and the fact that the teardown evidence indicates the engine was still turning slowly at impact would corroborate the fact that the engine did not have a major rotational failure and seize (Tab J).

The JFS was damaged by impact; however, several internal components were intact. The start fuel nozzle and spark plug were sent to San Antonio ALC for analysis. Functional check was accomplished by installation of these components in a newly overhauled JFS. The components functioned normally. The JFS fuel control was too badly damaged by impact to allow functional check. San Antonio also requested the JFS exciter and the engine start system controller for analysis, but these had been destroyed by the ground fire after the crash. With the available components, San Antonio ALC concluded that there was no evidence of a starting system malfunction (Tab J).

Operations Personnel and Supervision:

Operations and supervision were appropriate. Senior squadron personnel were on duty during the mission, and a Supervisor of Flying (SOF) was on duty. The SOF changed between briefing time and the time of the mishap. The SOF on duty during the mishap was not F-16 qualified; however, since another qualified F-16 pilot (Captain Whittemore) was on the scene in Phantom 16, the SOF was not called upon to participate during the emergency.

Crew Qualifications:

Captain West was current and qualified to fly the mission and had over 1,000 hours flying time in the F-16.

Medical:

The pilot was medically qualified for the conduct of the mission. Review of toxicology reports and pre- and post-flight medical information reveals no medical implications in the accident (Tab X).

Nav aids:

Nav aids functioned normally.

Weather:

Weather was above the minimum required for the mission.

Directives and Publications:

The following publications applied to the mission:

1F-16A-1
1F-16A-6
AFLCR 60-2, and OO-ALC Supplement thereto
OO-ALC/Hill AFB Regulation 60-3


DAVID A. DIETSCH, Colonel, USAF
Investigating Officer

Ut. Bates No. (PFS-)	FS Bates No.	PFS File Name	From	To	Date	Document Description	Issue	Sent to Date
39259-39266	56957-56964	Contention 7 Utah K	Long, Joseph H., Lt. Col.	Ninth Air Force Commander	09/07/90 to 09/21/90	<p>Aircraft Accident Investigation re: 08/07/90 F-16D (SN-84-1321) accident which occurred approximately six nautical miles northeast of Charleston AFB, SC. The flight departed Shaw AFB enroute to Myrtle Beach AFB, SC for an instrument approach, then proceeded direct to Shelly MOA for acrobatics. The flight then departed the MOA on an enroute decent to Charleston AFB for an additional instrument approach. During the descent, the aircraft developed engine problems and eventually failed. After determining the engine failure critical action procedure attempt to restart the engine would be futile, the pilots safely ejected, and the aircraft was destroyed. The engine had failed to operate normally for reasons which could not be determined in after-crash investigations.</p> <p>The 1st pilot had 950.3 F-16 hrs and 3003.4 hours total flying time. The 2nd pilot had 111.8 F-16 hrs and 138.8 total hours flying time. He was flying under the supervision of the instructor pilot and was qualified to perform the mission.</p> <p>Although weather was not a factor in the crash, poor visibility due to rain and fog, poor radio communications, and dense foliage hampered rescue procedures. Visibility was 5 miles with rain and light fog.</p>	K	

AIRCRAFT ACCIDENT INVESTIGATION

AUTHORITY: Under the provisions of Air Force Regulation (AFR) 110-14, the Ninth Air Force Commander appointed Lieutenant Colonel Joseph H. Long to conduct an Aircraft Accident Investigation of the F-16D (SN-84-1321) accident which occurred approximately 6 nautical miles northwest of Charleston AFB, South Carolina. The investigation was conducted from 7 Sep 90 to 21 Sep 90. Technical advisors were Lieutenant Colonel Thomas A. Pyrch (Operations), Captain Charles R. Epperson (Legal), Captain Edward J. Hayman (Maintenance) and Staff Sergeant James H. Lloyd, Jr. (Information Management Support).

