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AIRCRAFT ACCIDENT INVESTIGATION REPORT SUMMARY
OFFICE OF THE SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

1. AUTHORITY AND PURPOSE.

a. Authority. Under authority of Air Force Regulation (AFR) 110-14, the Ninth Air Force Commander (Rear), appointed Lt Col Donald W. Rupert (Tab Y-2) to conduct an aircraft accident investigation of a United States Air Force (USAF) F-16C aircraft (serial number 84-1379) accident that occurred on 15 February 1991 at 8:50pm local time (1650Z) 23 nautical miles south, southeast of Abu Dhabi, United Arab Emirates (UAE). The investigation was conducted from 29 April to 22 May 1991. Technical advice and support were provided by Capt David A. Cotton (Pilot Advisor), Capt Edward T. Moore (Maintenance Advisor), Capt (Dr) George F. Craft (Medical Advisor), Capt Charles R. Epperson (Legal Advisor) and Staff Sergeant William L. Walters (Administrative Support) (Tabs Y-3, Y-4, Y-5 and Y-6 respectively).

b. Purpose. An AFR 110-14 aircraft accident investigation is convened 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 it is not intended to determine the cause of the accident. In addition, the aircraft accident investigation officer cannot make conclusions and recommendations. This report is available for public dissemination under the Freedom of Information Act (5 U.S.C. 552) and AFR 12-30.

2. HISTORY OF FLIGHT.

a. Overview. On 15 February 1991, Capt Dale T. Cormier, an F-16 pilot, assigned to the 17th Tactical Fighter Squadron (TFS) from Shaw Air Force Base (AFB), South Carolina (SC), was performing lawful temporary duty with the 363d Tactical Fighter Wing (TFW) (Provisional), a fighting arm of the 14th Air Division, under the United States Central Command Air Forces (USCENTAF), a component of the United States Central Command (USCENTCOM), at Al Dhafra Air Base (AB), UAE. He was scheduled for three (Tabs K-3 through K-5) and flew two combat sorties that day supporting the coalition forces during Operation Desert Storm. His first two sorties of the day were uneventful (Tabs U-7, V-12, V-17 and V-19). Due to changes in operations in the intended target area and aircraft ground delays at his forward operating location, King Khalid Military City (KKMC), Saudi Arabia, the third sortie was rebriefed as a non-combat return flight to Al Dhafra AB (Tabs V-3, V-5, V-12 and V-15). Capt Cormier was number eight in an 8-ship formation flight. Weather for the flight was clear and the visibility was excellent (Tabs V-7, V-12, V-18 and W-2). The flight departed at sunset using 2-ship formation takeoffs and joined on a tanker aircraft for night air-to-air refueling. After refueling, the flight proceeded direct to the initial approach fix (named West) for the ASLAR (aircraft surge launch and recovery)/ILS

PFS Exh. 122

ADMINISTRATIVE COMMISSION

Subject No. 983

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Other 2/1/64 WITHDRAWN _____

DATE 2/1/64 Witness _____

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(instrument landing system) approach to Runway 31 at Al Dhafra AB. At approximately 100 nautical miles from West the 8-ship flight split into four elements (2-ship formations) to set up for the ASLAR/ILS approach. At about 40 miles from West at 6000 feet above mean sea level, Capt Cormier and his element leader checked and compared their inertial navigation systems for range and bearing to Al Dhafra AB (Tabs V-5, V-12 and V-18). Both agreed (Tab V-5). This was the last known transmission that Capt Cormier made. The element leader checked Capt Cormier's formation position approximately 10-15 miles from West and it was slightly wider than briefed (Tab V-10). This was the last known time he was seen alive. The mishap element leader discovered he was not in formation during the ASLAR/ILS approach and initiated the search for him (Tabs N-3, N-4, V-5 and V-9). Unknown to anyone at this time was that Capt Cormier's aircraft had crashed in a steep dive angle shortly after beginning the ASLAR/ILS approach (Tabs J-7, J-8 and M-2). Ejection was not attempted (Tabs J-11 through J-13). Capt Cormier died in the crash (Tab X-2). Press releases were made at Shaw AFB, SC, by the 363d TFW Public Affairs Office. The local UAE press was not involved.

