UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT

A-10C, T/N 81-0963

52d FIGHTER WING
SPANGDAHLEM, GERMANY

LOCATION: SPANGDAHLEM AIR BASE, GERMANY

DATE OF ACCIDENT: 1 APRIL 2011

BOARD PRESIDENT: COLONEL PETER F. DAVEY

Conducted IAW Air Force Instruction 51-503

EXECUTIVE SUMMARY
AIRCRAFT ACCIDENT INVESTIGATION
A-10C, T/N 81-0963
SPANGDAHLEM AIR BASE, GERMANY
1 APR 2011

On 1 Apr 2011, 1548L, the mishap aircraft (MA), an A-10C, tail number 81-0963, assigned to the 81st Fighter Squadron, 52nd Fighter Wing, Spangdahlem AB, Germany entered an unusual attitude. This occurred as the mishap pilot (MP) experienced spatial disorientation (SD) while flying in close formation on an instrument approach in the weather. The MP broke out of the weather, recognized the unusual attitude, attempted briefly to recover the MA, felt "ground rush" and ejected based on the unrecoverable parameters. The MA impacted at nearly 90 degrees nose low in a field just north of Laufeld, Germany. The MP ejected at roughly 600 ft above ground level (AGL), did not receive full parachute deceleration and sustained significant injuries. The MA was destroyed with loss valued at $16,172,753.06 with an undetermined environmental clean-up cost.

The mishap flight (MF) planned, briefed, and executed a practice instructor pilot upgrade (IPUG) sortie to include chasing instrument approaches for the MP. The MP moved from chase to close formation off the mishap wingman (MW) prior to the MF entering weather at 5500 ft Mean Sea Level on the instrument approach. For approximately two minutes thereafter, the MP flew a stable close formation, slightly wider than normal. At 14 miles the MF began a 30 degree turn to intercept the instrument landing system inbound course, changed radio frequencies to tower, and established a smooth shallow descent. Once established, the MF configured with speedbrake and gear. During this configuration change, the MP descended 80 ft below the lead aircraft, lost sight of the MW, and executed incomplete lost wingman procedures. The MA then began a left hand roll to 45 degrees of bank resulting in a 15 degrees nose low attitude. The MA paused momentarily, then continued to roll from 45 degrees to approximately 180 degrees inverted resulting in a 60 degrees nose low attitude exiting the weather at 1500 ft AGL. Since the MA impacted in a clean configuration, the MP de-configured the aircraft somewhere between initiation of lost wingman procedures and just prior to exiting the weather. The MP's immediate action to recover the MA upon exiting the clouds and timely ejection decision starkly contrasts with the aircraft's preceding pattern and indicates that the MP did not correctly sense the aircraft's attitude prior to exiting the clouds. Additionally, the MP had not flown on the wing in the weather in about a year. Flying on the wing in the weather commonly causes SD and can be compounded by maneuvering, radio frequency and configuration changes, and limited recent experience.

The accident investigation board (AIB) president found clear and convincing evidence that the cause of the mishap was human factor error. Specifically, the MP suffered from SD in the weather and entered an unusual and ultimately unrecoverable attitude. Additionally, the AIB president found by a preponderance of the evidence, that vision restricted by meteorological conditions, procedural error, and recency of experience were substantially contributing factors to the mishap.

Under 10 U.S.C. 2254(d), any opinion of the accident investigators as to the cause 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 the accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.

SUMMARY OF FACTS AND STATEMENT OF OPINION
A-10C, T/N 81-0963
1 APRIL 2011

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COMMONLY USED ACRONYMS AND ABBREVIATIONS

781	Aircrew/Mission Flight Data Document
3 AF	3rd Air Force
52 FW	52nd Fighter Wing
52 OG	52nd Operations Group
81 FS	81st Fighter Squadron
A1C	Airman First Class
ACBT	Air Combat Training
ACC	Air Combat Command
ACES II	Advance Concept Ejection Seat
ADAC	Allegmeiner Deutscher Automobil-Club
ADC	Area Defense Counsel
ADI	Altitude Direction Indicator
ADO	Assistant Director of Operations
AEF	Air Expeditionary Force
AF	Air Force
AFB	Air Force Base
AFI	Air Force Instruction
AFTO	Air Force Technical Order
AGL	Above Ground Level
AIB	Accident Investigation Board
AMU	Aircraft Maintenance Unit
AMXS	Aircraft Maintenance Squadron
ATC	Air Traffic Control
ATIS	Automatic Terminal Information System
BD	Battle Damage
BFM	Basic Flight Maneuvers
BMC	Basic Mission Capable
Capt	Captain
CAS	Close Air Support
CAT	Crisis Action Team
CMR	Combat Mission Readiness
Col	Colonel
Comm	Communication
CT	Continuation Training
DEROS	Date Eligible to Return From Overseas
DM	Davis Mothan
DME	Distance Measuring Equipment
DO	Director of Operations
ELT	Emergency Locator Transmitter
EOC	Emergency Operations Center
EPE	Emergency Procedure Evaluation
FAC	Forward Air Control
FAF	Final Approach Fix
FCF	Functional Check Flight
FS	Fighter Squadron
GCI	Ground Control Interception
HATF	High Altitude Tactical Formation
HARM	High Speed and a Radiation Missile
HFACS	Human Factors Analysis and Classification System
HUD	Head-Up Display System
HSI	Horizontal Situation Indicator
IAW	In accordance with
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IMDS	Integrated Maintenance Data System
IP P	Instructor Pilot
IPUG	Instructor Pilot Upgrade
L	Local Time
Lt Col	Lieutenant Colonel
MA	Mishap Aircraft
Maj	Major
MAJCOM	Major Command
MDS	Mission Design Series
MF	Mishap Flight
MOA	Military Operating Area
MP	Mishap Pilot
MW	Mishap Wingman
NAF	Numbered Air Force
NATO	North Atlantic Treaty Organization
NAVAIDS	Navigation Aids
NL	Nose Left
NOTAMs	Notices to Airmen
NVG	Night Vision Goggles
OBOGS	On Board Oxygen Generating System
OEF	Operation ENDURING FREEDOM
OG	Operations Group
OIF	Operation IRAQI FREEDOM
Ops	Operations
Ops Sup	Operations Supervisor
ORI	Operational Readiness Inspection
ORM	Operational Risk Management
OSS	Operations Support Squadron
OUP	Operations Unified Protector
PCS	Permanent Change of Station
PEX	Patriot Excalibur
PHA	Preventive Health Assessment
PIREP	Pilot Report
PLF	Parachute Landing Fall
RAP	Ready Aircrew Program
RMM	Removable Mass Memory Device
RTB	Return to Base
SEFE	Standardized Evaluation Flight Examiner
SEPT	Situational Emergency Procedure Trainer
SIB	Safety Investigation Board
Sim	Simulator
SOF	Supervisor of Flying
Sortie	Flight
Spatial-D	Spatial Disorientation
STAN	Standard
TACAN	Tactical Air Navigation
TAC Eval	Tactical Evaluation

TDY	Temporary Duty	U.S.C.	United States Code
TMA	Training Military Area	VIS	Visibility
T/N	Tail Number	VFR	Visual Flight Rules
TO	Technical Order	VMC	Visual Meteorological Conditions
URITS	USAFE Rangeless Interim	Vol	Volume
Training System		VVI	Vertical Velocity Indicator
USAF	United States Air Force	WOC	Wing Operations Center
USAFE	United States Air Force Europe		

The above list was compiled from the Summary of Facts, the Statement of Opinion, the Index of Tabs, and Witness Testimony (Tab V).

