UNITED STATES AIR FORCE AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

MC-12W, T/N 09-0676

361ST EXPEDITIONARY RECONNAISSANCE SQUADRON
451ST AIR EXPEDITIONARY WING
KANDAHAR AIRFIELD (KAF), AFGHANISTAN

LOCATION: USCENTCOM AOR
110 NM NORTHEAST OF KAF

DATE OF ACCIDENT: 27 APRIL 2013

BOARD PRESIDENT
BRIGADIER GENERAL DONALD J. BACON

CONDUCTED IAW AIR FORCE INSTRUCTION 51-503

EXECUTIVE SUMMARY

AIRCRAFT ACCIDENT INVESTIGATION

MC-12W, T/N 09-0676
110 NM NORTHEAST OF KANDAHAR AIRFIELD, AFGHANISTAN
27 APRIL 2013

On 27 April 2013, at approximately 1243 local time (L) in Afghanistan, an MC-12W, tail number 09-0676 impacted terrain 110 nautical miles northeast of Kandahar Airfield (KAF) while on a combat intelligence, surveillance, and reconnaissance (ISR) mission. The four crewmembers on board were the Mishap Mission Commander (MMC), Mishap Pilot (MP), Mishap Sensor Operator (MSO), and Mishap Tactical Systems Operator (MTSO). The four airmen were killed instantly on impact and the Mishap Aircraft (MA), valued at $19.8 million, was destroyed. The crew and MA were deployed to the 361st Expeditionary Reconnaissance Squadron, 451st Air Expeditionary Wing, KAF, Afghanistan.

The four aircrew were highly respected airmen and combat veterans with 4,845 combat flying hours and 836 combat sorties between them. The MMC, who had 1,749 flying hours, was assigned to Scott Air Force Base (AFB), Illinois as an aircraft commander in the KC-135, and was on temporary duty with the MC-12W program. The MP, who had 2,434 flying hours, was newly assigned to Beale AFB, California as a new MC-12W mission commander and had extensive combat experience in the EC-130H from his previous assignment. The MSO, who had 3,147 flying hours, was assigned to Tinker AFB, Oklahoma as an instructor air surveillance technician in the E-3, and was on temporary duty with the MC-12W program. The MTSO, who had 1,494 flying hours, was assigned to Beale AFB, California and had extensive combat experience in the MC-12W and other tactical ISR aircraft.

The MA, callsign Independence 08, departed KAF at 1157L and entered orbit at 1229L. The MA encountered deteriorating weather in the orbit and was climbing from 20,000 to 23,000 feet mean sea level (MSL) at 1241L to fly above the weather when the mishap occurred. In addition, the crew had found an enemy combatant and was in the process of adjusting their orbit to enhance mission success. The board president found, by clear and convincing evidence, the cause of the mishap was a stall due to insufficient airspeed, while in a climbing left turn, which developed into a left spin followed quickly by a left spiral, from which the crew was unable to recover. Additionally, the board president found, by a preponderance of evidence, each of the following three factors substantially contributed to the mishap: (1) orbit weather that impeded visibility and masked the horizon; (2) pilot inexperience in the MC-12W; and (3) known MC-12W program risks associated with sustaining required combat capability in theater. The MC-12W program accepted increased risk with mitigation measures and enabled the capture or killing of over 700 high value enemy combatants, while improving over-watch surveillance for coalition ground forces.

Under 10 U.S.C. § 2254(d) the opinion of the accident investigator 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.

SUMMARY OF FACTS AND STATEMENT OF OPINION
MC-12W, T/N 09-0676
27 APRIL 2013

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COMMONLY USED ACRONYMS AND ABBREVIATIONS

9 RW — 9th Reconnaissance Wing
9 RW/CC — 9th Reconnaissance Wing Commander
12 AF — Twelfth Air Force
361 ERS — 361st Expeditionary Reconnaissance Squadron
361 ERS/CC — 361st Expeditionary Reconnaissance Commander
361 ERS/DO — 361st Expeditionary Recon- -naissance Squadron Director of Operations
427 RS/CC — 427th Reconnaissance Squadron Commander
427 RS/DO — 427th Reconnaissance Squadron Director of Operations
489 RS/CC — 489th Reconnaissance Squadron Commander
451 AEW — 451st Air Expeditionary Wing
451 EAMXG/CD — 451st Expeditionary Aircraft Maintenance Group Deputy Commander
A1C — Airman First Class
ABM — Air Battle Manager
AC — Air Conditioner
ACC — Air Combat Command
ACGU — Australia, Canada, Great Britain, United States
AD — Airworthiness Directive
ADB — Aircraft Discrepancy Book
ADI — Attitude Direction Indicator
ADO — Assistant Director of Operations
AEF — Air Expeditionary Forces
AESG — Aeronautical Systems Group
AEW — Air Expeditionary Wing
AF — Air Force
AFB — Air Force Base
AFCENT — Air Forces Central Command
AFE — Aircrew Flight Equipment
AFI — Air Force Instruction
AFIP — Air Force Institute of Pathology
AGE — Aerospace Ground Equipment
AGL — Above Ground Level
AHRS — Attitude Heading Reference System
AHS — Attitude Heading System
AIB — Accident Investigation Board
AM — Aircraft Mechanic
AO — Area of Operation
AOA — Angle of Attack
AOR — Area of Operation
ARMS — Aviation Resource Management System
ASD — Average Sortie Duration
ATC — Air Traffic Control
ATIS — Advanced Technical Information System
ATO — Air Tasking Order
ATP — Airline Transport Pilot
AUX — Auxiliary
BDOS — Beale Deployment One Stop
BLOS — Beyond Line of Sight
BOG — Boots On Ground
C — Celsius
CAE — CAE Inc. (formerly Canadian Aviation Electronics)
CAS — Close Air Support
CAOC — Combined Air and Space Operations Center
CARs — Corrective Action Reports
CC — Commander
CM — Crew Member
CMR — Combat Mission Ready
CO — Cryptological Operator
CRC — Control and Reporting Center
CRM — Crew Resource Management
CT — Continuation Training
CVR — Cockpit Voice Recorder
DNIF — Duties Not to Include Flying
DoD — Department of Defense
DO — Director of Operations
DOT — Director of Training
DOX — Director of Operations: Plans
EO/IR — Electroptic/Infrared
EP — Emergency Procedure
EPA — Environmental Protection Agency
ERS — Expeditionary Reconnaissance Squadron
ESIS — Electronic Stand by Instrument System
ETMPL — Equipment Technical Manual-Project Liberty
FAA — Federal Aviation Administration
FAR — Federal Aviation Regulations
FCF — Functional Check Flight
FCIF — Flight Crew Information File
FL — Flight Level
FLCH — Flight Level Change
FLCS — Flight Control System
FM14/MC — Freedom 14 Mission Commander
FMC — Fully Mission Capable
FMV — Full Motion Video
FO — Foreign Object
FOB — Forward Operating Base
FOV — Field of View
fpm — Feet Per Minute
FPS — Fire Protection System
FRC — Fault Reporting Codes
FS — Fighter Squadron
FSI — Flight Safety Incorporated
FSR — Field Service Representative
ft — Feet

FTU	Flying Training Unit
G or g	Gravitational Force
GAF	Ground Assault Force
GPS	Global Positioning System
GPU	Ground Power Unit
HAF	Helicopter Assault Force
HBC	Hawker Beechcraft
HFACS	Human Factors Analysis and Classification System
HUD	Head-Up Display
HQ	Headquarters
IA	Inspection Authorization
IAW	In Accordance With
IED	Improvised Explosive Device
IFE	In-flight Emergency
IFF	Identification Friend or Foe
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
IMIS	Integrated Maintenance Information System
INS	Inertial Navigation System
IP	Instructor Pilot
IPUG	Instructor Pilot Upgrade
(m)IRC	Internet Relay Chat
IFIS	Integrated Flight Information System
IR	Infrared
ISAF	International Security Assistance Force
ISB	Interim Safety Board
ISOPREP	Isolated Personnel Report
ISR	Intelligence Surveillance Reconnaissance
IQT	Initial Qualification Training
JA	Judge Advocate
JDOC	Joint Defense Operations Center
JPED	Joint Personal Effects Depot
JTAC	Joint Terminal Air Controller
K	Thousand
KAF	Kandahar Airfield
KCAS	Knots Calibrated Airspeed
KTAS	Knots True Airspeed
kts	Knots
L	Local Time
LN	Local National
LWD	Left Wing Down
M	Million
MA	Mishap Aircraft
MAJCOM	Major Command
MC	Mishap Crew
MDS	Mission Design Series
MEF	Mission Execution Forecast
METAR	Meteorological Aviation Routine Weather Report
MFD	Multi-Function Display
MID	Mission Integrated Systems Division
mIRC	Internet Relay Chat
MMC	Mishap Mission Commander
MOA	Military Operating Area
MP	Mishap Pilot
MR	Mission Readiness
MSCT	Multi-Source Correlation Tracker
MSL	Mean Sea Level
MSO	Mishap Sensor Operator
MTSO	Mishap Tactical Systems Operator
MQT	Mission Qualification Training
MWS	Major Weapons System
MXM	Maintenance Mechanic
NAF	Numbered Air Force
NCD	No Computed Data
ND	Nose Down
NOAA	National Oceanic Atmospheric Administration
NIPRnet	Non-Classified Internet Protocol Router Network
NM	Nautical Miles
NOTAMs	Notices to Airmen
OEM	Original Equipment Manufacturer
OG	Operations Group
OI	Operation Instruction
OPFOR	Opposing Force
Ops	Operations
Ops Tempo	Operations Tempo
ORM	Operational Risk Management
OS	Operations Supervisor
OSC	On Scene Commander
OSHA	Occupational Safety and Health Administration
OSS	Operations Support Squadron
P	Pilot
PA	Public Affairs
P-factor	Propeller Factor
PARs	Performance Assessment Reports
P&W	Pratt and Whitney
PAO	Poly-alpha-olefin
PC	Pyramid Controller
PCS	Permanent Change of Station
PFD	Pilot Flight Display
PHA	Physical Health Assessment
PIREPS	Pilot Reports
PMP	Packaged Maintenance Plan
POH	Pilot Operating Handbook
POL	Petroleum, Oil, And Lubricant
PPEF	Performance Plan Evaluation Form
PR	Personnel Recovery
PSI	Pounds Per Square Inch
QA	Quality Assurance
QAE	Quality Assurance Evaluator
QASP	Quality Assurance Surveillance Plan
QCP	Quality Control Program
RAP	Ready Air Crew Program
RED HORSE	Rapid Engineer Deployable Heavy Repair Squadron Engineers
RM	Roommate