PURPOSE: An aircraft investigation is convened under AFR 110-14 to collect and preserve all relevant evidence for possible use in claims, litigation, disciplinary actions, adverse administrative proceedings, or for any other purposes deemed appropriate by competent authority. The investigation is to obtain factual information and is not intended to determine the cause of the accident. In addition, the aircraft accident investigation board cannot draw conclusions nor make recommendations. This report is available for public dissemination under the Freedom of Information Act (5 U.S.C. 552) and AFR 12-30.

SUMMARY OF FACTS

1. **History of Flight:** On 7 August 1990, First Lieutenant Tortsen K. Arnold and Lieutenant Colonel Gregory W. Lewis were scheduled for an instrument mission. The flight, call sign PACA 54 (K-2) departed Shaw AFB SC at 1002 EDT enroute to Myrtle Beach AFB, SC for an instrument approach, then proceeded direct to Shelley MOA for acrobatics. PACA 54 then departed the MOA on an enroute descent to Charleston AFB, SC for an additional instrument approach. During the descent the aircraft developed engine problems. On the approach the engine eventually failed, the pilots safely ejected and the aircraft was destroyed (V-2, V-5). The crash site was 6.4 nautical miles northwest of Charleston AFB, SC, coordinates 35 degrees 57.4 minutes north latitude, 80 degrees 6.6 minutes west longitude (A-1). The Charleston and Shaw AFB Public Affairs offices handled news inquiries (Z-2, Z-3).

2. **Mission:** The mission was scheduled to accomplish a mission qualification training (MQT) upgrade single ship instrument mission for Lt Arnold with Lt Col Lewis performing as instructor pilot. The planned mission included afterburner takeoff direct to Myrtle Beach for an instrument approach, direct to Shelley MOA for acrobatics, direct to Charleston for another instrument approach, direct to McEntire NGB for practice simulated flame out patterns and then return to Shaw AFB (V-2, V-5).

3. **Briefing and Pre-flight:** Lt Arnold and Lt Col Lewis arrived for duty at approximately 0700 and 0730 respectively. Both had adequate crew rest. Lt Col Lewis and Lt Arnold discussed, planned, and prepared for the mission together. Lt Col Lewis conducted the briefing utilizing the squadron standard briefing guide. He emphasized engine emergencies and instrument procedures. Ground operations, taxi, and pre take-off procedures were conducted without any significant events (V-2, V-5).

4. Flight: PACA 54 took off at approximately 1002 EST. They flew directly to Myrtle Beach for an instrument approach and then to Shelley MOA for acrobatics. They departed the MOA, with an enroute descent into Charleston AFB for an instrument approach to runway 15. Passing 4000 - 5000 feet, the pilots heard the engine miss and thump. Lt Arnold observed momentary RPM fluctuations. Lt Col Lewis pulled the throttle to idle power and directed Lt Arnold to turn the EEC/BUC switch to off. Lt Col Lewis referred to the abnormal engine response emergency procedure checklist while Lt Arnold continued to fly. They declared an emergency with approach control and planned a full stop landing. Approach control vectored PACA 54 to a 6 mile final (N-1). As PACA 54 was turning onto final at about 185 knots and 1800 feet MSL, the engine sputtered again and quit. Lt Arnold immediately went EEC/BUC switch to BUC. Lt Col Lewis took control of the aircraft and also selected BUC. As Lt Col Lewis watched the engine unwind, he rolled the aircraft to a level altitude and began the engine failure critical action procedure. Lt Col Lewis attempted to zoom the aircraft and said "Throttle Off", the third step in the emergency procedure. Lt Arnold attempted to retard the throttle to off. At this time the RPM had decayed to 45%. Lt Col Lewis determined an attempt to restart the engine would be futile and commanded ejection. Both pilots pulled their ejection handles. Ejection was successful at approximately 1000 feet. The aircraft crashed 6 miles northwest of Charleston AFB in a thickly wooded area. Lt Col Lewis parachuted into a large tree and became hung upside down 50 - 60 feet high as the raftline and chute cords tangled with the tree. He cut himself free and climbed down the tree. Lt Arnold's parachute also caught up in a tree, with him hanging three feet above ground. He was able to release himself and jump to the ground. A Medical University Medivac and Navy helicopter were immediately on scene. The Navy helicopter crew directed the pilots toward a logging road. Upon reaching the road, they were met by a base ambulance, received medical attention and transported to the hospital (V-2, V-5).