SUMMARY OF FACTS

1. AUTHORITY, PURPOSE, AND CIRCUMSTANCES

a. Authority

On 25 May 2011, Lieutenant General Stephen P. Mueller, Vice Commander, United States Air Forces Europe (USAFE), appointed the Board President, pursuant to Air Force Instruction (AFI) 51-503, to conduct an aircraft accident investigation of a mishap that occurred on 1 April 2011 involving an A-10C aircraft, tail number (T/N) 81-0963, at Spangdahlem Air Base (AB), Germany (Tab Y-3 to Y-4). The investigation was conducted at Spangdahlem AB, Germany, from 1 June 2011 through 24 June 2011. Technical advisors included a pilot member, medical member, legal advisor, maintenance member, and recorder (Tab Y-5 to Y-6).

b. Purpose

This is a legal investigation convened to inquire into the facts surrounding the aircraft or aerospace accident, to prepare a publicly-releasable report, and to gather and preserve all available evidence for use in litigation, claims, disciplinary actions, administrative proceedings, and for other purposes.

c. Circumstances

The accident board was convened to investigate the Class A accident involving an A-10C aircraft, T/N 81-0963, assigned to the 81st Fighter Squadron (81 FS), 52nd Fighter Wing (52 FW), Spangdahlem AB, Germany, which occurred during a training mission on 1 April 2011.

2. ACCIDENT SUMMARY

The mishap aircraft (MA), an A-10C, T/N 81-0963, departed Spangdahlem AB, Germany, at 1412 local time (L) (1212 Greenwich Mean Time or Zulu time (Z)) on 1 April 2011, to conduct a practice Instructor Pilot Upgrade (IPUG) air-to-air training mission. During return to base (RTB), at approximately 1548L, the aircraft entered an unusual attitude in the weather. Once breaking out of the weather, the mishap pilot (MP) was unable to recover the aircraft, and it impacted in a field just north of the village of Laufeld, Germany. The MP ejected at roughly 600 ft above ground level (AGL), did not receive full parachute deceleration and sustained significant injuries. The MA was destroyed upon impact; financial loss to the Air Force for the aircraft and installed items totaled $16,172,753.06 (Tab P-3). Additionally, expenses for environmental clean-up and damage to the field have yet to be determined.

3. BACKGROUND

The 81st Fighter Squadron (81 FS) owned the MA. The 81 FS is a squadron within the 52nd Operations Group (52 OG). The 52 OG is in turn a part of the 52 Fighter Wing (52 FW) and the 3rd Air Force (3 AF). 3 AF is a Numbered Air Force (NAF) within USAFE.

a. 52nd Fighter Wing

The mission of the 52 FW, located at Spangdahlem AB, Germany, is to support NATO and combatant command authorities. The 52nd FW maintains, deploys and employs fighter aircraft and theater airspace control capability and supports strategic mobility operations. The 52 FW consists of 5 groups: the 52nd Operations Group, the 52nd Maintenance Group, the 52nd Mission Support Group, the 52nd Medical Group, and the 52nd Munitions Maintenance Group (Tab CC-3 to Tab CC-4).

b. 52nd Operations Group

The 52 OG is prepared for worldwide mobilization and employment of two combat-ready fighter squadrons, one theater air control squadron and one multi-national radar threat training detachment in support of NATO commanders and US combatant authorities. It ensures war fighting capability with one operations support squadron. It is comprised of 550+ personnel, 42 F-16CJ and 18 A/OA-10 fighter aircraft, 2 TPS-75 radar units, and 10 threat simulators (Tab CC-6).

c. 81st Fighter Squadron

The mishap unit, the 81 FS also known as "the Panthers," boasts a proud record of flying nearly 70 years of distinguished flying in defense of America's interests abroad. The squadron flies the A-10C Thunderbolt II aircraft, the world's premiere close air support aircraft, affectionately known as the Warthog. The squadron deployed to Bagram Air Base, Afghanistan, in June 2003, September 2004, May 2006 and January 2008 to provide close air support to coalition ground forces supporting Operation ENDURING FREEDOM. During these deployments the Panthers performed an intensive regimen of combat patrols to find, fix and destroy elusive, guerilla-type enemy combatants in support of ground forces (Tab CC-8 to Tab CC-9).

d. A-10C Thunderbolt II

It was designed specifically for the close air support mission and had the ability to combine large military loads, long loiter and wide combat radius, which proved to be vital assets to the United States and its allies. The A-10 Thunderbolt II has excellent maneuverability at low air speeds and altitude, and is a highly accurate weapons-delivery platform. The aircraft can loiter near battle areas for extended periods of time and operate under 1,000-foot ceilings (303.3 meters) with 1.5-mile (2.4 kilometers) visibility. The wide combat radius and short takeoff and landing capability permit operations in and out of locations near front lines. The aircraft has participated in Operations Desert Storm, Southern Watch, Provide Comfort, Desert Fox, Noble Anvil, Deny

Flight, Deliberate Guard, Allied Force, Enduring Freedom, Iraqi Freedom, and Odyssey Dawn (Tab CC-11 to CC-12).

4. SEQUENCE OF EVENTS

a. Mission

The mishap mission was planned and briefed as a Basic Fighter Maneuvers (BFM) training flight to TMA-D, Dutch controlled airspace located in the southern portion of the Netherlands (Tab R-4). BFM training consists of one fighter aircraft attacking (or being attacked by) another fighter aircraft within visual range of each other at pre-determined parameters of airspeed, altitude and distance between the aircraft. The two-ship flight of A-10Cs was composed of the mishap pilot (MP), call sign Repo 01, and the mishap wingman (MW), Repo 02.

Although the mission was originally scheduled as a continuation training (CT) sortie, the Mishap Flight (MF) planned and executed the sortie as a "practice" IPUG for the MP (Tabs R-4, V-1.3 and V-2.2). The mission overview included all mission tasks normally accomplished on the BFM IPUG ride in the 81 FS syllabus, to include chased instrument approaches (Tabs R-4, V-1.3, V-2.5 and Z-4). Although the MP had not been entered into the IPUG program, the MW was a current and qualified IP who maintained supervision responsibilities throughout the mission (Tabs G-3, V-1.26 andV-2.2).