ROZ	Restricted Operations Zone
RPL	Required Proficiency Level
RPMs	Revolutions Per Minute
RSTA	Reconnaissance, Surveillance, and Target Acquisition
RW	Reconnaissance Wing
SA	Situational awareness
SARM	Squadron Aviation Resource Management
SAR	Search and Rescue
SB	Service Bulletin
SELO	Standardization Liaison Officer
SIB	Safety Investigation Board
SII	Special Interest Item
Sim/SIM	Simulator
SIPRnet	Secret Internet Protocol Router Network
SKL	Secure Key Loader
SM	Site Manager
SNP	Student Non-Progress
SO	Sensor Operator
SOC	Squadron Operations Controller
SOE [sic SOP]	
SOP	Standard Operating Procedure
SOF	Supervisor of Flying
SPECI	Special Meteorological Report
SPIN	Special Instruction
TAC	Tactical Air Controller
TAF	Terminal Aerodrome Forecast
TAR	Training Activity Report
TBR	Time Between Removal
TCAS	Traffic Coalition Avoidance System
TCU	Towering Cumulous
TDF	Tactical Data/Digital Facsimile
TDY	Temporary Duty Assignment
TIC	Troops In Contact
T/N	Tail Number
TO	Technical “Tech” Order
TOC	Tactical Operations Center
TOD	Tech Order Data
TR	Transition Rides
TSO	Tactical Systems Operator
TTP	Tactics Techniques and Procedures
ULN	Unit Line Number
UPT	Undergraduate Pilot Training
USAF	United States Air Force
USCENTCOM	United States Central Command
UXO	Unexploded Ordinance
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VP	Viper Pilot
VPP	Voluntary Protection Program
VSI	Stall Speed in a Given Configuration
VSS	Video Select Switch
WAG	Wild Guess
WXFL/CC	Weather Flight Commander
WOM	Word of Mouth
Z	Zulu/Greenwich Mean Time

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 AND PURPOSE

a. Authority

On 29 April 2013, General Hostage, Commander, Air Combat Command (ACC) appointed Brigadier General Donald J. Bacon to conduct an aircraft accident investigation of the 27 April 2013 mishap of an MC-12W aircraft, tail number (T/N) 09-0676, 110 miles northeast of Kandahar Airfield (KAF), Afghanistan. The aircraft accident investigation was conducted in accordance with Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*. The Accident Investigation Board (AIB) President went to KAF shortly after the mishap to observe the mishap site, and the AIB convened at Beale Air Force Base (AFB), California, from 6 June 2013 through 3 July 2013. Also appointed were a legal advisor, maintenance member, pilot, flight surgeon, physiologist, recorder, and a reporter (Tab Y-9). The 645th Aeronautical Systems Group (AESG) Commercial Derivative Projects Chief Engineer, a Project Liberty Program Manager, a weather specialist, a Federal Aviation Administration (FAA) safety inspector, and an MC-12W sensor operator were appointed as functional area experts to assist the board (Tabs Y-13 and Y-17).

b. Purpose

This is a legal investigation convened to inquire into the facts surrounding the aircraft 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.

2. ACCIDENT SUMMARY

On 27 April 2013, at approximately 1243 local time (L), the mishap aircraft (MA), an MC-12W "Liberty," T/N 09-0676 assigned to the 361st Expeditionary Reconnaissance Squadron (361 ERS), 451st Air Expeditionary Wing (451 AEW), crashed in a deserted area 110 miles northeast of KAF during an Intelligence, Surveillance and Reconnaissance (ISR) mission (Tabs Q-6, DD-47, and DD-52). The crew was killed on impact (Tab X-3 to X-4). The mishap crew (MC) consisted of the Mishap Mission Commander (MMC), the Mishap Pilot (MP), the Mishap Sensor Operator (MSO), and the Mishap Tactical Systems Operator (MTSO) (Tabs X-3 and DD-59). The mishap aircraft (MA) was destroyed with the loss valued at $19.8M (Tab P-3). After recovery operations, the remaining wreckage was destroyed in place for security reasons (Tab DD-55). There were no civilian injuries, and there was no damage to private property (Tab P-2).

3. BACKGROUND

The 9th Reconnaissance Wing (9 RW) located at Beale AFB, California, owned the MA (Tab Q-7). The 9 RW and its subordinate units are components of Twelfth Air Force (12 AF), which is a numbered air force (NAF) within ACC (Tab Q-7). The MA was operated by the

361 ERS, which falls under the 451 AEW (Tabs Q-7, and CC-15 to CC-17). Both the 361 ERS and 451 AEW are located at KAF, Afghanistan (Tabs CC-13, CC-15, and CC-17).

a. Air Combat Command (ACC)

ACC is the primary force provider of combat airpower to America's warfighting commands. To support global implementation of national security strategy, ACC operates fighter, bomber, reconnaissance, battle-management, and electronic-combat aircraft. It also provides command and control, communications and intelligence systems, and conducts global information operations. ACC organizes, trains, equips and maintains combat-ready forces for rapid deployment and employment while ensuring strategic air defense forces are ready to meet the challenges of peacetime air sovereignty and wartime air defense (Tab CC-3).

b. Twelfth Air Force (12 AF)

Headquarters 12 AF is located at Davis-Monthan AFB, Tucson, Arizona. Twelfth Air Force is one of four numbered air forces assigned to ACC. It provides combat ready forces to ACC, and trains and equips ten combat wings and one RED HORSE squadron. Additionally, 12 AF is responsible for the operational readiness of twenty 12 AF-gained units in the Midwestern United States (Tab CC-7).

c. 9th Reconnaissance Wing (9 RW)

The 9 RW is located at Beale AFB, California, and is responsible for providing national and theater command authorities with timely, reliable, high-quality reconnaissance products. To accomplish this mission, the wing is equipped with the nation's fleet of U-2, MC-12W, and RQ-4 reconnaissance aircraft and associated support equipment. The wing also maintains a high state of readiness in its expeditionary combat support forces for potential deployment in response to theater contingencies (Tabs CC-11 and CC-21).

d. 451st Air Expeditionary Wing (451 AEW)

The 451 AEW, located at Kandahar Airfield, Afghanistan, provides a persistent and powerful airpower presence in the Afghanistan area of operations, to include tactical airlift, close air support, ISR, command and control, airborne datalink, combat search and rescue, casualty evacuation and aeromedical evacuation capabilities whenever and wherever needed (Tab CC-13).

e. 361st Expeditionary Reconnaissance Squadron (361 ERS)

The 361 ERS was activated on 1 May 2010 and is located at Kandahar Airfield, Afghanistan. The 361st flies the MC-12W "Liberty" and provides real-time tactical ISR, with analysts and aircrew deployed together for seamless operations in support of counter-insurgency efforts. The unit has been instrumental in the capture or elimination of more than 4,000 individuals and continues to fly the highest sortie rates of any manned aircraft in the Air Force Inventory (Tabs CC-15 and CC-17).

f. MC-12W

The MC-12W "Liberty" is a medium-to-low-altitude, twin-engine turboprop aircraft. It is a militarized version of the Hawker Beechcraft Super King Air 350 and 350ER. The aircraft provides manned ISR support directly to ground forces. The MC-12W is not just an aircraft, but a complete collection, processing, analysis and dissemination system. A fully operational system consists of a modified aircraft with sensors, a ground exploitation cell, line-of-sight and satellite communications datalinks, along with a robust voice communications suite. The aircraft is equipped with an electro-optical infrared (EO/IR) sensor and other sensors as the mission requires. The MC-12W system is capable of worldwide operations (Tab CC-23).

(1) Relevant Operational Limitations at the Time of Mishap (Tab DD-9).

Maximum Speed in Smooth Air ....245 knots/.58 Mach (whichever occurs first)
Design Maneuvering Speed ....182 knots
Emergency Descent Speed..........................182 knots
Turbulent Air Penetration Speed ....170 knots
Minimum Airspeed for Sustained
Flight in Icing ....140 knots
Air Minimum Controllable Speed ....101 knots, with flaps up
Stall speed at maximum gross weight.........99 knots (King-Air 350, non-ISR modified)
Maximum acceleration limits ....3.01 /-1.21 G's with flaps up
Normal on-station orbit speed.....................130 +10/-5 knots (Tab V-5.5)

(2) MC-12W Pilot Instrumentation

The Mishap Aircraft was fitted with the Rockwell Collins Pro Line 21 system, a fully-integrated "Glass Cockpit" avionics system that is designed to address a wide range of aircraft and missions (Tabs BB-33 to BB-39 and DD-56). The pilot instrumentation consists of three separate displays: a Pilot Flight Display (PFD) for each pilot, and a centrally-located Multi-Function Display (MFD). The MC-12W Mission Commander's PFD is visible during takeoff and landing; however, it is covered by a monitor throughout the "mission employment" phase of flight. In order to control the aircraft during mission employment, the Mission Commander (right seat) flies referencing the Pilot (left seat) instrumentation (see Figure 1). This is known as flying "cross-cockpit." For this reason, the Pilot is the typically the primary operator of the flight controls throughout the mission. (Tabs Z-5 and DD-56).

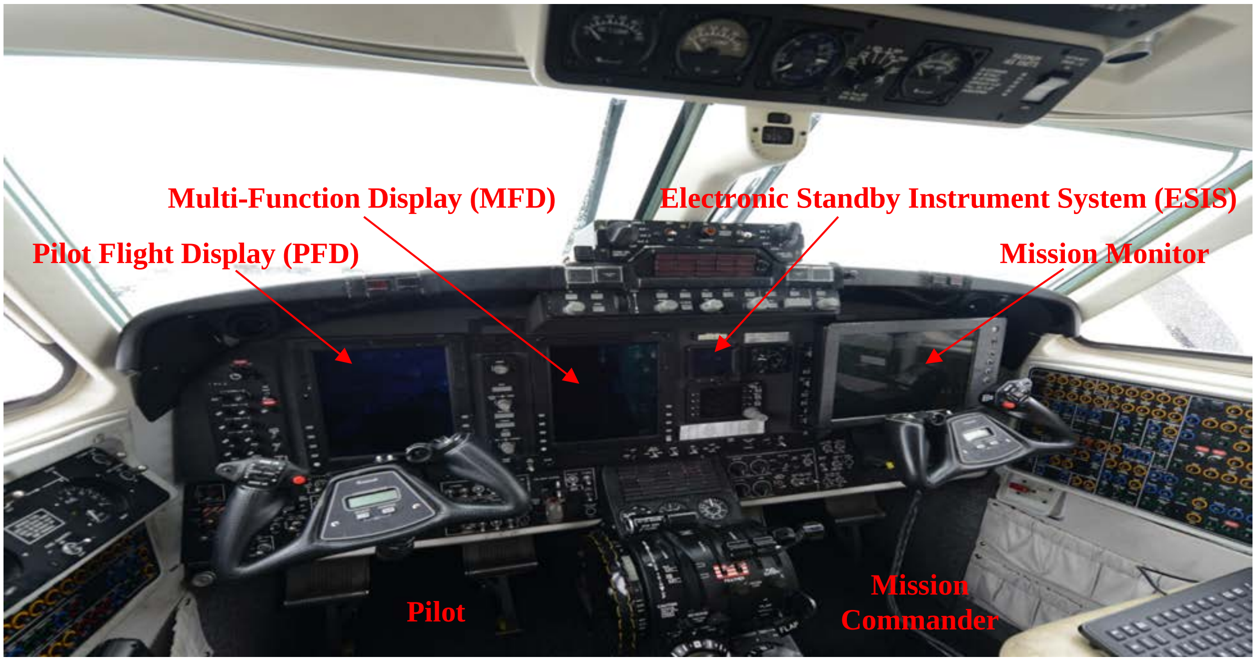

Figure 1. MC-12W Cockpit (Tab Z-5)

g. Crew Positions

Mission Commander. The Mission Commander is ultimately responsible for the safe and effective employment of the aircraft, the overall success of the mission, and meeting the Supported Unit's objectives. The Mission Commander will delegate tasks to the Pilot, Sensor Operator, and Tactical Systems Operator as needed to optimize mission execution (Tab BB-42). The Mission Commander occupies the right seat of the MC-12W cockpit, and is equipped with a workstation consisting of a mission monitor and keyboard. The mission monitor covers the right side Primary Flight Display during all phases of flight except takeoff and landing (Tabs Z-5 and DD-56). As the Mission Commander qualification is a higher-level certification than the Pilot, all Mission Commanders are inherently authorized to fly in the left seat (Pilot) position, and assume Pilot responsibilities while in that position (Tab DD-56).