b. Mission. The mishap flight was mission number 17160 of the Operation Desert Storm Air Tasking Order for 15 February 1991 (Tab N-4). Pilots on the flight were assigned this mission by the 17th TFS (Tabs K-4 and K-5) with approval by the Wing commander. The mission leader of the returning 8-ship flight (callsigns FIDO 21 through 28) was Maj Daniel K. Kamps, callsign FIDO 21 (Tab V-3 and V-14). The flight leader of the second 4-ship was Capt Karl S. Petersen, callsign FIDO 25 (Tab V-12 and V-14). The element leader of the last 2-ship was Capt Chris M. Peloza, callsign FIDO 27 (Tabs V-5 and V-9). Capt Cormier was the number eight man, callsign FIDO 28. Each F-16 was configured with a centerline electronic countermeasures pod, one heat-seeking missile on both wingtip stations and four empty weapons pylons (Tab M-2). After headquarters cancelled the third combat sortie of the day, Maj Kamps properly coordinated a mission change to just a return flight to Al Dhafra AB (Tab V-3).

c. Weather. The weather was clear for the entire flight. Visibility was in excess of 25 nautical miles in flight with no ceiling or weather hazards at the destination. The moon was below the horizon and its illumination at the time of the accident was nil (Tabs V-7, V-12, V-18 and W-2).

d. Mission Preparation.

(1) Capt Cormier arrived at squadron operations in Al Dhafra AB on 15 February 1991 at 8:25-8:30am (0425-0430Z) and began preparation for the day's three flights (Tab V-13). Mission briefings began at 8:40am (0440Z). This short time for personal preparation prior to mission briefs was quite normal at this stage in offensive operations. A mission planning cell, consisting of other pilots and intelligence officers, did the majority of the pre-mission work so that the pilots who were going to fly the

mission(s) would have sufficient crew rest (Tab V-14). All three sorties scheduled for this day were briefed. The mission briefing covered intelligence, weather, target descriptions and mission overview. This was followed by flight briefings to provide additional required details. The 8-ship briefed first, followed by the individual 4-ships (Tab V-14). FIDO 25 specifically briefed the night recovery and awareness of spatial disorientation. (Tabs V-15 and V-16).

(2) After two uneventful sorties the pilots prepared to fly their last combat mission of the day out of King Khalid Military City with landing at Al Dhafra AB (Tabs U-7, V-12, V-17 and V-19). Because headquarters cancelled the mission before takeoff, their bombs were downloaded (Tabs V-3 and V-17). Following discussions with Lt Col Emery, the DETCO (detachment commander), Maj Kamps rebriefed the last mission to be a non-combat recovery to Al Dhafra AB (Tabs V-3, V-5 and V-12). All mission pilots were present during the briefing, which included night formation takeoffs, night air-to-air refueling, in flight formations to be flown and ASLAR/ILS approaches to full stop landings. (Tabs V-3 and V-5).

e. Flight.

(1) Pre-flight Operations. After engine start for the original third mission of the day Capt Cormier's aircraft developed a malfunction with both multifunction displays (MFDs). This failure would have prevented him from flying a combat mission. The MFDs are required to be operational to select and release bombs. Several attempts were made by maintenance to fix the problem prior to flight (Tabs V-17, V-19, V-21, V-22, V-24 and V-27). None were effective (Tabs V-19, V-21, V-24 and V-27). When the third combat mission of the day was cancelled and the mission was changed to just a return flight to Al Dhafra AB, it became possible for Capt Cormier and his aircraft to return with the mutual support of his flight. Functioning MFDs are not required for flight from a safety-of-flight standpoint, especially when no bombs are on the aircraft. This did result in his having no over-all radar display. However, the radar also was not required for the return mission. Nonetheless, he still had access to the automatic acquisition modes of the air-to-air portion of his radar, and lock-on information could have been displayed on his head-up display (HUD). He still could have armed, aimed and launched his heat-seeking missiles in self-protection, if required. Testimony from other pilots (Tabs V-8 and V-15) in the flight revealed that they would also have flown this flight without MFDs.