The 81 FS Director of Operation (DO) authorized the flight as a CT mission, but was unaware of the plan to conduct IPUG training (Tab K-7, R-40, and V-3.11 to V-3.12). The 81 FS/DO also served as the Operations Supervisor (Ops Sup) during the conduct of the mission (Tab V-3.3).

b. Planning

Repo 1 planned and briefed the mission as a "practice" IPUG (Tab R-4, V-1.3 and V-2.2). The 81 FS Ops Sup and Squadron Duty Officer (SDO) conducted a mass briefing for all pilots flying that morning at 1130L (R-4). The mass brief covered weather, NOTAMS, airfield status, an emergency procedure (EP) discussion, and an intelligence update (Tabs R-39, V-3.5). During the mass brief, the MP briefed the Ops Sup on the Operational Risk Management (ORM) factors for the flight with the risk rated as "Medium" for weather and changed airspace (Tabs V-1.27 and R-16). The MP did not brief the instructor training as a potential ORM factor (Tab R-45 and V-1.24).

The MP conducted the individual mission briefing using the 81 FS standard briefing guide for the administrative portion prior to talking to BFM instructional techniques (Tabs R-4, V-1.3 and V-2.4). During the brief, the MW briefed IP chase techniques for Traffic Pattern (TP) stalls, instrument approaches, and overhead patterns and discussed the potential for spatial disorientation when flying close in the weather (Tabs R-5, R-14 and V-2.5). The MP briefed unusual attitude procedures in detail and lost wingman procedures as standard, meaning that in case of lost wingman the flight would follow the procedures established in AFI 11-2A/OA-10 Volume 3 (Tab V-1.5, V-2.6).

c. Preflight

The Mishap Flight (MF) members met at the operations desk for a final update briefing on weather, potential divert locations, and airfield status (Tabs R-41, V-1.6, V-2.3 and V-3.5). Aircraft engine start and taxi to the arming area were uneventful. No problems of any kind were noted or observed on either of the two aircraft. (Tabs V-1.6, V-2.7)

The MA was configured with 1150 rounds of 30 mm Target Practice ammunition, two TGM-65's (training versions of the maverick air-to-ground missile), and an AN/ALQ-131 Electronic Counter Measure (ECM) pod (Tabs D-22, D-28 and P-3). Of note for the investigation, all aircraft were equipped with United States Air Forces in Europe (USAFE) Rangeless Interim Training System (URITS) pods. The URITS pod is similar in size and shape to an AIM-9 (small air-to-air missile). It is normally mounted under the right wing on the outer most pylon and captures precise aircraft flight parameters which are used to reconstruct aircraft maneuvers during mission debriefs. All airspeeds described in the mishap sequence are ground speed as determined from the URITS data.

d. Summary of Accident

The two A-10Cs took off twelve minutes behind schedule at 1412L and departed for TMA-D (Tab R-4). Departure to TMA-D was uneventful (Tabs R-4, V-1.6 and V-2.3). The BFM portion of the sortie was executed as briefed and was unremarkable (Tab R-4, V-1.6 and V-2.3). The planned series of chased Traffic Pattern (TP) stalls that followed the BFM was also unremarkable (Tabs R-5, V-1.6 and V-2.6 to 2.7). The MF ensured all switches were safe, conducted a battle damage check, and departed TMA-D (Tabs R-5, V-2.7). At this time, the MW turned off the aircraft recording device (Tab R-11). At 1540L, approximately 50 NM north of Spangdahlem, in vicinity of Norvenich AB, the MP passed the tactical lead to the MW and moved to chase position (Tab V-2.7).

The MW proceeded direct to the Initial Approach Fix (IAF) on a 197 degree heading for the ILS 23 approach at Spangdahlem (Tabs N-30 to N-31, R-5 and DD-5). Between 15:45:37L and 15:46:37L, in a descent from 5800 ft MSL to 5000 ft MSL, the MF entered the clouds (Tabs M-3, R-5, V-1.7 and V-2.3). Prior to entering the weather, the MW directed the MP to rejoin to a close formation (Tab V-1.8, V-2.3). At 15:46:32L, the MW began a 10-15 degrees banked turn to intercept the inbound course for the ILS, rolling out on final with a heading of 222 degrees (Tab DD-5). During this turn, the MF changed radio frequencies from approach control to Spangdahlem tower (Tabs N-30 to N-31, V-1.10 and DD-5). After roll-out, the MP moved to a slightly wide, but very stable, close formation with approximately 10 ft of wingtip clearance (Tab DD-5) for 40 seconds. During this time, the MP lost sight of the MW briefly due to the clouds, but immediately picked up visual and continued the approach (Tab V-1.10).

At 15:47:40L, the MA descended 12-15 ft in relation to the MW and stabilized for 5 seconds (Tab DD-5). Between 15:47:47L and 15:47:55L, the MA descended 80 ft below the MW and slowed from 230 kts to 200 kts (Tab DD-5). This correlates to the MW's direction to configure the aircraft (Tabs R-5, V-2.3). The MW was able to visually confirm that MA was configured with speed brakes and gear, but unable to verify the flaps prior to the MW losing sight of the MA (Tab R-8). At that point, the MP lost sight of the MW and paused a second prior to making the

lost wingman call (Tab 1.11). At 15:47:55L, the MP transmitted the lost wingman call on tower frequency (Tab N-7 to N-8). The MA then rolled to 10-15 degrees of bank and maintained that bank angle for 5 seconds (Tab DD-5). This approximates the beginning of the expected lost wing procedure for straight and level flight, "simultaneously inform the leader and turn away using 15 degrees of bank for 15 seconds, then resume heading and obtain separate clearance (AFI 11-2A/OA-10 Vol 3)." During this turn the MA continued to descend to 3800 ft MSL and slow to 193 kts (Tab DD-5).

Approximately two to three seconds after the MP's "lost wingman" call the MW transmitted, "Two's continuing the approach. Clean up and climb (Tab R-10)." Per AFI 11-2A/OA-10V3, "The flight leader should acknowledge the lost wingman's radio call and transmit attitude, heading, altitude, airspeed and other parameters as appropriate." The MW failed to make this radio call and it is unknown if the mishap pilot heard the "clean up and climb" call (Tab V-1.11). After this, the MW made one additional attempt to contact the MP and got no response (Tab R-5). Assuming that the MP had pushed to approach frequency to get a separate clearance, the MW made no further attempt to contact the MP until after completing the approach (Tab R-6).