Pilot. The Pilot is responsible for navigation and aircraft performance in order to optimize employment of mission sensors. Additionally, the Pilot assists the Mission Commander in aircraft deconfliction and coordination (Tab BB-42). The Pilot occupies the left seat of the MC-12W cockpit (Tab DD-56).

Sensor Operator. The Sensor Operator is primarily responsible for executing the Full Motion Video (FMV) tasking provided by the Supported Unit. Tasks include adjusting Field of View (FOV), zoom level, focus, polarity, and sensor modes for the sensor ball. Additionally, the Sensor Operator manages mission radios, line-of-sight datalinks, and beyond line of sight (BLOS) datalinks (Tab BB-42). The Sensor Operator is seated in the cabin area just aft of the wing, on the left hand side.

Tactical Systems Operator. The Tactical Systems Operator is responsible for executing all Special Intelligence taskings, and is seated in the aft cabin area on the right hand side.

h. Stalls

An aerodynamic stall is a condition in which the angle of a wing compared with the relative air movement about the wing exceeds a critical value. In other words, there is a critical angle wherein smooth airflow separates from the top of the wing. This results in a significant, abrupt decrease in lift. Generally, an aircraft will stall at a lower speed with power applied, and a higher speed if the engines are at idle. Though the MC-12W is equipped with a stall warning horn and stalls can be detected by a noticeable increase in "deck angle" and buffeting, they may also occur with little or no warning (Tabs V-23.4 to V-23.6 and DD-56). Turbulence varies the angle of attack of an aircraft wing as it moves through the air mass. Increased turbulence can make the aircraft more susceptible to stalling (Tab DD-31). Stall recovery technique is dependent on aircraft configuration, but generally involves reducing the wing's angle of attack, increasing airspeed, and regaining and maintaining coordinated flight. The MC-12W program uses published King Air 350 stall speeds since there are no stall speeds published specifically for the MC-12W (Tab DD-56).

i. Spins

A spin is an aerodynamic phenomenon that occurs when one wing enters a more pronounced stall than the other wing. The preconditions of a spin are stall and yaw. If yaw is introduced to a stalled aircraft, one wing will be placed in a deeper stall condition than the other. This causes the aircraft to autorotate towards the deeper-stalled wing. A spin is characterized by high angle of attack, low indicated airspeed, and a high rate of descent (Tab DD-56).

The recovery procedure, per the Pilot Operating Handbook (Tab BB-22):

SPINS

> Intentional spins are prohibited. If an intentional spin is encountered, perform the following procedure IMMEDIATELY-THE LONGER THE DELAY, THE MORE DIFFICULT RECOVERY WILL BECOME. Steps 1 through 3 should be done AGGRESSIVELY and SIMULTANEOUSLY. The full forward position of the control column may be reduced slightly, if required, to prevent the airplane from exceeding a 90° nose down (inverted) attitude.

1. Control Column......................... FULL FORWARD, AILERONS NEUTRAL
2. Full Rudder................................ OPPOSITE THE DIRECTION OF SPIN
3. Power Levers............................. .IDLE
4. Rudder....................................... NEUTRALIZE WHEN ROTATION STOPS
5. Execute a smooth pullout.

NOTE

> The Federal Aviation Administration does not recommend the spin-testing of multi-engine airplanes. The recovery technique presented above is based upon the best available information, but

> shall not be construed as any assurance that the airplane can, in fact, be recovered from a spin. In accordance with industry practice, no spin tests have been conducted on this airplane.

Spin testing has not been performed on the MC-12W or King Air 350, nor were computer modeling/wind tunnel tests run to calculate aerodynamic effects of the ISR modifications on spin recovery. Aerodynamic analysis and limited stall characteristics testing was conducted for the modified aircraft per applicable FAA Aviation Regulations (FARs) and was found compliant (Tab DD-31).

j. Spiral Dive

A spiral dive is a steep-angle, descending turn resulting in a rapid descent which, if uncorrected, can lead to overstress of an aircraft's physical structure in a relatively short period of time. A spiral is characterized by low angle of attack, high indicated airspeed, and high rate of descent. Spiral recovery technique generally involves arresting roll, reducing power setting, reducing "G" loading, then making a coordinated unusual attitude recovery so as to regain wings-level, un-accelerated flight (Tab DD-56).

k. Avionics and Spin/Spiral Recovery Factors

(1) AHS 3000 Attitude Heading Reference System (AHRS)

The MC-12W uses the Rockwell Collins AHS 3000 to measure angular rate and linear acceleration about the body of the aircraft. The AHS can process 90 degrees of pitch, 180 degrees of roll, and 180 degrees of heading change, at a maximum change rate of 128 degrees per second, which is approximately one revolution every 3 seconds. It provides usable information through all normal aircraft maneuver profiles (Tab BB-34).

(2) Electronic Standby Instrument System (ESIS)

The L-3 model GH-3100 ESIS provides a backup reference for aircraft attitude, airspeed, altitude, heading, and basic navigation. It is mounted between the MFD and PFD, and is visible to both Pilot and Mission Commander during the mission. The ESIS is capable of providing attitude and heading information throughout 90 degrees of pitch, 180 degrees of roll, and 180 degrees of heading (Tab BB-36 to BB-39).

(3) Pilot Flight Display "Declutter" and "No Computed Data" (NCD) Display Modes

When an MC-12W's pitch angle exceeds 30 degrees nose-up or 20 degrees nose-down, or bank angle is greater than 65 degrees, the "declutter" function automatically removes non-critical information from the PFD. Additionally, warning chevrons appear, cueing the pilot to pull towards the depicted artificial horizon (see Figure 2). This mode automatically removes all data from the PFD with the exception of red chevrons that indicate which direction to maneuver the aircraft for safe recovery if the necessary data is being received by the AHRS to generate chevrons. The PFD reverts to the normal display when pitch angle is returned to less than or equal to 25 degrees nose-up, 15 degrees nose-down, and 60 degrees bank angle (Tab BB-30 to BB-31).

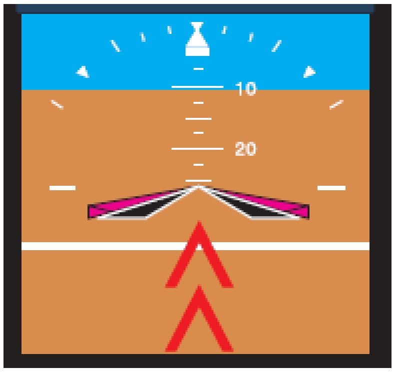

Figure 2. Declutter Display (Tab BB-30)

If the rate of pitch or roll exceeds 125 degrees per second, the PFD reverts further into a "No Computed Data" mode. This mode automatically removes all data from the PFD with the exception of red chevrons that indicate which direction to maneuver the aircraft for safe recovery. "Airspeed" and "turn and slip" indications are removed in this mode (Tabs DD-17 to DD-18 and DD-57).

(4) ESIS Unusual Attitude Indications

The ESIS display has no comparable declutter feature; instead, it has chevrons fixed to the pitch index at +45 and +65 degrees of nose-high pitch, and -35, -50 and -65 degrees of nose-low pitch. These chevrons are situated to point towards the horizon line and serve the same purpose as the chevrons on the PFD declutter mode, to assist the pilots to safely recover the aircraft (Tab BB-37).

(5) Effect of "Declutter" and "NCD" Display Modes on Spin Recovery Procedures

In both "Declutter" and "NCD" display modes, the chevrons cue the pilot to raise the nose of the aircraft towards the horizon. Though this is useful in most unusual attitude conditions, it is opposite the direction of initial input required to recover from both spins and spirals (Tab DD-56).

Turn and slip indications are the only way spin direction can be reliably determined when flying in instrument meteorological conditions (IMC), or "in the weather" where reference to flight instruments are necessary to determine aircraft attitude, and they are critical for correct, prompt spin recovery (Tab DD-57). Airspeed indications are used to differentiate spin from spiral, and execute appropriate recovery methods (Tab BB-22). Neither turn and slip nor airspeed is available in "NCD" mode (Tab DD-57).

4. SEQUENCE OF EVENTS

a. Mission

The MA, callsign Independence 08, was tasked by Air Force Central Command's (AFCENT) Air Tasking Order to provide ISR approximately 110 NM northeast of KAF, Afghanistan. They were scheduled to take off at 1200L (0730Z, or Greenwich Mean Time), fly to their mission area, provide ISR support, and return to KAF (Tab DD-52). It was scheduled as a 5 hour sortie, and the 361 ERS Operations Supervisor authorized the mission (Tab DD-59).

b. Planning

Mission planning was normal, except the crew departed the squadron area 15 minutes earlier than standard, to give the MP more time to accomplish pre-takeoff checklist items. This was the MP's first sortie in-theater, and his first MC-12W combat sortie (Tabs G-10, V-1.4, and V-1.7).

The mishap crew reported to the 361 ERS for their required show time of 0930L, to plan for their mission briefing (Tabs R-13 to R-14, R-59, and V-1.4 to V-1.5). A normal planning cycle consists of reviewing the current weather report, or Mission Execution Forecast (MEF), Notices to Airmen (NOTAMs), crew qualification and currency, Isolated Personnel Reports (ISOPREPs), and other individual tasks. The mishap crew completed these tasks with no known deviations (Tabs R-13 and V-1.4).

At 1000L the MMC briefed the crew in accordance with AFI 11-2MC-12W, Vol 3, *MC-12W Operations Procedures*, Attachment 4 requirements. A normal briefing consisted of an intelligence report, weather review, mission location and altitude, fuel required, timeline of planned events, communications plan, airspace restrictions, and other specific details pertinent to their mission (Tab BB-23 to BB-27). The MMC was known to provide thorough briefs and took extra time to mentor the MP (Tab R-12). The crew had ample time to perform all preflight duties and appeared upbeat and ready for the mission (Tab V-1.4).