(2) Flight Operations. Takeoff was at 7:00pm (1500Z) (Tabs K-4 and K-5). The takeoff and departure were normal. There were no problems enroute to the airborne tanker, during air-to-air refueling, nor afterwards enroute to the initial approach fix (Tabs V-3 and V-12). At no time during the flight did Capt Cormier appear to have any trouble maintaining formation position (Tab V-5). Approximately 100 miles out from West, the initial approach fix, FIDO 21 split the flight up into four 2-ship

elements with 8-10 mile spacing between elements. Each element crossed West in turn (Tabs N-2 and N-3). The FIDO 27 element crossed the 240 degree radial at 24-25 DME, west of the initial approach fix at 6000 feet above sea level with Capt Cormier on the left side (Tab N-3 and V-8). The FIDO 27 made a left turn to a 100 degree heading while beginning a gradual descent. At 19 miles from the Al Dhafra TACAN (tactical air navigation) the FIDO turned right to intercept the 17 mile arc from the Al Dhafra TACAN, counterclockwise as published. FIDO 27's attention was inside his cockpit, flying the instrument approach, until passing 4000 feet above sea level when he looked out to check his wingman's formation position and was unable to locate him. He informed FIDO 21 that he had lost visual contact with his wingman (Tabs V-5, V-8 and V-9). He tried to contact FIDO 28 using both his radios, but had no success (Tabs N-3, N-4 and V-5). No one else heard a response either. With the flight leader's approval, the FIDO 27 discontinued his instrument approach and searched for FIDO 28 visually and with his radar until he had to land because of low fuel. For fuel and traffic congestion considerations FIDO 21 through 26 elected to land. FIDO 27 was unable to make contact with FIDO 28 and landed about 10 minutes after the rest of the flight (Tabs V-3, V-5, V-12 and V-18).

g. Crew Rest. AFR 60-1, requires that aircrewmembers of single piloted aircraft (like the F-16) not operate aircraft beyond 12 hours after they report for work on any day in which they do flight duties. It also requires there be at least 12 hours from the time they leave work the previous day until reporting for work the next day; in this period they must also be allowed time for 8 hours of uninterrupted sleep. Capt Cormier had adequate crew rest prior to reporting for duty on the day of the mishap (Tabs V-13 and V-14). He had been on duty for 12 hours and 25-30 minutes at the time of the mishap. The Tactical Air Command Supplement to AFR 60-1 allows wing commanders to waive crew rest requirements, as was sometimes necessary for best execution of Operation Desert Storm. The flying schedule was scrutinized and approved daily by the Wing commander and was considered waiver authority.

h. Impact. The mishap aircraft impacted unpopulated, flat desert terrain (Tabs P-2 and S-2) at 45 feet above mean sea level (Tab C-2) in approximately 90 degrees of left bank and 60 degrees nose low at an undetermined airspeed according to analysis of the recovered cockpit flight instruments (Tabs J-7 and J-8). This is substantiated by the debris pattern (Tabs R-2 and R-3) and increased damage to the left wing components as compared to the right wing. The water table in this area was only seven feet below the surface. The portion of the crater, created by the crash, below seven feet would fill up with water, hampering evidence gathering efforts.

3. LIFE SUPPORT EQUIPMENT.

a. Ejection Seat. The Directorate of Material Management at

Kelly AFB, Texas, performed a laboratory analysis on components of the ACES II ejection seat. Based on macroscopic and microscopic physical evidence they determined no ejection attempt was made by the pilot and that the ejection seat was operational at the time of impact. No evidence of any escape system failure was found (Tabs J-11 through J-13).

b. Personal Survival Equipment. All inspections of the pilot's personal and survival equipment were current (Tabs O-2 through O-12). The Directorate of Material Management at Kelly AFB, Texas, performed a comprehensive series of studies on the recovered flight gear and survival equipment. From their investigation they determined that the pilot was in a conscious state and operating the flight controls at the time of impact. All evidence denoted the instantaneous demise of the pilot. There was no evidence of any personal or survival equipment failure (Tabs J-11 through J-13).