Five seconds after entering the 15 degree bank, and approximately 2-3 seconds after the MW's radio transmission, the MA rolled out of the bank and continued a slight descent for about 5 seconds to an altitude of 3700 ft MSL (Tab DD-5). The MA continued to slow throughout the descent (Tab DD-5). At 15:48:06L, the MA started a slow left hand roll, reaching approximately 45 degrees in two seconds, then paused for two seconds at 45 degrees of bank and approximately 15 degrees nose low at 3500 ft MSL and 173 kts (Tab DD-5). It is unknown at what point the MA was deconfigured, but the slow airspeed in the descent indicates that the gear was probably down or in the process of being raised just prior to this roll. In the next three seconds, the MA's roll rate increased significantly and the aircraft rolled from 45 degrees of left bank to 180 degrees inverted (Tab DD-5). During this roll, the MA's nose sliced down to 60 degrees nose low at 3000 MSL and the MA entered an unrecoverable position (Tabs DD-5, FF-3).

At 15:48:13L the MA emerged from the clouds inverted, 60 degrees nose low, at 200 kts and approximately 1500 ft AGL which equates to 2900 ft MSL (Tabs F-15 DD-5). The MP immediately experienced "ground rush" and made an initial attempt to pull to the horizon, placing the aircraft in a 90 degrees nose low position (Tabs V-1.12, DD-5). The MP assessed that the aircraft would not recover from the dive and, at 15:48:15L, released the stick to eject (Tabs V-1.12, DD-5).

e. Impact

The MA impacted a grass field, at the crest of a gently sloping ridgeline, just north of the village of Laufeld at 15:48:18L (Tabs R-6, S-3, and S-7). The MA impacted the ground at an angle of 90 degrees nose low, on a heading of 047, at an estimated airspeed of 230 knots, and in a clean configuration with gear and flaps up and speed brakes closed (Tabs H-5, J-10 to J-11 and S-7).

f. Life Support Equipment, Egress and Survival

At 15:48:16L, the MP initiated the ejection sequence approximately 600 ft AGL, just 1.5 seconds prior to MA impact (Tabs DD-3, EE-8). The estimated MA parameters at the time of ejection

placed the ejection within the MA's Advanced Concept Ejection Seat (ACES) II envelope for Mode I ejection (Tab H-12). In Mode I, the seat drogue shoot does not deploy, reducing the time required for the personnel recovery shoot to deploy and inflate (Tab H-4). Using the data acquired from the URITS pod, a simulation on the ejection sequence was performed. The simulation showed that recovery time was marginal (approximately 2 seconds from pulling handle to impact with ground) with the MP landing less than 50 meters from the impact crater (Tab H-9, H-15). The simulation indicated that the pilot did not get full deceleration from the parachute (Tabs H-15, EE-8 to EE-10). Fire damage to the parachute also showed that the parachute canopy was still in the reefed (non-inflated) configuration at the time of exposure to the aircraft explosion on impact, further indicating that the MP did not get full deceleration (Tab H-21).

During the ejection sequence, the aft canopy link shear actuator failed resulting in the canopy not cleanly departing the aircraft (Tab H-15). However, the canopy tore free of the aircraft and did not interfere with the rest of the ejection sequence (Tab H-15). Additionally, the MP's personal locator beacon (PLB) power was extremely low during transmission (Tab H-37). The MW was only able to hear the PLB when within two nautical miles of the crash site and no Air Traffic Control (ATC) agency was able to hear the beacon (Tab V-2.13 to V-2.14).

g. Search and Rescue (SAR)

Several residents of Laufeld witnessed the crash and contacted the local emergency response agency immediately (Tabs R-68, R-70, and R-72). A number of residents went to the aid of the MP despite the fact that the wreckage was burning close by (Tabs H-9, R-72 and R-74). The first two residents on scene found the pilot laying on his right side with the parachute still connected to the harness (Tab R-72, R-74). They cut the parachute lines and harness to disconnect the MP from the parachute and remained with the pilot until professional help arrived (Tab R-72, R-74).

A helicopter sponsored by the German auto-club ADAC, responded to the call for assistance and was on site within 5-6 minutes of notification (Tabs R-66, V-3.8). The ADAC physician noted that the MP was complaining of pain in his shoulder and back, but was able to move all four extremities on command (Tab R-64). Due to the fear of secondary explosions from the crash site, the medical aircrew immobilized the MP quickly, remaining on the ground for only 5-8 minutes (Tab R-66). The MP was medically evacuated to the regional hospital in Trier (Tab R-64, R-66).

After flying another instrument approach to get below the weather, the MW proceeded to the crash scene to begin the SAR effort (Tab V-2.4, V-3.7). At 16:07L, the MW informed ATC about the impact point location on ten mile final and the tower controllers began their emergency checklist (Tabs N-21, V-2.4 and V-4.5). By this time, a Laufeld fire truck was already at the crash site and the ADAC helicopter was en route (Tab V-2.4 and V-2.13). The MW took a mark to capture the coordinates of the crash site, informed ops of the position and, after seeing the MP loaded into the helicopter, returned to land (Tab V-2.4).

h. Recovery of Remains

Not applicable.

5. MAINTENANCE

a. FORMS DOCUMENTATION

A detailed review of active and historical Air Force Technical Order (AFTO) Form 781 series aircraft maintenance forms revealed no discrepancies indicating engine, mechanical, or flight control anomalies existing on the MA (Tab D-5 to D-117). A thorough review of the active AFTO 781 forms and AFTO 781 historical records for the time period 90 days preceding the mishap revealed no evidence of mechanical, structural, or electrical failure (Tab D-5 to D-117).

The Integrated Maintenance Data System (IMDS) historical records for 90 days prior to the mishap were used to validate and confirm all form entries (Tab U-7 to U-70). None of the open Time Compliance Technical Orders (TCTOs) in the active forms restricted the MA from flying (Tabs D-119 to D-120, U-3). TCTO compliance did not contribute to the accident.

b. INSPECTIONS

A review of the AFTO 781K forms and IMDS indicated all required inspections were completed as scheduled or not yet due (Tabs D-5 to D-19, U-7 to U-70).

c. MAINTENANCE PROCEDURES

Review of the MA's AFTO 781 series forms and IMDS revealed all required maintenance actions were in compliance with standard operating procedures (Tabs D-5 to D-117, U-7 to U-70). There is no evidence that maintenance procedures to the MA were relevant to the mishap.

d. MAINTENANCE PERSONNEL AND SUPERVISION

A detailed review of all pertinent maintenance training records revealed no discrepancies that contributed to the mishap. All personnel had adequate training and experience (Tab U-71 to U-814).

e. FUEL/HYDRAULIC/OIL INSPECTION ANALYSIS

Fuel samples from the fuel truck used to defuel the MA were tested and passed six days prior to the mishap (Tab D-121 to D-122, D-127 to D-128). Hydraulic fluid testing analysis from the MA was not available. Joint Oil Analysis Program (JOAP) records indicate both engines were code Alpha, a designation given when there is no adverse negative trending analysis evident that would halt continued flying operations (Tab U-5 to U-6). There is no evidence to indicate that fluids were relevant to the mishap.

f. UNSCHEDULED MAINTENANCE

Review of AFTO 781 series forms and IMDS revealed three routine in flight operational checks of training munitions, none of which were relevant to the mishap (Tab D-27 to D-28).

g. AIRCRAFT AND AIRFRAME

1). Attitude Director Indicator (ADI). The ADI tends to retain the pitch and roll indications existing upon loss of electrical power. All other indications are easily changed as a result of impact forces. The ADI was almost completely destroyed by impact damage. The sphere and roll gimbal were captured by impact in a position that correlated to left wing down approximately 15 degrees and nose down 90 degrees (Tab J-3).