The mishap crew received their "step briefing" from the Squadron Operations Supervisor, which included a review of their mission's operational risk (Tabs R-59 and V-1.4). Operational Risk Management (ORM) is a logic-based, common sense approach to making calculated decisions on human, material, and environmental factors before, during, and after operations (Tab BB-27). The ORM sheet in use by the 361 ERS at the time was divided into three sections: individual, mission, and environmental. The MP assessed his individual risk "high" due to his having less than 100 MC-12W hours. The MSO also assessed his individual ORM "high" for an undetermined reason. The mission risk section was assessed "medium" due to the sortie being the MP's first flight in-theater. Environmental risk factors were assessed "medium" due to forecast low cloud ceilings and high crosswinds at their projected land time. The ORM sheet was marked "medium" or "high" in 6 out of 32 categories. Since the remaining areas were "low," the mishap crew had a "low" overall ORM score, meaning they were assessed to be at a low risk for mishaps; thus, they were not required to contact squadron leadership for mission approval (Tab K-23). Since this was the MP's first sortie in theater, the mishap crew walked to the aircraft, or "stepped," 15 minutes early to give the MP more time to execute pre-takeoff checklists (Tab V-1.4).

c. Preflight

Preflight was normal, with the exception of the following two deviations from the Pilot Checklist:

- Propeller levers were kept in the "FEATHER" setting during engine start. "FEATHER" is the correct position for "external power" starts, which is the primary starting method used during Mission Qualification Training (MQT) at Beale AFB; however, operations at KAF require "battery" starts (Tab V-27.8 to V-27.9). The correct propeller lever setting for battery starts is "FULL FORWARD" (Tabs V-27.8 to V-27.9, BB-20, and DD-57). This deviation was corrected after engine start (Tab V-27.8 to V-27.9).

- The flaps were not retracted prior to the pilots indicating they were ready to taxi, requiring crew chief prompt and subsequent retraction (Tabs V-27.8 to V-27.9 and BB-21).

The crew called maintenance to the cockpit on two occasions prior to taxi: the first time to investigate inoperative left-side fuel gauges, and the second time to address a slow Electronic Standby Instrument System (ESIS) power-up. Both items corrected themselves after maintenance was hailed, but before any maintenance was performed (Tab V-27.5 to V-27.6). All required checklist items were accomplished prior to taxi with no mission impact (Tab V-27.8). The mishap crew took off three minutes early, at 1157L (Tab DD-52).

d. Summary of Accident

After takeoff at 1157L, the MA encountered isolated towering cumulus buildups en route to their operating area. They stowed and unstowed the sensor ball on two occasions during their climb and en route to their orbit, indicating visible moisture above the freezing level. The MSO reported on-station in Internet Relay Chat (mIRC) at 1229L (Tab DD-52). mIRC was the MA's primary method of communication with Air Traffic Control (ATC) and Supported Unit (Tab DD-52). Upon entering the operating area, they encountered a cloud deck partially covering their orbit area and a large, rapidly building towering cumulous (TCU) cloud in the center of their orbit area from 17,000 ft to 24,000 ft mean sea level ((MSL), all altitudes are in MSL unless otherwise indicated) (Tabs F-11, N-6 and DD-52).

While in their first orbit, the MA was in the clouds approximately one-half of the time, and the conversation on board indicated they were flying in light to moderate turbulence (Tab DD-52). The sensor field of view (FOV) showed ground visible below the TCU with no intermediate cloud layers (Tab DD-52). At 1234L, the MSO made the following weather comment in mIRC, "…looking at scattered and broken 16-170 [cloud base at 16,000 to 17,000 ft], plus this giant thing we're flying around going up to about FL240 [24,000 ft]" (Tab N-6). The TCU continued to grow and drift into the MA's orbit, prompting a request to climb from 20,000 ft to 23,000 ft (Tabs N-2 and N-6). This translates to climbing from 13,800 to 16,800 ft above ground level (AGL), or height above terrain (Tab DD-54). The request and approval were transmitted over mIRC. mIRC communications were tasked to the MMC while the MP was at the controls (Tabs N-2 to N-3, and N-6). The MA was in a left hand orbit, preparing to shift the orbit, when the MP initiated the climb with the autopilot on at 1240:40L. They were in IMC, meaning that they were in weather conditions that required reliance on aircraft instruments for attitude reference (Tabs N-2 and DD-52).

The MP initiated the climb in auto-pilot, utilizing either the constant pitch or constant vertical speed (VS) mode rather than the Flight Level Change (FLC or "filtch") mode (Tabs DD-53 and DD-57). In each of these three possible modes, the pilot manually sets the throttles. The FLC mode will hold a constant airspeed and climb at a rate commensurate with the additional power increase. Since the other two modes will not self-adjust commensurate with power input, power application must be more closely monitored when using the constant pitch or VS mode (Tab DD-57). It has been estimated that about half the pilots use a similar technique and execute flight level changes, or changes in altitude, with the auto-pilot in VS mode (Tab V-9.12).

While or just after initiating the climb, the MP continued working an orbit adjustment to better service tracking an active target, and approximately ten seconds after the climb was initiated, the climb rate increased (Tabs DD-53 and EE-3). Fifteen seconds afterward the MP noticed he had allowed the MA airspeed to decrease during the climb, stating, "A little slow, correcting." Seven seconds later, the MMC said, "Alright, firewall," meaning to advance the throttles as far forward as they would go, and one second later, the auto-pilot was disengaged (Tabs N-3 and DD-54).

The propellers on the MC-12W do not counter-rotate, and advancing the power in the MC-12W produces left-handed torque and P-factor, creating a left yaw and making the aircraft to want to turn left; the MA was already in a left-hand turn and left bank (Tab EE-3). Two seconds after calling to "firewall" the throttles, and one second after auto-pilot disengagement, video feed was lost and the bank angle warning tone sounded, indicating the MA left bank had rapidly increased to greater than 50 degrees. The MMC again called for full power, and four seconds later, the MMC directed "eyes inside," telling the MP to refer to his instruments for attitude and airspeed information; contemporaneously, the stall warning sounded. The stall warning horn stopped after five seconds, and a second later, background noise indicates items began flying around within the cockpit and the bank angle warning stopped (Tab DD-54).

The bank angle warning can stop even when an aircraft is in excess of 50 degrees of bank when the pilot flight display (PFD) reverts to "No Computed Data" mode due to excessive roll, pitch, or yaw changes (Tab DD-54). In "No Computed Data" mode, the PFD would remove all data except for red chevrons that would cue the pilot to "pull up" in the direction of the chevrons to recover the aircraft from an unusual attitude (Tab DD-54). Right after background noise indicated items began flying around within the cockpit and the bank angle warning stopped, the MP stated, "Whoa, pull up" (Tabs N-3 and DD-54).

The MMC then advised the MP to look at his airspeed and the MMC took the aircraft, calling for a reduction in power. Four seconds after the MMC took the aircraft, the aircraft overspeed warning sounded, followed by the landing gear horn sounding. The landing gear horn indicates the throttles were reduced toward idle, and it did not sound until 15 seconds after initial stall warning sounded. The CVR stopped at this point (Tab DD-54). The MA reached a maximum recorded height of 20,900 ft. and lost approximately 15,000 ft before impacting the ground

(Tabs N-3 and DD-54 to DD-55). A description of the last 94 seconds of flight, integrated with words and sounds from the cockpit voice recorder follows:[1]

12:40:48 MMC: Alright, go ahead and push up the power. I asked for 230 [23,000 ft] for now just to keep us out of this for a little while anyway. So, go ahead and climb to 230. And as soon as you're ready.

12:40:58 MP: Oh we're already approved? Okay cool. *The MP begins a shallow climb and airspeed begins to decrease (Tabs DD-53 and EE-3).*

12:41:00 MMC: Yup. As soon as you're ready you can go direct to that new start point and -

12:41:04 MP: Yea, once we make this turn here, I'll get that set in there. It's ready to be inserted.

12:41:08 MMC: Oh, cool. I'll let you do your business then.

1241:10 MA pitch increases, climb rate increases and airspeed decreases. *From approximately 10 seconds from climb initiation until loss of feed, the climb rate increases and the airspeed decreases at a rapid rate. (Tabs DD-53 and EE-3).*

12:41:12 MP: Cool. So once we make this turn I'll keep the roll going and then uh-

12:41:15 MMC: Roger, roger

12:41:25 MP: A little slow, correcting. *MP acknowledges the airspeed decayed while in the climb. If power is added, while at a high angle of attack, the engines' torque/p-factor causes a left-rolling tendency for the aircraft, which the autopilot would compensate for by repositioning the yoke and control surfaces to a "right bank" position. This characteristic of MC-12W departure from controlled flight is similar to a previously-recorded incident (Tab V-23.3 to V-23.4).*

12:41:32 MMC: Alright, firewall. *"Firewall" is jargon for maximum power, or pushing the throttles to the full forward position (Tab DD-53).*

12:41:33 Aural tone indicates MP has disengaged the auto-pilot. *If the yoke is displaced to the right by the autopilot as discussed above, neutralizing the yoke upon auto-pilot disengagement would put the aircraft into further left bank almost immediately (Tab DD-53).*

1241:34 Video feed lost due to MA unusual attitude. At loss of feed, calibrated airspeed was approximately 116 nautical miles per hour, or "knots" (Tab EE-3). *Coordinates of last known position plot are less than a mile from impact site (Tab DD-53).*

12:41:34 Contemporaneously, the "bank angle" warning is activated, indicating the aircraft has exceeded 50 degrees bank (Tab DD-53).

12:41:34 MMC: Max power, max power. *If the throttles were not at full power already, adding more power would increase left yaw.*

12:41:38 MMC: Alright, eyes inside, eyes inside. *An "eyes inside" call would advise the MP to reference the cockpit instruments for aircraft attitude and performance information instead of looking outside for visual cues. The*

[1] Bold text is crew communication from the CVR transcript at Tab N-2 to N-3. Normal font text is factual data; italics text is commentary. All times are local, and altitudes are MSL, or mean sea level, unless indicated otherwise. MA altitudes are taken from Mode C returns rather than the GPS altitudes in the animation at Tab EE.

aircraft was "in the weather," or in Instrument Meteorological Conditions, at the time (Tab DD-54).

12:41:38 Stall warning comes on; bank angle warning continues (Tab DD-54).

12:41:41 Mode C (altitude-encoded transponder return) indicates MA reaches a maximum recorded altitude of 20,900 ft (Tabs M-3 and DD 54). *"Mode C" is a channel that emits altitude information (Tab DD-54).*

12:41:42 MP: Max power. *MP confirms he has advanced throttles to maximum power.*

12:41:43 Stall warning horn stops (Tab DD-54).

12:41:44 Background noise indicates items flying around within the aircraft. *This would occur if the aircraft violently entered a spin. A spin could result from uncoordinated flight to correct excessive left bank, while in a stall, combined with the left-yawing tendency of two engines at maximum torque (Tabs DD-54 and DD-56).*

12:41:44 Bank Angle warning stops. *If a pilot flight display (PFD) reverted to "No Computed Data" mode due to excessive roll, pitch, or yaw change (in excess of 125 degrees per second), the audible bank angle warning would stop, and the PFD would be blank except for red chevrons cueing the pilot to "pull up" in the direction of the chevrons (Tabs DD-18 and DD-54). See sections 2.k(3) and (5).*

12:41:45 MP: Whoa, pull up. *Adding up elevator, in other words, "pulling up," or back on the yoke, would be counter to proper spin or spiral recovery procedures (Tab BB-57).*

12:41:48 MMC: Eyes inside. Look at your airspeed.

12:41:49 Bank angle warning comes on and stays on until loss of audio (Tab DD-54).

12:41:54 MMC: Eyes inside, eyes inside, my aircraft, power back.

12:41:56 MA Mode C indicates MA at 18,000 ft; descent rate of 11,600 fpm (this equates to 116 nautical miles per hour (knots) vertical velocity) (Tabs M-3 and DD-54).

12:41:57 MP: Your aircraft.