4. CRASH RESPONSE. The impact with the ground occurred at 8:50pm (1650Z) and was unobserved. This was determined by ground radar plot, when the element leader last confirmed the presence of his wingman, transcripts of radio transmissions (Tab N) and flight path reconstruction. After his initial approach, FIDO 27 returned to the location that he had last visual contact with FIDO 28, but was not able to locate him before he had to land. The 363 TFW Supervisor of Flying asked Al Dhafra's Approach Control to request the C-130 in the traffic pattern assist in locating FIDO 28. The C-130 crew agreed. About 10 minutes later they reported seeing a fire on the ground. A rescue helicopter responded from Bateen AB (Tab V-2). The helicopter first landed at Al Dhafra AB at roughly 9:30pm (1730Z) and picked up a pilot safety investigator and a flight surgeon to respond to the site. The crew then went direct to the impact site with the help of vectoring from Approach Control and the C-130 crew. The site was found without difficulty, and the helicopter landed nearby at roughly 9:50pm (1750Z) (Tabs O-14 and V-2). The crew verified that it was the sight of impact and that there was no survivor. This information was passed by radio to the 363 TFW command post (Tabs O-14 and V-2). Since the mishap site was in an isolated, unpopulated area of sandy desert, no attempt was made to dispatch fire fighting equipment. The small fires were allowed to burn out over night (Tab O-14).

5. MAINTENANCE AND MATERIEL.

a. Maintenance Documentation. A thorough review of the maintenance records revealed no discrepancies which were of a serious nature; i.e., could cause an accident. There were no overdue Time Compliance Technical Orders (TCTOs) nor Time Change Items (TCIs) (Tab H-7). Six scheduled inspections were overdue, but they were not the type which would cause or contribute significantly to an accident (Tab H-6). The AFTO Forms 781A were reviewed with no discrepancies noted (Tabs H-2, H-3 and U-2). The Joint Oil Analysis Program (JOAP) records were reviewed and showed no changes in wear level or abnormal trends in the engine while it was installed

in the mishap aircraft (Tab U-14). Sorties Maintenance Debriefing records for the past 10 days were also reviewed and showed nothing of a serious nature (Tabs U-16 through U-28).

b. Maintenance Personnel and Maintenance Supervision. The mishap aircraft received a preflight inspection at 0200 on the day of the mishap by a qualified crew chief (Tab H-8). The aircraft flew two combat missions and received an integrated combat turn-around (ICT) after each mission by qualified technicians (Tab H-8). The Exceptional Release (ER) was properly signed off by a qualified production superintendent prior to the aircraft's third sortie of the day, on which the mishap occurred (Tab U-7).

c. Fuel, Hydraulic and Oil Inspection Analyses. Although fuel, hydraulic, oil and LOX (liquid oxygen) samples were taken and analyzed, this investigation team was not able to find any formal documentation. However, the Chief Quality Assurance inspector for the Wing provided a memorandum for record (Tab J-14) attesting that no abnormalities were discovered in any of those samples.

d. Air Frame and Aircraft Systems.

(1) Engines. Analysis of the mishap aircraft's engine found no evidence of any damage or distress other than that caused by the crash impact. There were several indications that the engine was operating at a power setting between 80% and MIL power at impact (Tabs J-2 through J-6). The hydrazine tank gauge was captured at 95% (Tab J-9), which is the lower limit that a pilot can accept as "Full" prior to flight. Hydrazine would normally be depleted below 95% if an engine had failed, or if a major electrical or hydraulic problem had occurred, and the emergency power unit was operating.

(2) Instrument Systems. All instruments had sustained major crushing impact damage and were very fragmented. Capture marks on both attitude indicators showed the same pitch attitude (Tabs J-7 and J-8), indicating that both had electrical power and were probably operating at the time of impact. Further evidence to confirm that electrical power was on the aircraft was that the right wing tip light was illuminated at impact (Tab J-9). Its electrical source is not one that is maintained by emergency systems when a serious electrical problem occurs. Nothing was noted during the analysis of the recovered instruments that would indicate instrument or instrument system failure prior to impact (Tabs J-7 through J-9).