2). Standby Attitude Indicator. The design of the indicator is such that it can continue to operate for up to nine minutes after loss of electrical power due to the inertia of its self-contained gyro. This indicator sustained crushing impact damage and was extremely fragmented. Only the pitch drum and part of the roll gimbal were received for analysis. Impact marks on the drum correlated to a pitch reading of approximately 80 degrees nose down. No roll reading could be obtained (Tab J-3).

3). Horizontal Situation Indicator (HSI). The HSI employs a high-ratio gear mechanism to position the numerous presentations. It will retain most indications existing upon loss of electrical power. The HSI was almost completely destroyed by impact damage. The compass card was captured by impact at approximately 070 degrees. The course window tapes appeared to have been indicating either 227 or 237 degrees at the time of impact. No other readings could be obtained (Tab J-3).

4). Altimeter. The design of the altimeter is such that unless immediate capture of the drum readout occurs, the presentation can change as a result of impact forces. The altimeter was almost completely destroyed by impact damage. The drum readout was captured by impact in a position that correlated to 1,700 ft. The barometric pressure setting could not be determined (Tab J-4). Nothing was noted during this analysis that indicated instrument system failure prior to impact or loss of input signal (Tab J-4).

5). Landing Gear. The physical evidence suggests that all three landing gear were in the up and locked position at the point of impact (Tab J-5, J-6, J-11).

6). Primary Flight Controls. The physical evidence suggests that all primary flight controls were working properly and all mechanical components were properly secured. With the roll and pitch in neutral surface positions (Tab J-6 to J-11).

7). Secondary Flight Controls. The physical evidence suggests that all secondary flight controls were working properly and all mechanical components were properly secured. The slats and flaps were in the retracted position. The speed brakes were in the retracted close position (Tab J-10 to J-11).

8). On Board Oxygen Generator System (OBOGS). A thorough review of maintenance history of the OBOGS revealed no abnormalities or adverse trends. OBOGS malfunction or contamination is not related to the mishap (Tab U-12).

6. WEATHER

a. Forecast Weather

The Spangdahlem AB weather forecast included on the mission execution forecast for 1 Apr 2011 was valid from 0700L to 0500L on 2 Apr 2011 (Tab F-7). It predicted a broken layer of clouds at 700 ft and an overcast layer at 1,500 ft. From 1400L to 1500L the clouds were forecast to become scattered at 1,500 ft (Tab F-7). The term "scattered" means clouds cover less than 50% of the sky, and "broken" refers to cloud layers that cover more than 50% of the sky. The visibility was forecast to be unlimited all day (Tab F-7). The winds were forecast to be from 230 degrees (approximately southwest) at 10 knots changing to 220 degrees at 5 knots starting at 1400L (Tab F-7). The forecast weather in TMA-D called for broken layers from 1,100 to 3,000 ft, unlimited visibility, and flight level winds at 10,000 ft were forecast to be from 270 degrees (the west) at 40 knots (Tab F-8).

b. Observed Weather

On Spangdahlem AB, at 1544L, the winds were from 230 degrees (approximately southwest) at eleven knots with a broken layer of clouds at 1,600 ft, an overcast layer of clouds at 2,100 ft and unlimited visibility. The MW observed the base of the clouds at 1,500 ft AGL and the tops of the clouds at approximately 5,500 ft MSL (Tab V-2.3, V-2.7). By 1602L, the clouds were reported as overcast at 1,700 ft (Tab F-4).

c. Space Environment

Not applicable.

d. Operations

Weather was within operational parameters.

7. CREW QUALIFICATIONS

a. Training

The MP is a fully qualified 2-ship flight lead (Tab G-3). The MP performed his most recent mission qualification check in the A-10C on 3 December 2010 and completed his instrument qualification check on 20 January 2010 (Tab G-20). The MP was not formally in the IPUG program, but was described as "ready" by both the MW and DO to progress through a modified 4-ship flight lead upgrade program and IPUG (Tab V-2.22, V-3.14, and V-3.16). The MW was an IP who had supervision responsibilities during this "practice" IPUG sortie (Tab V-1.26, V-2.2).

The MP and MW were non-current in both formation approach and formation landing (Tabs G-13 and MP, V-2.19, V-2.24). Prior to the mishap, "formation approach" currency did not even appear on the currency tracking sheet posted in the squadron for mission planning (Tab V-3.21). However, the MF considered the two currencies to be "tied" to one another and recognized that they were out of "formation approach" currency due to also being out of "formation landing" currency (Tab V-1.21, V-2.24). These currencies were not required for the MF's plan to penetrate the weather in close, then immediately move back to a chase position (Tab V-1.5, V-2.5). All other flight currencies were up-to-date and all required training for the planned mission was current in-accordance with AFI 11-2A/OA-10, Volume 1, *Flying Operations, A/OA-10 Aircrew Training* dated 31 August 2006 (Tab G-13 to G-14).

b. Experience

The MP is a Senior Pilot with 1518.4 hours of pilot time, with 815.6 hours in the A-10A/C, and an additional 498.7 hours of navigator time as a B-52 Electronic Warfare Officer (Tabs G-4, G-5, G-7, and V-1.2). In a previous A-10 assignment the MP attained a 4-ship flight lead qualification (Tab V-3.15). Since returning to the A-10C on 7 November 08, the MP flew 92 sorties for 179.7 hours, with 38.7 hours of primary instrument time, but had yet to regain his 4-ship flight lead qualification (Tab G-4). The MP's last flying assignment was from May 2003 to June 2006 flying F-117s and T-38s (Tab G-4). The MP logged 502.6 total flight hours in the F-117, including 55.9 hours as a flight instructor and 17.3 hours as an evaluator (Tab G-5).

The MP had flown six sorties in the previous 30 days (Tab G-7). The MP flew his latest sortie on 15 March 2011, two weeks prior to the mishap (Tab G-24).