12:41:58 Overspeed warning tone is activated. *Overspeed warning comes on when the aircraft exceeds approximately 245 knots (Tabs DD-9 and DD-54).*

12:42:00 "Gear warning" horn sounds, indicating throttles pulled towards idle (Tabs DD-54 and DD-56). *Time from stall warning ceasing to overspeed warning is approx 15 seconds. Such rapid acceleration is indicative of an extreme nose-down attitude.*

1242:02 Last CVR data (Tab DD-54).

1242:03 Mode C indicates MA at 14,700 ft; descent rate of 28,285 fpm (i.e. 283 knots vertical velocity) (Tabs M-3 and DD-54).

1242:23 Last ATC Radar return indicates MA ground speed of 316 knots (Tabs M-3 and DD-54).

The MA lost approximately 15,000 ft before impacting the ground (Tabs N-3 and DD-54 to DD-55).

e. Impact

The MA impacted valley terrain at approximately 1243L on 27 April 2013 approximately 110 NM northeast of KAF (Tabs DD-47 and DD-55). The MA impacted with the fuselage slightly nose-low, in a left bank, with minimal forward momentum (Tabs S-3 and DD-35). The MA was destroyed upon impact and burned during the post-crash fire (Tabs S-3 to S-11). With the exception of the right wingtip and winglet, which was located 500 meters (1,640 ft) from the impact site, all other aircraft wreckage was within a 50-meter (164 ft) radius (Tab DD-55). A Local National (LN) witness reported seeing the MA descending in a left turn, and reported seeing either a puff or trail of black smoke prior to impact (Tab DD-35).

f. Egress and Aircrew Flight Equipment (AFE)

There is no crew egress option for an airborne MC-12W, and there is no evidence the crew attempted to abandon the aircraft. The main cabin door was recovered 30 meters (98 ft) from the impact site intact, though significantly crushed at the door's base. This deformation, and its distance from the impact site, is consistent with its ejection from the pressurized cabin upon impact; the door handle was in the "CLOSED" position (Tabs Z-3 and DD-57).

g. Search and Rescue (SAR)

A nearby MC-12W from another unit located the MA wreckage approximately 53 minutes after loss of video feed. The crash site was under constant, persistent overwatch from this time until recovery (Tabs V-3.4, V-22.4 to V-22.5, and DD-55).

At 1244L, a "Feed Sour" statement was sent on mIRC to indicate no one had received the MA's FMV feed for a prolonged period. This was followed by several attempts to hail aircraft on mIRC on both primary and emergency frequencies (Tabs V-22.4 and DD-55). Twenty-six minutes later, the ground unit the MA was supporting received reports of a downed aircraft (Tab DD-55). Freedom 14, a nearby MC-12W from another unit, was tasked at 1325L to support the SAR effort, and within 3 minutes, a ground party from a nearby forward operating base (FOB), FOB Warrior, departed for the crash site. Freedom 14 reported on station within 10 minutes, and was followed by a 2-ship flight of F-16's for the SAR effort (Tabs V-22.4 and DD-55). Freedom 14 noted 20 to 30 non-hostile persons gathering around the debris. To disperse the crowd, the F-16s performed a low altitude "show of force" and the crowd departed. At 1425, a 2-ship A-10 formation relieved the F-16s (Tabs V-3.4 and DD-55). The ground team and a helicopter both arrived on scene at 1432L, and at 1635L, the ground team reported "4 HEROES RECOVERED" (Tab DD-55).

A second ground team arrived at the crash site at 2130L for additional equipment recovery and investigation. The remaining wreckage was destroyed in-place for security reasons after the second recovery team departed (Tab DD-55).

h. Recovery of Remains

A special operations ground team, in conjunction with the Interim Safety Board (ISB) recovered remains and accompanying personal effects under expedited conditions. All were transferred to the Office of the Armed Forces Medical Examiner at Dover AFB, Delaware. Personal effects were processed through the Joint Personal Effects Depot (JPED) and given to the appropriate surviving family members (Tab DD-11 to DD-12). Air Force Mortuary Affairs Office, HQ USAF handled all mortuary affairs (Tab X-3).

5. MAINTENANCE

a. Forms Documentation

The MC-12W was maintained by contract personnel in accordance with Federal Aviation Administration regulations (Tab V-25.3). As such, Air Force Technical Order 781-series forms were not used to document maintenance on the MC-12W. Instead, the contractor used a series of forms they developed (Tab D-13 to D-198). A thorough review of the forms documenting recently performed maintenance on the MA revealed only one minor discrepancy. There was hail damage from a storm that occurred on 22 April 2013 identified on the left wing, nose, and fuselage. There were documented repairs on the fuselage and nose, but not on the wing (Tabs D-47 to D-48, U-3 to U-5, and DD-65). Although the damage on the wing was deemed by competent engineering authorities to be within limits, such a disposition should have been annotated in the forms (Tabs U-4, V-25.5, and BB-43). However, this discrepancy was administrative in nature, and, as the appropriate engineering authorities declared the dents to be within limits, did not affect the physical airworthiness of the aircraft. A search going back two years into the maintenance records revealed no recurring issues or other significant findings (Tab DD-33).

b. Inspections

The inspection program for the MC-12W was based on a 200-hour interval, at which time critical aircraft systems are inspected and time change items are replaced (Tab BB-46). Contract maintenance noted no issues with the aircraft, engines, or propellers during the most recent 200-hour inspection, completed on 14 April 2013 (Tab DD-33).

c. Maintenance Procedures

Maintenance procedures performed on the aircraft were done in accordance with directives by qualified personnel (Tab DD-33). During the launch process, the crew called for maintenance for two issues. First, the left auxiliary and extended range fuel tank indicators failed their start-up test. On a subsequent test, the indicators began operating on their own prior to maintenance's arrival. Additionally, the Electronic Standby Indicating System (ESIS) displayed a "fault" indication, but began operating normally after completing its start-up process. Issues that arise during the launch process and are resolved after restarting and retesting the item are not uncommon. There is no evidence to suggest they were related to the mishap. (Tabs V-25.8 and V-27.5).

d. Maintenance Personnel and Supervision

Government oversight of MC-12W contract maintenance is accomplished by a Quality Assurance Evaluator (QAE) in accordance with the Quality Assurance Surveillance Plan (QASP). According to the QASP, the QAE is required to perform 25 inspections per month across 22 maintenance functions such as aircraft towing, toolbox and aircraft forms management, engine run, and fuel servicing. Results are documented on a Performance Plan Evaluation Form (PPEF) at the end of each month (Tabs DD-39 and DD-41). The QAE sends the PPEF to the 451st Expeditionary Maintenance Group Commander for his review and approval. A review of the PPEF for April 2013 revealed the QAE actually exceeded the requirement and performed 37 inspections that month. The contractor attained a 100% pass rate (Tab DD-41).

In addition to the QAE, the contractor has its own in-house oversight process. The requirements for contractor-provided oversight are contained in the contractor's Quality Assurance Manual. According to this document, the contractor is required to perform 25 inspections per month independent from QAE inspections (Tab DD-43). A review of the Quality Assurance Manual and results indicated the contractor was also meeting inspection goals (Tab DD-45 to DD-46). Furthermore, a review of training records revealed that all personnel involved in the hail damage repair and launch of the aircraft on the mishap sortie were qualified on each task performed (Tab DD-33).

e. Fuel, Hydraulic and Oil Inspection Analyses

Fuel from the fuel truck that serviced the aircraft prior to the mishap sortie was found to meet all specifications, and contained no contamination (Tab DD-27 to DD-29). No hydraulic fluid, oil, or oxygen was available for analysis.

f. Unscheduled Maintenance

The MA sustained hail damage to the nose, forward fuselage and left wing five days prior to the mishap sortie (Tab U-3 to U-5). After maintenance records were thoroughly reviewed and personnel involved in the repairs were interviewed, corrective actions were found to be in accordance with applicable directives (Tabs D-47 to D-48 and V-31.4). In addition, functional checks of the stall warning transducer and left wing deice boot confirmed these items were operating normally when the hail damage repairs were complete (Tabs D-43 and D-49). None of the other unscheduled maintenance events preceding the mishap were found to be relevant (Tab DD-33).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS.

a. Engine Component Analysis

Prior to the mishap flight, both engines had 3951.0 hours of operating time. Components from both PT-6A-60A turboprop engines were recovered from the crash site and sent to Pratt & Whitney for analysis. Analysis of the components indicates both engines were operating and producing power at the time of impact (Tab J-13).

b. Right Wingtip Analysis

The right winglet and 30-inch section of the right wingtip were found approximately 500 meters (1,640 ft) from the crash site. The item was sent to Wright Patterson AFB, Ohio, for analysis. Though the strength and metallurgical composition of some individual components were below allowable tolerance, engineers determined there were no structural flaws that would have caused the wingtip to depart the aircraft under normal operating conditions (Tabs FF-10, FF-11, FF-28 and FF-29). The wingtip departed the MA prior to impact due to ductile overload (Tab FF-11). The MA was in a high-speed left spiral, where heavy stress would have been placed on the wing.

7. WEATHER

a. Forecast Weather

The Mission Execution Forecast (MEF) is the primary weather source for aircrew prior to departure. The forecast weather per the 0430L (0000Z) MEF showed a weather pattern typical of post-low pressure system (trough) passage (Tabs F-4 and V-10.4). Visual Meteorological Conditions (VMC), or clear weather at and near the surface, prevailed at KAF at takeoff time, with 8,000-meter (4.9 mile) visibility, winds out of the west at less than 15 knots, and a solid overcast at 14,000 ft (Tabs F-3, V-10.3 and 52).

The en route and working area weather was forecast to have scattered clouds at 14,000 ft above ground level (AGL) through 18,000 ft AGL and an additional scattered cloud layer from 25,000 ft AGL through 30,000 ft AGL (Tab F-4). Forecast winds for the orbit area at 14,000 ft were out of the southwest at 15 knots; winds at 24,000 ft were forecast from the west-southwest at 50 knots (Tab F-7). No thunderstorms were forecast within 100 miles from the takeoff location (Tab V-10.3).

b. Observed Weather

Weather in the orbit area showed clouds from approximately 16,000/17,000 ft to 24,000 ft, with sporadic precipitation (Tab N-6). There was convective activity and building towering cummulus (TCU) within the orbit, but no reported lightning. The aircraft was in clouds for approximately one-half of the first orbit track, with cloud coverage growing during each orbit (Tab DD-52). Turbulence in the orbit appeared light to moderate. An MC-12W approximately 40 miles from the orbit reported moderate turbulence in clouds, and trace icing around the time of mishap (Tab V-22.4 to V-22.5). The MA was in the clouds and in IMC conditions when the sensor feed was lost (Tab DD-54). There is no indication the mishap aircraft encountered severe turbulence or significant icing. Weather was within operational limits (Tab V-22.4 to V-22.5). There was also a thunderstorm watch for Forward Operating Base (FOB) Warrior, which is located 8 miles north of the crash site (Tab V-10.7). FOB Warrior issued several meteorological reports (METARs) showing observed weather near the MA's orbit area (Tab F-11).

c. Space Environment

Not Applicable.

d. Operations

Significant weather guidance (in effect at time of mishap) for MC-12W aircrews is outlined in Air Force Instruction 11-2MC-12W, Volume 3, MC-12W *Operations Procedures* (Tab BB-25 to BB-27). There was inclement weather in the target area, characterized by light to moderate turbulence, significant updrafts, and precipitation. There is no evidence suggesting the towering cummulus cloud over the target area developed into a thunderstorm while the MA was on-station, or that significant icing was present (Tab DD-53). Weather was within the MC-12W's operational limits.