(3) Flight Controls and Related Systems. An analysis of flight control and hydraulic components was conducted by F-16 Mechanical Equipment Specialists at the Air Logistics Center, Hill AFB, Utah, to ascertain and document the position of flight control surfaces and whether the aircraft had hydraulic pressure at the time of impact (Tabs J-15 through J-17). All actuators recovered from the crash site were analyzed; these items included

the left flaperon integrated servo actuator (ISA), left and right horizontal tail ISAs, leading edge flap (LEF) power drive unit (PDU), LEF rotary actuators, LEF asymmetry brakes, and both flight control accumulators. The F-16 Mechanical Equipment Specialists concluded from the available evidence that there were no abnormalities apparent in the flight control and hydraulic systems at the time of the mishap (Tab J-17). The near stream-lined and identical positions of the horizontal tails (Tabs J-15 and J-16), the stream-lined position of the rudder (Tab J-16) and symmetrical LEF condition (Tab J-16) indicate that there was no commanded rolling motion on the aircraft at the time of the impact. The horizontal tail positions and the 4-degree LEF deflection (Tab J-16) indicate the aircraft was not performing a hard turn or pull-out maneuver when it impacted, as would be expected if the pilot realized he was about to strike the ground.

6. PILOT QUALIFICATIONS.

a. Qualification. Capt Cormier was current and fully qualified to fly the mission under investigation and had no discrepancies noted on his previous two checkrides (Tabs G-5 and G-6).

b. Flying Experience. Capt Cormier's flying experience is shown in this lifetime flight summary (Tabs G-2 and G-3):

Mission Pilot/First Pilot in the F-16	373.1
Instructor Pilot/First Pilot in the AT/T-38	<u>1312.1</u>
TOTAL PILOT	1685.2
Other (T-37)	1.3
Student Pilot	<u>196.3</u>
GRAND TOTAL	1882.8

He had opportunity to be quite proficient with the following sorties and hours flown in the previous 30/60/90 days (Tab G-3):

30 Day:	24 Sorties/84.4 Hours (all combat)
60 Day:	31 Sorties/103.2 Hours
90 Day:	44 Sorties/130.0 Hours

c. Training Deficiencies. No deficiencies in required training were noted.

d. Operations Supervision. No shortcomings in operations supervision were found.

e. Experience with Spatial Disorientation or G-Induced Loss of Consciousness (GLOC). There were no incidents of spatial disorientation or GLOC noted in Capt Cormier's medical (Tab X) or flying training records.

7. MEDICAL. Capt Cormier was medically qualified for flight at the time of the accident (Tab T-3). The toxicology report revealed no evidence of prescribed or illegal drugs or alcohol in the deceased (Tab X-2). The autopsy revealed no evidence of any

pre-existing disease (Tab X-2). The autopsy was not able to determine whether he was wearing his spectacles at the time of the mishap. However, a maintenance technician chief observed that when he got out of the cockpit to brief his final mission, Capt Cormier placed his spectacles on the HUD (head-up display), where they would be immediately available for flight (Tab V-24).

8. NAVIGATION AIDS AND FACILITIES. The TACAN (tactical air navigation) at Al Dhafra AB was certified on 16 Oct 90 and was not due another certification until 15 Oct 91 (Tab V-4). The ASLAR approaches to Runway 31 at Al Dhafra AB were never officially commissioned as done in the continental United States due to time constraints and lack of properly qualified personnel in theater. However, the ASLAR procedures were reviewed by both local and USCENTAF TERPS (terminal instrument procedures) specialists to ensure they met all US TERPS criteria, and were approved for use by the senior USAF operational commander at Al Dhafra. The ASLAR procedures were published in the 363 TFW Pilot Aid, dated 1 Dec 90, and the ASLARs had an effective date of 10 Dec 90 (Tab V-4). No pilot, nor other reports of navigation aid problems, were discovered during this investigation (Tab V-2).