The MP's flight time during the 90 days before the mishap is as follows:

	Hours	Sorties
Last 30 Days	12.1	6
Last 60 Days	18.7	10
Last 90 Days	22.9	12

(Tab G-7)

8. MEDICAL

a. Qualifications & Health

At the time of the mishap, the MP was fully medically qualified for flight duty without medical restrictions or waivers (Tab X-3). The MP's most recent flight physical on 23 Mar 2011 determined he was medically qualified for flight duties and qualified for worldwide military duty. Additionally, the MW and other ground maintenance crew members were medically qualified for duty at the time of the mishap (Tab X-3). Physical and medical qualifications were not factors in the mishap. The 72-hour/14-day histories of the MP, MW, and associated maintenance crew members revealed that all individuals were in good health and had no recent performance-limiting issues prior to the mishap (Tab X-3).

b. Pathology

Immediately following the mishap, commanders directed toxicology testing for all personnel involved in the flight and the launch of the MA. Blood and urine samples were submitted to the Armed Forces Medical Examiner System (AFMES) for toxicological analysis. This testing included carbon monoxide and ethanol levels in the blood and drug testing of the urine. Carboxyhemoglobin saturations of zero to three percent are expected for non-smokers and three to ten percent for smokers. Saturations above ten percent are considered elevated and are confirmed by gas chromatography. The carboxyhemoglobin saturation in the MP's blood was less than one percent (normal), as determined by spectrophotometry (Tab X-4). Testing was also performed on the MW and associated crew members and maintainers. All results were normal (Tab X-4). AFMES examined the blood for the presence of ethanol at a cutoff of twenty milligrams per deciliter. AFMES detected no ethanol in the MP's blood. Ethanol results were also negative for the MW and associated maintenance crew members (Tab X-4). Furthermore, AFMES screened the MP's, MW's, and maintenance crew members' urine for amphetamine, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates and phencyclidine by immunoassay or chromatography. AFMES detected none of these drugs in the MP, MW or associated crew members and maintainers (Tab X-4).

c. Lifestyle

There is no evidence that unusual habits, behavior or stress on the part of the MP, MW, or maintenance crew members contributed to this accident (Tab X-4). Review of 72-hour histories of the MP, MW, and pertinent maintenance crew members, revealed no lifestyle factors, including unusual habits, behavior or stresses which were causal or substantially contributory to the mishap (Tab X-4).

d. Crew Rest and Crew Duty Time

Air Force Instructions require pilots have proper "crew rest," as defined in AFI 11-202,Volume 3, *General Flight Rules*, 22 October 2010, prior to performing in-flight duties. AFI 11-202 defines normal crew rest as a minimum 12-hour non-duty period before the designated flight duty period (FDP) begins. During this time, an aircrew member may participate in meals, transportation, or rest as long as he or she has the opportunity for at least eight hours of uninterrupted sleep. A review of the duty cycles of the MP and MW leading up to the mishap indicated that both had adequate crew rest (Tab X-4). Both the MP and MW complied with the crew rest and duty day requirements on the day of the mishap. Fatigue was not indicated and is not a factor in this mishap.

9. OPERATIONS AND SUPERVISION

a. Operations

In the month prior to the mishap, the 81 FS executed a short notice deployment in support of operations in Libya (Tab V-2.14, V-3.3). However, in the week prior to the mishap, the ops

tempo had stabilized for the members of the squadron still remaining at Spangdahlem (Tab V-2.14, V-3.17). In the four months prior to the mishap, the MP functioned as the 52 FW Chief of Safety (Tab V-1.2). In that capacity the MP was not assigned within the 81 FS, but flew as an "attached" flyer. Due to the MP's position in the wing, he was not directly involved in the squadron's preparation for deployment and described his work level as "business as usual" (Tab V-1.18, V-3.17).

b. Supervision

The mishap sortie was scheduled and authorized by the 81 FS/DO as a CT BFM mission (Tabs K-7, R-39). The day prior to the flight, the MP asked the MW to conduct the sortie as a "practice" instructional BFM ride (Tab V-1.26, V-2.2). The MW agreed to supervise this additional training and the MP planned the sortie to replicate the BFM sortie in the 81 FS IPUG syllabus to include chasing instrument approaches (Tab V-1.26, V-2.2). The MW assumed that all pilots were regularly flying on the wing in the weather and was not aware that the MP had not flown on the wing in weather in "close to a year" (Tab V-1.20, V-2.15). Neither the MP nor the MW informed the DO, who was also acting as Ops Sup, of the additional training planned for the sortie and it was not briefed to the Ops Sup as part of the flight's ORM factors (Tab V-1.5, V-2.6 and V-3.11 to V-3.12).

10. HUMAN FACTORS

The board evaluated human factors relevant to the mishap using the analysis and classification system model established by the Department of Defense (DoD) Human Factors Analysis and Classification System (HFACS) guide, implemented by Air Force Pamphlet (AFPAM) 91-204, *USAF Safety Investigations and Reports,* dated 24 September 2008 (Tab BB-1). A human factor is any environmental, technological, physiological, psychological, psychosocial, or psycho-behavioral factor a human being experiences that contributes to or influences his performance during a task. The DoD has created a framework to analyze and classify human factors and human error in mishap investigations.

The framework is divided into four main categories: Acts, Preconditions, Supervision, and Organizational Influences. Each category is further subdivided into related human factor subcategories. The main categories allow for a complete analysis of all levels of human error and how they may interact together to contribute to a mishap. This framework allows for evaluation from the unsafe acts that directly are related to the mishap through the indirect preconditions, supervision, or organizational influences that may have led to the mishap. The relevant factors to this mishap are discussed below.

a. Acts: *those factors that are most closely tied to the mishap, and can be described as active failures or actions committed by the operator that result in human error or an unsafe situation.*

1) Procedural Error *Procedural error is a factor when a procedure is accomplished in the wrong sequence or using the wrong technique or when the wrong control or switch is used. This also captures errors in navigation, calculation or operation of automated systems*

(Tab BB-1). According to paragraphs 7.7.1.1 and 7.7.3 of AFI11-2A-OA-10V3, dated 11 February 2002, a lost wingman will "simultaneously inform the leader and turn away using 15 degrees of bank for 15 seconds, then resume heading and obtain separate clearance." URITS pod data indicates that the MP did a 15 degree bank but only held it for approximately 5 seconds (Tab DD-5). The action by the MP limited the mitigating effects inherent to this lost wingman procedure, specifically, to help the pilot recover the aircraft through a transition to a basic instrument crosscheck.