8. CREW QUALIFICATIONS

The mishap crew were all combat veterans, with impeccable reputations. (Tabs V-1.15 to V-1.16, V-2.3, V-5.3, V-7.3, V-8.2 to V-8.3, V-9.3, V-19.3 to 19.4, and V-20.3).

a. Mishap Mission Commander

The MMC was a "flow-through" MC-12W pilot permanently stationed at Scott AFB, Illinois (Tabs Q-6 and X-5). Flow-through manning is a process wherein a crewmember is temporarily removed from his/her Major Weapons System (MWS), trained through Initial Qualification Training (IQT) and MQT, deployed for approximately 180 days, then returned to their MWS, for a total temporary duty (TDY) of 9 months (Tab V-18.5 to V-18.6). The MMC was an experienced KC-135 pilot with 1,749.1 total hours, most of which were in the KC-135, and 737.1 combat hours. He upgraded to KC-135 Mission Pilot in August 2011. The MMC was scheduled to return to the KC-135 post-deployment. All past aircraft checkrides indicate strong performance, with no deviations (Tabs G-17 to G-29 and G-130 to G-178).

The MMC's performance during MC-12W MQT met or exceeded the Required Proficiency Level (RPL), with the exception of his "T-11" flight, where he "Student Non-Progressed" for improper airport arrival procedures. He re-took the sortie before moving onto his checkride. No similar deviations were documented in any prior grade sheets, and the MMC completed his checkride with no deviations (Tab G-130 to G-178).

After MQT, the MMC deployed to Afghanistan, where he flew his first MC-12W combat sortie on 4 March 2013; and he accumulated 201.5 MC-12W combat hours prior to the mishap. The MMC was qualified as "Certifier" on 26 April 2013 (Tabs G-17 to G-29 and T-7). The certifier program is a locally-developed training program instituted by the 361 ERS to season new Mission Commanders by flying them in the Pilot (left) seat with an experienced MC-12W Mission Commander in the right seat, prior to moving the inexperienced Mission Commander to the more technical and complex right seat. The mishap sortie was the MMC's first indoctrination flight while performing as a certifier (Tabs R-33 to R-36, T-7, V-1.8, and V-5.9). The MMC was current and qualified (Tab DD-51).

At the time of the mishap, the MMC's recent MC-12W flight time was as follows:

	Hours	Sorties
Last 30 Days	107.7	21
Last 60 Days	201.5	40
Last 90 Days	230.1	52

Figure 3. MMC's 30-60-90-Day Flying History (Tab G-19)

b. Mishap Pilot

The MP was a recently qualified MC-12W Mission Commander permanently stationed at Beale AFB, California. He was an experienced EC-130H pilot with 2,434 total hours, 1,428.8 of which were in combat, and he had upgraded to EC-130 Instructor Pilot in July 2012. All past aircraft checkrides indicate strong performance, with no major deviations (Tabs G-4 to G-16 and G-62 to G-129).

The MP's performance during MC-12W MQT met or exceeded all standards. He excelled in pattern work and mission employment. The MP completed his MC-12W checkride with no deviations (Tab G-62 to G-129).

The mishap sortie was the MP's first mission in Afghanistan, his first flight in 26 days, and his first MC-12W flight in 45 days. It was also his first documented left-seat sortie in 64 days, and first documented flight in IMC in 67 days (Tabs G-4 to G-16 and G-62 to G-129). Though inexperienced in the MC-12W, the MP was current and qualified (Tab DD-51).

At the time of the mishap, the MP's recent MC-12W/King Air-350 flight time was as follows:

	Hours	Sorties
Last 30 Days	3.2*	1*
Last 60 Days	18.5	7
Last 90 Days	41.7	17

Figure 4. MP's 30-60-90-Day Flying History (Tab G-5)

* BE-350 (King Air 350) time only

c. Mishap Sensor Operator

The MSO was an Air Operations Specialist permanently stationed at Tinker AFB, Oklahoma. He was an experienced E-3 Instructor Air Surveillance Technician with 2,360.5 E-3 hours and 786.5 MC-12W hours. This was his second combat deployment in the MC-12W, and he had 1,057 hours of combat flying experience (Tabs G-32 to G-42 and G-179 to G-185).

The MSO's performance during MC-12W MQT significantly exceeded all standards. Instructor comments on his grade sheets extolled his motivation to excel, extensive knowledge, and consistent above average performance. He completed the mission checkride on 7 February 2013 with no deviations. The MSO was current and qualified (Tabs G-183 to G-184, T-3 to T-4, and DD-51).

At the time of the mishap, the MSO's recent MC-12W flight time was as follows:

	Hours	Sorties
Last 30 Days	103.1	20
Last 60 Days	165.0	32
Last 90 Days	176.2	36

Figure 5. MSO's 30-60-90-Day Flying History (Tab G-33)

d. Mishap Tactical Systems Operator

The MTSO was permanently stationed at Beale AFB, California. He was an experienced Cryptologic Operator and Korean linguist with 1,494.6 hours in six aircraft types. The MTSO had accumulated 1,422.4 combat hours. All past aircraft checkrides indicate strong performance with no major deviations (Tabs G-44 to G-59 and G-186 to G-191).

The MTSO's performance during MC-12W MQT met or exceeded all standards. His previous experience and knowledge base allowed him to "proficiency advance" through five mission syllabus rides (Tab T-5). He completed the Mission Checkride on 28 December 2012. The MTSO was current and qualified (Tab DD-51).

At the time of the mishap, the MTSO's recent MC-12W flight time was as follows:

	Hours	Sorties
Last 30 Days	102.4	20
Last 60 Days	184.2	37
Last 90 Days	184.2	37

Figure 6. MTSO's 30-60-90-Day Flying History (Tab G-46)

9. MEDICAL

a. Qualifications

At the time of the mishap, all members had current annual physical examinations and were medically qualified for flight duty without restrictions. The MMC, MP, and MTSO had current and valid medical waivers. The MSO had no medical conditions requiring waiver for flight duties (Tab X-3 to X-11).

b. Health

The AIB Medical Member reviewed all MC medical records and all relevant testimony relating to MC well-being for the 72-hour time period prior to the mishap. The MC members were in good health, and there was no evidence that any medical condition or medication was relevant to the mishap (Tabs V-12.4, V-14.3, V-17.3, V-19.3, and X-3 to X-4).

In addition, the AIB Medical Member reviewed all laboratory and toxicology reports for tested maintenance members and found no evidence that any medical condition or substance relevant to the mishap (Tab X-3 to X-4).

c. Pathology and Toxicology

The cause of death for all crew members was "Multiple Injuries" with no evidence of significant natural diseases or pre-existing conditions. Available testing revealed no evidence of ethanol or screened drugs of abuse or medications (Tab X-3 to X-4).

d. Lifestyle

The MC members were reported to be well rested and adjusted. There were no lifestyle factors relevant to the mishap (Tabs V-12.4, V-14.3, V-17.3 V-19.3, and X-3 to X-4).

e. Crew Rest and Crew Duty Time:

AFI 11-202, Volume 3, *General Flight Rules*, 22 October 2010, paragraph 9.8 requires aircrew members have proper "crew rest" prior to performing flight duties. It defines normal crew rest as a minimum 12-hour non-duty period before the designated flight duty period begins. During this time, an aircrew member may participate in meals, transportation or rest, as long as they have the opportunity for at least eight hours of uninterrupted sleep (Tab BB-16 to BB-18). A review of all mishap crew members' the duty cycles and testimony of their contacts revealed no crew rest or crew duty time requirements were violated. There was no evidence of fatigue prior to the mishap (Tabs V-15.15, V-17.3, V-19.7, and V-20.7).

10. OPERATIONS AND SUPERVISION

a. Operations

The 361 ERS had provided ISR support for combat operations in Afghanistan since May 2010 (Tab CC-15). The unit had a high operations tempo, conducting 24/7 operations with a 99.96% success rate, meaning 99.96% of the time a ground force commander expected to have an MC-12W overhead, it was there (Tab V-18.8). At the time of the mishap, approximately 60% of aircrews were "flow-throughs" (on temporary duty with the MC-12W program from other weapon systems) and 20% of all the deployed aircrew rotated out each month (Tabs V-9.10 and V-18.6). Though the overall operations tempo was high, the 361 ERS was able to sustain this over the last 3 years (Tabs V-1.12 and V-6.5).

The four crew members, combined, had 8,824 flying hours, 4,846 combat flying hours, and 836 combat sorties. The two pilots, however, had most of their hours in other weapon systems, and were on their first MC-12W deployment (Tabs G-10 to G-11, G-22 to G-23, G-37, and G-52). All four crewmembers were qualified and current in the MC-12W (Tabs G-3 to G-4, G-17 to G-18, G-31 to G-32, and G-44 to G-45). The MMC qualified as a certifier on 26 April 2013, prior to his third month deployed and on his first MC-12W deployment, and was flying his first certifier sortie during the mishap (Tabs T-7 and V-5.10). The MP was on his first MC-12W combat sortie, and was required to fly with a certifier (Tab V-1.8).

b. Supervision

The mishap crewmembers were under supervision of the 361 ERS, 451 AEW, KAF, Afghanistan. Local supervision showed adherence to ORM assessment programs, and no deficiencies were noted with respect to published AFIs or flying operations regulations (Tab K-20 to K-23).

The Squadron Commander (CC) and Director of Operations (DO) were actively involved in direct supervision of the squadron. Each worked 12-hour shifts to ensure 24/7 availability of senior leadership. Operations Supervisors were empowered to make decisions in times of their temporary absence (Tab R-26 to R-27). Operations Supervisors were selected based on flight commander recommendations and approved by the DO and CC. They were interviewed and given guidance by the DO and sat one full supervised tour with a qualified Operations Supervisor before assuming this role. They worked 12-hour shifts during which they identified and mitigated operational risks. The Operations Supervisors made decisions regarding crew alternates and weather, while double-checking crew qualification and currency before crews stepped to the aircraft. They also had authority to sign off ORM without higher approval if the risk is assessed as "medium," whereas the CC or DO signed off the ORM checklist if the risk was evaluated overall as "high" (Tabs K-23, R-25 to R-27, V-1.4, and V-5.11). The crews did not need Operations Supervisor or CC/DO approval when ORM is reflected as "low" (Tab K-23).

On the mishap ORM worksheet, 6 out of the 32 assessed items were marked as "medium" or "high." Two of the four mishap crew rated themselves as high risk in the individual section, but this is only one portion of the overall risk. Since the remaining items were assed "low," the mission had an overall assessment as "low" (Tab K-23). Also, the ORM process identified the MP's inexperience in the MC-12W, but was not designed to reflect this as the MMC's first certifier ride. Scheduling a more experienced certifier on the MP's first combat sortie was not discussed (Tab V-5.10). At the time of the mishap sortie, the MMC was a new certifier and was completing his second month on his first MC-12W deployment (Tab G-24). Flow-through manning and scarcity of experienced MC-12W pilots resulted in few deployed instructor pilots, and made it difficult to fully mitigate inexperience levels while scheduling (Tabs R-33 and V-7.8 to V-7.9). The CC and DO were the only two MC-12W instructors in the squadron at the time of the mishap (Tab V-5.2).