9. DIRECTIVES AND PUBLICATIONS.

a. Publications and directives applicable to the mishap were:

- (1) AFR 51-37, Instrument Flying.
- (2) AFM 55-8, The US Standard Flight Inspection Manual.
- (2) AFR 60-1, General Flight Rules.
- (3) AFR 60-16, Flight Rules.
- (4) TACM 51-50, Tactical Aircrew Training.
- (5) TACR 55-116, F-16 Pilot Operational Procedures.
- (6) T.O. 00-20-1, Preventive Maintenance Programs General Policy Requirements and Procedures.
- (7) T.O. 00-20-5, Aircraft, Drone, Aircrew Training Devices, Engines and Air-Launched Missile Inspections, Flight Reports and Supporting Maintenance Documents.
- (8) T.O. 1F-16C-1, Flight Manual.
- (9) T.O. 1F-16C-1CL-1, Flight Manual Checklist.
- (10) 363 TFW Pilot Aid for Al Dhafra AB.

b. One minor deviation to AFR 60-16 was noted. Technically FIDO 27 did not intercept the published inbound course (060 degrees) at the initial approach fix (West) for the ASLAR/ILS

Approach to Runway 31 at Al Dhafra AB and did not have a parallel or intercept heading to that course prior to descending out of 6000 feet above mean sea level. The flight path flown was not unsafe in such clear weather and should have been easier to fly as a wingman because less turning was accomplished.

Donald W. Rupert

DONALD W. RUPERT, Lt Col, USAF
AFR 110-14 Accident Investigation Officer

1 Atch
Glossary

GLOSSARY

NOTE: Acronyms, jargon and terms are explained in the context in which they appear in this report. These definitions are not meant to be overly technical, may not be universal and may be limited to this report.

<u>ITEM</u>	<u>EXPLANATION</u>
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1Lt	Military rank of First Lieutenant in the pay grade of O-2.
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AB	Air Base.
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AFB	Air Force Base.
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AFM	Air Force Manual.
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AFR	Air Force Regulation.
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AFTO	Air Force Technical Order. "AFTO" usually precedes any Air Force aircraft maintenance documentation form, as in "AFTO Form 781A."
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AIS	Avionics Intermediate Station. The maintenance organization where line replaceable units or "aircraft black boxes" are repaired.
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"Alpha check" Normally a query by one flight member to another to compare bearing and range to a stated location. Often accomplished prior to commencing an instrument approach to identify possible navigational problems that may effect one's ability to safely fly an approach.

"Ammo"	Short for "ammunition." It includes bullets, bombs and missiles.
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ASLAR	Aircraft Surge Launch and Recovery. An instrument flight procedure designed to launch and recover large numbers of aircraft in the shortest amount of time as often required for combat operations.
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ATO	Air Tasking Order. These military orders to perform flight operations were provided daily by the Joint Force Air Component Commander in a specified format to all fixed-wing aircraft units flying in Operation Desert Storm.
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Capt	Military rank of Captain in the pay grade of O-3.
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CB	Circuit Breaker.
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ITEM EXPLANATION

"Code x" After a mission, the pilot reports the status of his aircraft as Code 1, Code 2 or Code 3. If the aircraft is Code 1, it has no discrepancies. If the aircraft is Code 2, it has one or more minor but flyable discrepancies. If the aircraft is Code 3, it has one or more major discrepancies and the aircraft cannot be flown until these problems are repaired.

CND Cannot Duplicate. Term used when a maintenance technician cannot duplicate a reported aircraft discrepancy.

"Decel Point" The place where the aircraft landing first in a 2-ship formation, which previously split up at the Drag Point, puts his landing gear down and slows to standard airspeed (180 knots for the F-16).

DETCO Detachment Commander. Officer in charge of operations at the forward operating location.

"Drag Point" The published location on an ASLAR approach where the aircraft landing second in a formation puts his landing gear down and slows to standard airspeed (180 knots for the F-16).

DTC Data Transfer Cartridge. A programmable cartridge, the size of a thick paperback book, that is capable of transferring flight planning, weapons and communications data from a mission support computer in an F-16 squadron to the aircraft. The pilot normally transfers the mission planning data after engine start and before takeoff.

ECM Electronic Counter Measures. Aircraft self protection from external electronic threats.