The second aspect to the above AFI deals with the flight lead's responsibilities, which are to "acknowledge the lost wingman's radio call and transmit attitude, heading, altitude, airspeed and other parameters as appropriate" so the lost wingman can base his "lost wingman procedure on the flight lead's transmitted parameters" (Tab BB-1). Testimony shows that the flight leader, the MW, acknowledged the lost wingman's radio call by stating "Two is continuing the approach, clean up and climb" but did not state attitude, heading, altitude, airspeed or any other parameters (Tab R-5, V-2.4). That was MW's last directive to the MP (Tab V-2.4, R-5). Clear direction given by the flight lead is key in reestablishing the lost wingman's proper flight parameters.

b. Preconditions: *those factors in a mishap if active and/or latent preconditions such as conditions of the operators, environmental or personnel factors affect practices, conditions or actions of individuals and result in human error or an unsafe situation.*

1). Vision Restricted by Meteorological Conditions *Vision Restricted by Meteorological Conditions is a factor when weather, haze, or darkness restricted the vision of the individual to a point where normal duties were affected* (Tab BB-1). Interviews and weather data indicate vision was severely restricted as the weather was "pretty thick." (Tabs R-5, F-4). The MW further described the weather as "very thick" and that it was approximately from 5500 ft AGL to 1500 ft AGL (Tab V-2.7, R-5). In addition, the MW reported seeing the MP "disappear momentarily" and then reappear in position only to "disappear momentarily" again due to the "thick" weather (Tab V-2.3, R-5). Since vision is the key primary sensory system in spatially orientation, restricted vision environments often cause pilots to base their spatial orientation on less accurate systems such as the vestibular (inner ear) and somatosensory (seat-of-the-pants) systems. This can lead to an increase in a pilot's susceptibility to spatial disorientation.

2). Spatial Disorientation *Spatial Disorientation is a failure to correctly sense a position, motion, or attitude of the aircraft or of oneself within the fixed coordinate system provided by the surface of the earth and the gravitational vertical* (Tab BB-1). Prior to entering the weather and for nearly two minutes thereafter, the MP flew in a stable fingertip close formation off the MW's aircraft. Approaching the IAF on a 14 mile final the MF began a 30 degree turn to intercept ILS inbound course and established a smooth shallow descent. During this turn the MF changed radio frequencies to tower. After flying on the wing for nearly two minutes the MP configured his gear and speedbrake, and subsequently descended 80 ft below the lead aircraft. At 15:47:5L, the MP called lost wingman and started banking left 15 degrees for only 5 seconds, after which he rolled out for 5 seconds (Tab DD-5). At that time the MP was at 3700 ft AGL and began a left hand roll to 45 degrees of bank resulting in a 15 degrees nose low attitude. The MP paused briefly and continued to advance the roll from 45 degrees to

approximately 180 degrees, becoming inverted with a 60 degrees nose low pitch attitude (Tab DD-5). At this point, after losing approximately 800 ft of altitude, the MP exited the weather at 1500 ft AGL. The MP de-configured the MA at some point between his lost wingman call and exiting the weather as evidenced by the aircraft impacting in a clean configuration. URITS pod evidence suggests that the MP de-configured after the 45 degree left bank (Tab DD-5).

Upon exiting the weather the MP was clearly aware of his attitude and immediately attempted to recover altitude by pulling back on the controls. The MP stated that at the moment he flew out of the clouds he immediately noticed the aircraft to be "pointed down" and that he "instinctively" pulled back on the stick as he was "trying to bring the nose back up" (Tab V-1.12, V-1.16). The pilot's immediate aggressive action to recover the aircraft upon exiting the clouds and timely ejection decision contrasts starkly with the aircraft's preceding pattern. This clearly indicates the pilot did not correctly sense the attitude of the aircraft prior to exiting the clouds (Tab DD-5). It should be noted that flying on the wing in the weather is a very common cause of spatial disorientation.

Several other predisposing factors may have increased the MP's susceptibility to spatial disorientation. According to the MP, he had limited recent experience flying on the wing in weather, having not performed this in close to a year (Tab V-1.20). The MW was also not certain when the MP last flew on the wing of another aircraft in weather (Tab V-2.15). Flying on the wing in the weather is a specific maneuver which commonly causes spatial disorientation, and if minimally practiced will require even greater concentration on the part of a pilot. A second set of issues are the potentially distracting actions which the MP had to carry out within a narrow timeframe, such as staying on the wing of his flight lead, maneuvering his aircraft following the lost wingman call, changing his radio frequency, and changing aircraft configuration (Tabs V-1.5, DD-5, V-2.4, V-2.3). Also, the continually changing attitude of the MA may have had a strong impact on the MP's vestibular system (Tab DD-5). When a pilot loses visual reference as happened in this case to the MP, vestibular references become very strong. If not recognized and confirmed with instrumentation, a pilot can be very easily lulled into trusting the vestibular system which can quickly lead to spatial disorientation.

11. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Primary Operations Directives and Publications

1. Air Force Instruction (AFI) 11-2A/OA-10, Volume (Vol) 1, A/OA-10—*Aircrew Training*, 31 August 2006
2. AFI 11-2A/OA-10, Vol 2, A/OA-10—*Aircrew Evaluation Criteria*, 16 November 2005
3. AFI 11-2A/OA-10, Vol 3, A/OA-10—*Operations Procedures*, 11 February 2002,
4. AFI 11-202, Vol 3, *General Flight Rules,* 22 Oct 2010
5. AFI 51-503, *Aerospace Accident Investigations,* 26 May 2010
6. AFI 91-204, *Safety Investigations and Reports*, 24 September 2008

Maintenance Directives and Publications

1. AFI 21-101, *Aerospace Equipment Maintenance Management*, 1 June 2004

NOTICE: The AFIs listed above are available digitally on the AF Departmental Publishing Office internet site at: **http://www.e-publishing.af.mil**.

b. Known or Suspected Deviations from Directives or Publications

There are no known or suspected deviations from directives or publications by crew members or others involved in the mishap mission apart from those discussed in paragraph 10-A.

ADDITIONAL AREAS OF CONCERN

No additional areas of concern contributed to this aircraft accident.

28 June 2011

PETER F. DAVEY, Colonel, USAF
President, Accident Investigation Board

STATEMENT OF OPINION
A-10C, T/N 81-0963 ACCIDENT
1 APR 2011

Under 10 U.S.C. 2254(d), any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report, if any, may not be considered as evidence in any civil or criminal proceeding arising from the accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.