To mitigate the risk associated with inexperienced aircrews, the 361 ERS developed a 10-ride "certifier program" which designated experienced mission commanders to further prepare inexperienced mission commanders and pilots for combat flying (Tab V-7.8 to 7.9). To be selected as a certifier required combat experience, leadership recommendation, and a discussion of certifier responsibilities, training, and tasks (Tabs R-33 to R-36, T-7, and V-1.8). The ORM and certifier programs were used to assess and mitigate risks.

11. HUMAN FACTORS

a. Overview

A taxonomy was developed to identify hazards and risks, called the DoD Human Factors Analysis and Classification System (DoD-HFACS). This guide is designed for use as a comprehensive tool for human error investigation, data identification, analysis and classification. It is designed for use by all members of an investigation board to accurately capture and recreate the complex layers of human factors. The human factors relevant to this mishap are discussed below (Tab BB-4).

Since the mishap aircrew perished, no firsthand accounts of the immediate events leading up to the mishap are available. Human factors are extrapolated from CVR data, witness testimony, radar logs, and reconstruction of the accident through sensor feeds. It should also be noted that while each factor is independently relevant, many of the factors are interrelated, and they are not mutually exclusive.

b. Relevant Human Factors

(1) Program and Policy Risk Assessment. This is a factor "when the potential risks of a large program, operation, acquisition or process are not adequately assessed and this inadequacy leads to an unsafe situation" (Tab BB-13).

In this case, the potential risks were assessed, but program and policy risks are still relevant to the mishap. Since its inception in 2008, the MC-12W program consistently trains nearly 300 pilots per year, flies 75% of all ISR missions, and shoulders 25% of total combat flying missions in the AFCENT AOR. Nearly 20,000 sorties and over 100,000 combat flying hours have been accomplished in the last five years with a success rate of 99.96% (Tabs CC-15 and V-18.8). It is the single most requested asset in the AOR, has been instrumental in the capture or elimination of over 700 high value targets, and has saved countless coalition lives through over-watch and improvised explosive device (IED) detection (Tabs V-18.8 to V-18.9 and V-18.13).

Program success came with the assumption of certain risks including rapidly implemented training programs and the delay of program normalization (Tabs V-18.2 to V-18.3, and V-18.7). Normalization refers to aligning a program with accepted Air Force common practices (Tab DD-56). This lack of normalization is evidenced by a "flow-through" manning process with its associated challenges, crew position waivers, and a non-standard aircraft certification/testing process for the mission-required MC-12W modifications (Tabs V-7.9 to V-7.10 and V-18.2 to V-18.7). "Flow-through" manning is a process wherein a crew member is removed from their major weapons system (MWS), trained and deployed in the MC-12W, and then returned to their MWS (Tabs V-11.3, V-18.5, and V-18.7 to V-18.8). These program risks are most visible from a human factors perspective in organizational training gaps and limited pilot experience.

(2) Organizational Training Issues. According to the DoD HFACS, organizational training issues are a factor, "when one-time or initial training programs, upgrade programs, transition programs or other training that is conducted outside the local unit is inadequate or unavailable and this creates an unsafe situation" (Tab BB-14).

MC-12W training is divided into two parts: Initial Qualification Training (IQT) and Mission Qualification Training (MQT). IQT teaches crews how to fly a civilian King Air 350, and MQT teaches crews to employ the MC-12W in combat. IQT consists of six simulator rides, is provided at three sites by contract instructors, and is the same training civilians receive to be qualified in the King Air 350. MQT consists of 15 sorties, is provided by military units at Beale AFB, and focuses on mission-related tasks. The first two MQT sorties transition the pilot from

IQT and focus strictly on basic airmanship, or flying skills. IQT and MQT are relevant to this mishap because both training and aircraft experience affect basic airmanship skills including recognition of and recovery from unsafe aircraft attitudes (Tabs V-5.6, V-13.2 and V-18.2 to V-18.5).

IQT is conducted in a King Air 350 simulator and is not MC-12W specific (Tabs V-1.6, V-5.6, V-6.2, V-7.3, and V-18.3). The King Air 350 was designed for executive transport, and this mission shapes IQT (Tab V-6.10, and V-18.2 to V-18.3). The MC-12W is physically different, its mission is different, and it is more mentally demanding and challenging than the King Air 350. For example, the MC-12W has over 40,000 additional parts and systems, and different aerodynamic characteristics (Tabs V-2.6, V-18.2 to V-18.4, and DD-31). It is fitted with extra fuel tanks and an array of antennae and other external equipment, weighs more, and has more drag than the King Air 350. The MC-12W did not undergo normal developmental or operational testing to account for these differences (Tabs V-18.3 to V-18.4 and DD-31).

Orbit stall training was limited (Tabs V-5.4, V-9.3 to V-9.4, V-11.2, V-18.13, and V-23.6). This is significant as a typical mission sortie includes substantially more time in orbit than in any other phase of flight, and the orbit is flown relatively close to stall speed (Tab DD-57). Four previous MC-12W orbit stalls that resulted in significant, near catastrophic altitude loss highlight this limited training (Tabs V-18.10 to V-18.13 and V-23.2 to V-23.6). These four near misses occurred in adverse weather and also show why training and experience in weather is important. (Tab V-18.13). Training in the often unpredictable weather experienced in Afghanistan cannot be replicated at Beale AFB, where it is largely clear all summer and has mild winter weather (Tabs V-6.4 and V-8.7). Before the mishap flight, the MP had not flown in Instrument Meteorological Conditions (IMC) in 67 days (Tab G-96).

After IQT, pilots transition to MQT. MQT is focused primarily on mission employment rather than on basic airmanship or “stick and rudder” training. Additionally, unlike more normalized airframes, there was no combat mission ready top-off program to bridge the gap between MQT and crews deploying to combat (Tabs V-9.7, V-11.3, and V-18.2 to V-18.5).

The Pilot Flight Display in the MC-12W has “Declutter” and “No Computed Data” modes. During unusual aircraft attitude scenarios, these modes automatically replace the normal instrument display with a simplified recovery mode, which displays only essential data (“Declutter” and “No Computed Data” modes are discussed in detail in section 13 of this report). Pilots may be unfamiliar with the “Declutter” or “No Computed Data” modes since neither IQT nor MQT emphasize them, nor can they be safely replicated in the aircraft (Tabs V-2.6, V-13.7, and V-18.12). Unfamiliarity with the “Declutter” or “No Computed Data” modes could lead to confusion and delayed or improper stall/spin recovery (Tabs V-8.5 and V-9.4).

(3) Limited Recent Experience. According to the DoD HFACS, limited recent experience is a factor, “when the supervisor selects an individual whose experience for a specific maneuver, event or scenario is not sufficiently current to permit safe mission execution” (Tab BB-12).

In this mishap, although all crewmembers were current, limited recent experience is still relevant. The MP had 2,434 hours in an EC-130H, but had only 21 primary hours and 41.7 total hours in the MC-12W/King Air 350 and had not flown the MC-12W for 45 days before the mishap (Tab G-3 to G-16). Most mission commanders are deployed with approximately 40 hours of MC-12W flight time, only about half of which is primary flight time (Tab V-5.9). The MP's last flight prior to the mishap sortie was in an unmodified King Air 350, and occurred 26 days prior to the mishap. On the mishap sortie, the MP was flying in the left seat. His most recent flight in the left seat of the MC-12W was 64 days prior, and the mishap sortie was his first flight in combat (Tabs G-3 to G-16 and G-61 to G-99). The MMC had a total of 1,749 hours, primarily in a KC-135. He had 242 combat hours in the MC-12W; however, he was not instructor qualified and the mishap sortie was his first ride as a "certifier" (Tabs G-17 to G-30, G-130 to G-160, T-7, and V-5.9 to V-5.10). The MSO and MTSO were both current and qualified, and both were highly experienced in the MC-12W (Tabs G-31 to G-43, G-44 to G-60, G-179 to G-181, and G-186 to G-189).

Both pilots were on their first MC-12W deployment and were inexperienced in their roles on the mishap sortie (Tabs G-5 to G-10, G-19 to G-22, and V-5.10). Their limited recent experience was compounded by the fact that they had not flown together in the past (Tabs V-5.11 and V-8.7).

(4) Vision Restricted by Meteorological Conditions. According to the DoD HFACS vision restricted by meteorological conditions is a factor, "when weather, haze, or darkness restricts the vision of the individual to a point where normal duties are affected" (Tab BB-11).

Sensor camera data, coalition surface personnel, and mIRC data indicate the crew's vision was restricted by clouds near the time of departure from controlled flight and they likely did not have a visually discernible horizon. Cloud tops reached 24,000 feet during the time of the mishap (Tabs V-10.4 to V-10.7, V-22.5, DD-50, and DD-53).

Weather is relevant because lack of external visual cues is almost universally causal to known instances of spatial disorientation. Spatial disorientation, which is a failure to correctly sense a position, motion, or attitude of the aircraft or one's self in reference to the ground, can lead to unrecognized dangerous aircraft attitudes. In this case, the mishap crew's visual cues were limited during their climb and initial departure from controlled flight, and their initial recovery actions would have occurred in an environment lacking a visually discernible horizon (Tab V-23.5 and DD-53 to 54).

5) Breakdown in Visual Scan is a factor "when the individual fails to effectively execute learned/practiced internal or external visual scan patterns leading to an unsafe situation" (Tab BB-9 to BB-10).

Breakdown in Visual Scan is relevant because increased attention on weather, the evolving mission, and other associated tasks may have resulted in a breakdown of the normal visual scan pattern (Tab DD-25). The cockpit voice recorder (CVR) indicates there were mission and weather-related task changes as the MP initiated his climb. The MA airspeed decreased from 150 knots to 116 knots during the final seconds of controlled flight. The MP's visual scan failed to timely identify the decreasing airspeed (Tabs N-2 and DD-25).

6) 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" (Tab BB-9).

Procedural Error is relevant because though the MP exercised a "max power" procedure in conjunction with the slow airspeed and subsequent stall warning, there is no evidence of an immediate pitch correction to reduce the angle of attack and avoid a stall (Tab N-3). Due to left-turning tendencies of propeller-driven aircraft, power application without reducing the angle of attack could lead to additional yaw in the same direction as the established turn. Both stall and yaw are necessary preconditions for a spin (DD-56 to DD 57). In addition, after departure from controlled flight, the MP delayed 15 seconds in executing a "power idle" procedure (Tabs N-3 and DD-25). Finally, the MP called "Whoa, pull up," and may have prematurely pulled up as a "No Computed Data" screen on the PFD would have prompted (Tab N-2). Pulling up too early will exacerbate either a spin or a spiral (Tabs DD-53 and DD-56).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

(1) AFI 11-2MC-12W, Volume 3, *Flying Operations*, 9 March 2012
(2) AFI 11-202, Volume 3, *General Flight Rules*, 22 October 2010
(3) AFI 51-503, *Aerospace Accident Investigations, 26 May 2010*

AFI 91-204, *Safety Investigations And Reports*, Attachment 5, 24 September 2008

NOTICE: All directives and publications listed above are available digitally on the AF Departmental Publishing Office internet site at: http://www.e-publishing.af.mil.

b. Other Directives and Publications Relevant to the Mishap

(1) Hawker Beechcraft, *Pilot Checklist – Model B300*, June 2011
(2) Hawker Beechcraft, *Superking Air B300/B300C Maintenance Manual*, 1 November 2012
(3) Operator's Guide, Pro Line 21 Avionics System with IFIS for the Beechcraft King Air, 9 December 2010
(4) Installation Manual, AHS-3000 Attitude Heading Reference System, 1 October 2002
(5) Installation and Operation Manual, Electronic Standby Instrument System, 23 February 2010
(6) Air Force Tactics, Techniques, and Procedures 3-1.MC-12W, 25 January 2013
(7) TO 51-00-00, Super King Air B300/B300C Maintenance Manual, 1 May 2008

c. Known or Suspected Deviations from Directives or Publications

None.