"Element" Two aircraft in formation with each other. One pilot is designated as the leader and the other as the wingman. Pilots must be specifically qualified to be an "element leader."

EOR End of Runway. The last place an aircraft receives a final "once over" by ground technicians to check for leaks and other malfunctions before taking off.

EPU Emergency Power Unit. An onboard emergency backup which provides emergency electrical and hydraulic power to the F-16 aircraft in the event of electrical, hydraulic or engine failure.

ER Exceptional Release. A signature in the aircraft forms made by a qualified aircraft maintenance officer or senior non-commissioned officer which releases the aircraft for flight.

FAF Final Approach Fix. The published location on an approach at which the final approach begins.

ITEM EXPLANATION

FAS Final Approach Speed. The published location on an ASLAR approach where all aircraft slow to their final approach airspeed.

FIDO Fighter Duty Officer. An fighter pilot who did mission planning duties as part of the mission planning cell.

"Fingertip" Also known as "close formation." The wingman flies on an angle of about 45 degrees back from his leader. If he flew straight forward to pass his leader, they would have 3 feet of wingtip clearance. This is the normal formation in clouds.

FL Flight Level. Expressed in hundreds of feet above sea level for a "standard" day; altimeter setting = 29.92.

FO Foreign Object. Any item which may be ingested by an aircraft engine causing damage.

FOD Foreign Object Damage.

FOL Forward Operating Location. An air base, other than the aircraft's main operating base, where limited or temporary operations occur. In combat, an FOL is closer to the area of operations than the main base.

"Frag" Short for "fragmentary portion of the air tasking order."

GS Ground Speed. Speed of an aircraft over the ground.

HEI High Explosive Incendiary. A type of bullet used in an aircraft's gun system which explodes and burns upon impact with a target.

"Hit the tanker" Pilot jargon for receiving fuel from an airborne tanker aircraft.

"Hot Pits" The area where aircraft are refueled with engines running and the pilot in the cockpit. The fuel for this operation is piped in from distant tanks.

HUD Head-Up Display. A see-through glass display on top of the F-16's instrument panel that allows the pilot to simultaneously look outside his aircraft and see key information projected on the combining glass. Information that can be displayed on the HUD includes aircraft airspeed, altitude, attitude (pitch and roll), target location, weapons aiming cues and radar lock-on data. All this data is also available on other instruments inside the cockpit with the exception of most weapons aiming cues.

.IAF Initial Approach Fix. The point at which an instrument approach begins.

ITEM EXPLANATION

ICT Integrated Combat Turnaround. A procedure used by maintenance technicians in combat which allows the aircraft to be refueled, serviced and uploaded with ordnance within minimum time, usually about 30 minutes. The procedure is done immediately following an aircraft's combat mission and allows the aircraft to fly another mission with minimal ground time.

ILS Instrument Landing System. Electronic system which provides the pilot with glideslope and course guidance to the landing runway.

INS Inertial Navigation System. A prime sensor for aircraft velocity, attitude and heading, and is a source of navigation information that is not dependent upon electronic transmissions from navigational aids.

INU Inertial Navigation Unit. The onboard computer which governs the aircraft's inertial navigation system.

ISA Integrated Servo Actuator. The mechanical device that uses hydraulic pressure to position a flight control surface to a commanded position.

JOAP Joint Oil Analysis Program. A program that directs an engine oil sample be taken after each aircraft mission and analyzed for abnormal amounts of various metals.

KKMC King Khalid Military City. A military base in north-eastern Saudi Arabia.

LEF Leading Edge Flap. The movable flight control surface on the leading edge of the F-16's wing that is automatically positioned by the flight control computers to an optimum position as a function of airspeed and angle of attack.

LOX Liquid Oxygen. The aircraft is serviced with LOX which is converted to gaseous oxygen for the pilot.

Lt Col Military rank of Lieutenant Colonel in the pay grade of O-5.

Lux A measure of light intensity. 1 lux = 1 lumen per square meter. 1 lux = 0.0929 foot candles.

Maj Military rank of Major in the pay grade of O-4.