5. Impact: The aircraft impacted in an undeveloped heavily wooded area 6.4 miles from Charleston AFB (A-1, R-2, R-3, Z-4). The aircraft caught fire and was destroyed. The aircraft heading was 235 degrees (magnetic); attitude at impact was wings level with 9 degrees nose down, airspeed was 157 knots (J-2). The engine was at low to zero RPM at ground impact. For an undetermined reason the engine failed to operate properly before ground impact (J-11).

6. Ejection Seat: The two ejection seats functioned normally upon initiation (V-2, V-5).

7. Personal and Survival Equipment: All inspections of the mishap pilots' personal and survival equipment were current (U-4). Lt Col Lewis became tangled in a tree upside down 50 to 60 feet above ground. Lt Col Lewis did not wear a parachute lowering device (PLD) and climbed down from the tree. Lt Col Lewis was medically exempt from wearing a PLD (U-5).

13. Operations Personnel and Supervision: The mission was conducted under the authority of the 363 TFW and the 19 TFS (K-2, K-3). The briefing was conducted by Lt Col Lewis using the 363 TFW briefing guide and was thorough and complete (V-2, V-5).

14. Pilot Qualifications:

a. Lt Col Lewis was current and fully qualified to conduct the mission (G-2, G-4, G-6, T-5). His flying experience follows (G-2).

<u>Aircraft</u>	<u>Hours</u>
F-16	950.3
A-10	2036.4
F-5	1.0
AT/T-38	15.7

30/60/90 Day Summary

30 Day	15 Sorties/33.4 Hours
60 Day	18 Sorties/38.7 Hours
90 Day	25 Sorties/50.7 Hours

b. Lt Arnold initially failed to complete the MQT program and was subsequently grounded. He was reinstated into the program by the squadron commander after a records review. Lt Arnold had approximately a seven week layoff. His last flight was accomplished on 12 Jun 90. This was his first sortie after restarting. Lt Arnold was flying under the supervision of an instructor pilot and was qualified to perform the mission (G-2, G-4, G-6, T-2). His flying experience follows (G-2).

<u>Aircraft</u>	<u>Hours</u>
F-16	111.8
AT/T-38	27.0

30/60/90 Day Summary

30 Day	0 Sorties/0 Hours
60 Day	1 Sortie/1.6 Hours
90 Day	6 Sorties/8.4 Hours

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15. Medical: Lt Col Lewis and Lt Arnold were medically qualified for flight (T-6, T-4) Lt Col Lewis suffered minor contusions and abrasions of the shoulder, hips, and lower leg from the ejection and subsequent parachute landing in the tree (X-3). Lt Arnold suffered no injuries from the ejection and subsequent parachute landing (X-2). The toxicology report revealed no illegal or prescription medications and no alcohol for either pilot (X-2, X-3).

16. Navigation Aid and Facilities: All applicable navigation aids were operational.

17. Weather: The Charleston AFB weather at the time of mishap was 900 scattered, measured 2200 feet overcast; visibility 5 miles with rain and light fog, and the winds were from the northeast at 8 knots (K-4, K-5).

18. Directives and Publications:

a. Directives and publications applicable to the mishap were:

- (1) AFR 60-16, General Flight Rules
- (2) TACM 51-50, Tactical Aircrew Training
- (3) TACR 55-116, F-16 Pilot Operational Procedures
- (4) TACR 55-116/SAFB Sup 1, Local Operational Procedures
- (5) TO 1F-16C-1, Flight Manual
- (6) TO 1F-16C-1CL-1, Flight Manual Checklist
- (7) 363 TFW Briefing Guide

b. No deviations to regulations occurred.


JOSEPH H. LONG, Lt Col, USAF
AFR 110-14 Accident Investigation Officer