13. ADDITIONAL AREAS OF CONCERN

None.

3 July 2013

DONALD J. BACON
Brigadier General, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

MC-12W, T/N 09-0676
110 NM NORTHEAST OF KANDAHAR AIRFIELD, AFGHANISTAN
27 APRIL 2013

Under 10 U.S.C. § 2254(d) the opinion of the accident investigator 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. INTRODUCTION

On 27 April 2013, at 1243, local time in Afghanistan, the mishap aircraft (MA), an MC-12W, tail number 09-0676 impacted terrain 110 miles NE of Kandahar Airfield (KAF) while on a combat intelligence, surveillance, and reconnaissance (ISR) mission. The MA stalled in a climbing left turn, which developed into a spin then spiral. The MA was deployed to the 361st Expeditionary Reconnaissance Squadron (ERS), 451st Air Expeditionary Wing, KAF. The Mishap Mission Commander (MMC), Mishap Pilot (MP), Mishap Sensor Operator (MSO), and Mishap Tactical Systems Operator (MTSO) were killed instantly upon impact. The MA, valued at $19.8 million, was destroyed.

2. AIRCREW BACKGROUND

The crew of the MA, callsign Independence 08, were outstanding combat veterans, with impeccable reputations. The four combined had 8,824 flying hours, 4,845 combat hours, and 836 combat sorties. The two pilots, however, had most of their hours in other weapon systems. The MMC was assigned to Scott AFB, Illinois as an Aircraft Commander in the KC-135 and on temporary duty with the MC-12W program. He had 1,749 flying hours and 938 combat hours, with 242 flying hours in the MC-12W. The MP was assigned to Beale AFB, California as a new MC-12W Mission Commander. Previously, he was an Instructor Pilot in the EC-130H. He had 2,434 flying hours and 1,428 combat hours, with 38.5 hours in the MC-12W. The MSO was assigned to Tinker AFB, Oklahoma as an Instructor Air Surveillance Technician in the E-3 and on temporary duty with the MC-12W program. He had 3,147 flying hours and 1,057 combat hours, with 752 hours in the MC-12W. The MTSO was assigned to Beale AFB, California as a Tactical Systems Operator. He had 1,494 total flying hours and 1,422 combat hours predominantly in the MC-12W and other tactical ISR aircraft. These four represented America's best airmen and served numerous rotations in the Middle East putting their lives on the line for our nation.

3. MISHAP CAUSE

The cause of this mishap, supported by clear and convincing evidence, was a stall due to insufficient airspeed, while in a climbing left turn, which developed into a left spin followed quickly by a high-speed spiral, from which the flight crew was unable to recover. Additionally, I find, by a preponderance of evidence, each of the following three factors substantially contributed to the mishap: (1) orbit weather that impeded visibility and masked the horizon; (2) pilot inexperience in the MC-12W; and (3) known MC-12W program risks associated with sustaining required combat capability in theater. Cockpit recordings reveal the MP was in control of the aircraft when it entered the stall, spin and spiral, and that the MMC then took control to attempt recovery.

The MA departed KAF at 1157L and entered the orbit at 1229L at 20,000 feet (ft) mean sea level ((MSL), all altitudes are in MSL). The crew promptly identified a target and planned to optimize their orbit for this target after making a climb to get clear of weather. At 1241L, the MP started a climb to 23,000 ft and the MA's airspeed decreased from 150 knots calibrated airspeed (KCAS) to the last recorded airspeed of 116 KCAS, which led to the stall. The MP was climbing in autopilot and had not sufficiently advanced the throttles. Analysis of recorded tracking data from ISR networks showed the decreasing airspeeds, and the cockpit recording revealed both the MMC's and MP's realization that the MA's airspeed became too slow. The MP then applied maximum power about the same time as the stall, which developed into a left spin and then left spiral. The cockpit recording also indicates the MP likely pulled back on the yoke, which would have exacerbated the spin and spiral. The MMC then took control and reduced power for spin/spiral recovery, but power was not reduced until 15 seconds after spin entry. By then the MA had oversped. The MMC was unable to recover, and the MA impacted terrain less than 1 mile from where it stalled. Prior to impact, a portion of the right wing tip separated from the aircraft due to the stress placed on the wing.

4. SUBSTANTIALLY CONTRIBUTING FACTORS

(a) Orbit Weather: During mission planning the crew received a weather forecast that showed scattered clouds in the orbit area. By the time the MA entered the orbit, conditions were deteriorating with cloud decks above their 20,000 foot orbit and light to moderate turbulence, and the crew reported a "giant" cloud in its orbit area. Just prior to the stall, the sensor ball video showed the MA penetrating a large cloud impeding visibility before the MP initiated the climb. The lack of a visible horizon made it more difficult for the MP to recognize the MA's attitude and the loss of airspeed. The lack of a visible horizon also hindered the MMC's and MP's ability to recover the aircraft.

(b) Limited MC-12W Pilot Experience: Although an experienced EC-130H pilot, the MP only had 41.7 flying hours in the MC-12W and King Air 350. This was his first MC-12W combat mission and first MC-12W sortie in 45 days, though he did have one King Air 350 sortie in between. Also, the MP's hours were roughly divided between left and right seat time, where the duties differ considerably. While in the right seat, pilots typically are not flying the aircraft, but are performing ISR mission duties. Therefore, the MP had less "stick time" than the 41.7 hours indicate, having logged 21 primary hours. The MP missed two checklist items prior to taxi, and though corrected, this is an indicator of inexperience. Inexperience would have made the MP less familiar with the MC-12W, affecting his visual scan and instrument crosscheck proficiency, and making him more susceptible to task saturation while tracking his first target on his first mission. This delayed detection of the pitch, the decreasing airspeed, and the imminent stall. During spin and spiral recovery, inexperience likely caused him to pull vice relax the yoke, and delayed prompt reduction of power. Finally, it was also the MMC's first flight as a newly qualified certifier who was just completing his second month of his first MC-12W deployment.

This explains his delayed intervention in both preventing the stall and recovering the MA. Limited weapon system experience is common with MC-12W combat operations due to the high rate of crews temporarily assigned to the platform. This is a result of known program risks.

(c) MC-12W Program Risk: The MC-12W program was started in 2008 to field immediate ISR capability for combat operations in Iraq and Afghanistan and went from contract to first combat sortie in 8 months. This urgency led to several aspects of the program not being normalized, which created increased risk, particularly aircrew inexperience and lack of instructors in the combat zone. Most mission commanders are deployed with approximately 20 hours of MC-12W primary flight time. Additionally, numerous aircrews, known as "flow-throughs," are loaned to the program from other weapon systems for 9 months and then returned to their primary airframe, creating continuous inexperience in the program. Approximately 60 percent of the 361 ERS's aircrews, such as the MMC and MSO, were "flow-throughs" at time of the mishap.

Since all newly qualified pilots are sent to theater within one or two months of qualification, their first or second sortie after training is usually in combat. Consequently, the 9th Reconnaissance Wing is not able to provide mission ready "top-off" training like most Air Force weapons systems do for newly qualified pilots. The 361 ERS mitigates this risk by providing a 10-ride certification program for new aircrews, but their certification rides, or "top-off" training, are in effect their first combat missions. Compounding this, "flow-throughs" results in a low number of deployed MC-12W instructor pilots, so certification rides are done by "certifiers" rather than instructor pilots. At time of the mishap, the 361 ERS only had two instructor pilots: the squadron commander and operations officer. Although the best mitigation available, certifiers are not qualified MC-12W instructors, and often are qualified in the MC-12W for only 2 or 3 months when selected as certifiers. Further, some "flow-through" certifiers are not qualified as instructors in their primary weapons system and not trained on instructing while performing their mission. In this mishap, the MMC and new certifier, had only 2 months of flying the MC-12W in Afghanistan and was not an instructor in his primary aircraft, the KC-135. Moreover, with 20 percent of the aircrews rotating in and out of Afghanistan each month, it is not uncommon for pilots to fly together for the first time on a combat sortie, such as happened in this mishap. Unfamiliarity hampers crew coordination, and the MMC was slow to intervene in this mishap. The result of this program risk is inexperienced MC-12W pilots deployed in combat, and inexperience substantially contributed to this mishap.

Program risk also impacts training. Because of limited training resources and the high demand in theater, only two training flights are devoted to "transition" sorties focused on basic airmanship, and training on stall and spin recovery is limited. This led to many MC-12W pilots not being very familiar with the "Declutter" and "No Computed Data" modes that appear on the Pilot Flight Display when the aircraft attains extreme pitch and bank angles by pointing towards the horizon. In either a spin or spiral, these modes can cue the pilot to "pull up," by pointing towards the horizon, which is the opposite required for proper recovery. In this mishap, the evidence indicates the MP received such a cue and likely pulled on the yoke during the spin.

Increased risk in fielding the MC-12 has been accepted because of the MC-12W's substantial combat capability and urgent requirement. The MC-12W has found and tracked over 700 high value enemy combatants, leading to their death or capture. Additionally, the MC-12W provides daily over-watch for our ground forces, which has enabled countless coalition forces to return home alive and free from injury. This MC-12W over-watch enables our ground forces to conduct operations outside their bases knowing they have eyes and ears above them looking for threats.

I also considered whether icing, turbulence, autopilot malfunction, and lack of developmental or operational testing contributed to the mishap. Icing and turbulence did not. The crew mentioned trace icing once, and they mentioned the ride was "bumpy," but there is no indication of significant icing or turbulence immediately prior to the stall. Similarly, there is no indication, either on the cockpit recording or otherwise the autopilot malfunctioned. The telling factor is that the crew set a climb and let the airspeed decay, which caused the stall. Finally, the aerodynamic differences between the MC-12W and King Air 350 would logically affect the stall speed and recovery characteristics. Because the actual differences are unknown, I cannot find the lack of typical developmental or operational testing contributed to the mishap.

5. CONCLUSION

I find by clear and convincing evidence the cause of the mishap was a stall due to insufficient airspeed, while in a climbing left turn, which developed into a left spin followed quickly by a high-speed spiral, from which the crew was unable to recover. Additionally, I find, by a preponderance of evidence, each of the following three factors substantially contributed to the mishap: (1) orbit weather that impeded visibility and masked the horizon; (2) pilot inexperience in the MC-12W; and (3) known MC-12W program risks associated with sustaining required combat capability in theater.

3 July 2013

DONALD J. BACON
Brigadier General, USAF
President, Accident Investigation Board

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