1. OPINION SUMMARY

On 1 Apr 2011, the MF planned, briefed, and executed a practice IPUG sortie to include chasing instrument approaches for the MP. The sortie was uneventful until just after the lead change in which the MP assumed chase position off the MW. At approximately 1546L, the MP flew his A-10C, T/N 81-0963, from chase to close formation prior to the MF entering weather at 5500 ft MSL on the instrument approach. After flying on the wing in the weather for nearly two minutes, the MP lost sight of the lead aircraft, initiated lost wingman procedures, and ultimately ended in an unusual attitude as the MP experienced spatial disorientation. At about 1548L the MP broke out of the weather at approximately 1500 ft AGL with the aircraft in an inverted 60 degrees nose low attitude. The MP recognized the unusual attitude, attempted briefly to recover the aircraft, but quickly felt "ground rush" and ejected based on the unrecoverable aircraft parameters. The aircraft impacted at nearly 90 degrees nose low in a clean configuration in a field just north of the village of Laufeld, Germany and was completely destroyed. The MP ejected at roughly 600 ft AGL, did not receive full parachute deceleration, landed 2 seconds later 50 meters away from the MA, and received significant injuries.

The AIB developed sufficient evidence to reach several conclusions using a combination of witness interviews, in-flight recorded data, technical analyses reports, simulator recreations, and other relevant documents. The AIB studied the training and personnel records of all personnel directly involved in the mishap and the MA's maintenance records, focusing on every maintenance action taken on the MA in the 90 days prior to the mishap. The AIB's medical advisor reviewed medical histories, toxicology data, and explored the roles of human factors. The AIB considered all plausible theories based on the evidence and reached the following conclusions. I find by clear and convincing evidence that the cause of the mishap was human factor error. Specifically, the MP suffered from Spatial Disorientation in the weather and entered an unusual and ultimately unrecoverable attitude.

2. DISCUSSION OF OPINION

a. Cause
Spatial Disorientation

Based on a thorough analysis of the URITS video reconstruction and the MP testimony, I determined that the MP experienced Spatial Disorientation as defined by DOD HFACS as

"a failure to correctly sense a position, motion, or attitude of the aircraft or of oneself within the fixed coordinate system provided by the surface of the earth and the gravitational vertical." I ruled out all other plausible explanations by a thorough review of all available data and conclude that the aircraft was mechanically sound, there were no dangerous weather phenomena present such as lightening, hail, etc., and no extenuating medical factors.

Prior to entering the weather and for approximately two minutes thereafter, the MP flew a stable close formation, slightly wider than normal off the MW. Approaching the IAF on a 14 mile final the MF began a 30 degree turn to intercept the ILS inbound course, changed radio frequencies to tower, and established a smooth shallow descent. Once established, the MF configured with speedbrake and gear. During this configuration change, the MP descended 80 ft below the lead aircraft. At 15:47:55, the MP called "lost wingman," banked left 15 degrees for only 5 seconds and rolled out for 5 seconds. At that time, the MA was at 3700 ft AGL and began a left hand roll to 45 degrees of bank resulting in a 15 degrees nose low attitude. The MA paused momentarily and continued to roll from 45 degrees to approximately 180 degrees inverted resulting in a 60 degrees nose low pitch attitude, exiting the weather at 1500 ft AGL. Since the MA impacted in a clean configuration, the MP de-configured the MA between initiation of lost wingman procedures and exiting the weather. Evidence suggests that the MP de-configured during the 45 degree left bank. Upon exiting the weather, the MP became aware of his attitude and immediately attempted to recover by pulling back on the controls. The pilot's immediate aggressive action and timely ejection decision contrasts starkly with the MA's preceding pattern and indicates the pilot did not correctly sense the attitude of the aircraft prior to exiting the clouds. Flying on the wing in the weather is a common cause of spatial disorientation and can be compounded by aircraft maneuvering, radio frequency changes and aircraft configuration changes. Due to the MP's limited recall, specific spatial disorientation classification is not possible with the existing evidence.

b. Contributing Factors

I find by a preponderance of evidence that Vision Restricted by Meteorological Conditions, Procedural Error, and Recency of Experience substantially contributed to the mishap.

1. Vision Restricted by Meteorological Conditions

During recovery, the MF entered a thick cloud deck with poor visibility at approximately 5500 ft MSL, extending to 1500 ft AGL. Prior to entering the cloud deck the MP moved from a chase position to a close position on the wing in order to maintain sight of the lead aircraft due to decreased visibility. Since the MP had to concentrate on the lead aircraft while flying formation, he had limited time to cross-check his own instruments and had no visible horizon. Though this is a routine required skill, it still sets the conditions that led to the spatial disorientation.

2. Procedural Error—Lost Wingman Procedures

The MF did not fully execute the Lost Wingman procedures found in AFI 11-2A/OA-10 Vol 3:

"In any lost wingman situation, immediate separation of aircraft is essential. Upon losing sight of the leader or unable to maintain formation due to spatial

disorientation (SD), the wingman will simultaneously execute the applicable lost wingman procedures while transitioning to instruments and inform the flight lead."

The lost wingman procedure for wings level flight (climb, descent, or straight and level) is to:

"*simultaneously inform the leader and turn away using 15 degrees of bank for 15 seconds, then resume heading and obtain separate clearance.*"

The MP held the 15 degrees of bank for only 5 seconds before rolling out. This procedure is designed to separate the aircraft, but also transition the pilot back to a basic instrument scan and crosscheck, so that he can orient his aircraft off of the ADI. This basic skill of flying instruments helps minimize the effects of Spatial Disorientation.

During a lost wingman procedure, the flight leader:

"*should acknowledge the lost wingman's radio call and transmit attitude, heading, altitude, airspeed and other parameters as appropriate. Wingman will base lost wingman procedure on the flight lead's transmitted parameters (use caution observing published terrain clearance limits). Flight leads will be directive to ensure aircraft separation as required by the situation.*"

After the "*Lost Wingman*" call, the MW stated, "*Two's continuing the approach. Clean up and climb.*" It is unclear if the MP heard this call, and if so, whether the call diverted his attention from establishing an active instrument cross-check scan to changing configuration. Though the MW acknowledged the MP's "*lost wingman*" call, he used non-standard procedures, never transmitted his attitude, heading, altitude, or airspeed, and was not directive for the situation in the MP's absence of communications until after completing his own approach.

3. Recency of Experience

The MF planned and briefed for the MP to chase the MW on an instrument approach, assume the close position in order to penetrate the weather, and return to chase when clear of the weather. The MP and MW were out of "formation approach" currency. The MF was not flying a "formation approach" with the intent of a formation landing or low approach. However, flying on the wing configured at slow speed while penetrating thick clouds requires the same skill sets. The MW offered chase instruction techniques and highlighted the dangers of spatial disorientation, but he was unaware that the MP had not flown on the wing in the weather in close to a year. Due to the weather conditions at Spangdahlem, most pilots recover on separate vectors to an instrument approach. Though the MP had overall flying recency and flew an unremarkable sortie to that point, his lack of recent experience of flying on the wing in the weather affected his proficiency to maintain the correct formation position while configuring the aircraft, correctly execute Lost Wingman procedures, and combat the effects of spatial disorientation.

PETER F. DAVEY, Colonel, USAF
President, Accident Investigation Board