MAJCOM Major Command. Normally commanded by a 4-star general.

MAP Missed Approach Point. The published location on an approach where the pilot must execute missed approach procedures if the runway is not in sight or if the aircraft is not in position to make a safe landing.

ITEM EXPLANATION

MAU-12 An F-16 pylon, which is bolted onto the aircraft and onto which bombs are loaded.

MFD Multifunction Display. Computer generated display system which can show weapons, radar and other aircraft data as selected by the pilot.

MK-82 Pronounced "Mark-82." A 500 pound, general purpose bomb.

MIL Military Power. 100% of aircraft engine power without use of afterburner.

MSgt Military rank of Master Sergeant in the pay grade of E-7.

MSL Mean Sea Level.

NAAR Night Air-to-Air Refueling.

NAVAID Navigational Aid. Normally refers to a facility of known location that transmits radio signals which are received by aircraft and can be used by aircrewmembers to determine geographic position.

P-1 Production Superintendent. The senior ranking non-commissioned officer who directs the aircraft maintenance production effort.

PDG Programmable Display Generator. The onboard computer which provides information to the multifunction displays.

PDU Power Drive Unit. The mechanical device that positions a flight control surface to a commanded position.

PRD Pilot Reported Discrepancy (on an aircraft).

RAPCON Radar Approach Control. A portion of the Air Traffic Control System that sequences the flow of aircraft from the enroute portion of their flight to the landing phase of flight. RAPCON is the facility that normally clears aircraft for instrument approaches to an airfield and provides vectors to aircraft for deconfliction.

"Redball" Short notice maintenance required immediately prior to takeoff.

"Route" A formation where the wingman flies about 45 degrees back from his leader and as close as two ship widths and as far out as 500 feet. Flexibility is designed into this formation to allow the wingman to perform normal cockpit duties without having to spend most of his concentration on maintaining an exact position.

RTB Return To Base. Normally refers to returning to one's deployed or home base.

<u>ITEM</u>	<u>EXPLANATION</u>
Sgt	Military rank of Sergeant in the pay grade of E-4.
SMS	Stores Management System. Aircraft computer program and display in the F-16 for management of onboard weapons.
SOF	Supervisor of Flying. Pilot on the ground in charge of flying operations.
"Sortie"	One aircraft mission involving flight.
SSgt	Military rank of Staff Sergeant in the pay grade of E-5.
TACAN	Tactical Air Navigation. A navigational aid at a known location that transmits bearing and distance information relative to itself. Aircrewmembers can read this information on instruments in military aircraft.
TACM	Tactical Air Command Manual.
TACR	Tactical Air Command Regulation.
TCI	Time Change Item. Any aircraft part that must be replaced after a determined number of hours, days, etc.
TCTO	Time Compliance Technical Order. Any aircraft system upgrade, change, improvement, etc., that must be completed by the determined grounding date.
TERPS	Terminal Procedures. Criteria by which instrument approaches are designed to avoid obstacles, insure adequate reception of navigational aid signals and provide sufficient room for aircraft to turn while flying a procedure, such as an instrument approach for landing.
TFS	Tactical Fighter Squadron.
TFW	Tactical Fighter Wing.
T.O.	Technical Order.
TOT	Time-Over-Target. Desired or required time to deliver weapons on a target or be in the given position to support others.
"Triple bang"	Pilot jargon for flying three times in one day.
UHF	Ultra High Frequency (Radio). Provides line-of-sight voice communication from 225.000 to 399.975 megahertz. In the F-16 this radio is nicknamed "Uniform."
US	United States
.USAF	United States Air Force

ITEM EXPLANATION

USCENTAF United States Central Command Air Forces. Sometimes shortened to CENTAF. Command in charge of coordinating and directing the use of coalition air power in Operation Desert Storm.

USCENTCOM United States Central Command. Sometimes shortened to CENTCOM. Command in charge of Operation Desert Storm.

VHF Very High Frequency (Radio). Provides line-of-sight voice communication from 116.000 to 151.975 megahertz. In the F-16 this radio is nicknamed "Victor" and also covers frequencies from 30.000 to 87.975 megahertz.