

UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT



C-17A, T/N 00-0173

3RD WING

JOINT BASE ELMENDORF-RICHARDSON, ALASKA



**LOCATION: JOINT BASE ELMENDORF-RICHARDSON,
ALASKA**

DATE OF ACCIDENT: 28 JULY 2010

**BOARD PRESIDENT: BRIG GEN CARLTON D. EVERHART II
CONDUCTED IAW AIR FORCE INSTRUCTION 51-503**

EXECUTIVE SUMMARY

AIRCRAFT ACCIDENT INVESTIGATION

C-17A, T/N 00-0173 JOINT BASE ELMENDORF-RICHARDSON, ALASKA 28 JULY 2010

On 28 July 2010, at approximately 1822 hours local time (L), a C-17A, Tail Number 00-0173, executed a takeoff from Runway 06 to practice maneuvers for the upcoming 31 Jul 10 Arctic Thunder Airshow at Joint Base Elmendorf-Richardson. After the initial climbout and left turn, the mishap pilot executed an aggressive right turn. As the aircraft banked, the stall warning system activated to alert the crew of an impending stall. Instead of implementing stall recovery procedures, the pilot continued the turn as planned, and the aircraft entered a stall from which recovery was not possible. Although the pilot eventually attempted to recover the aircraft, he employed incorrect procedures, and there was not sufficient altitude to regain controlled flight. The aircraft impacted wooded terrain northwest of the airfield, damaged a portion of the Alaskan Railroad, and was destroyed.

The mishap aircraft was assigned to the 3rd Wing based at Joint Base Elmendorf-Richardson, Alaska. The mishap crew was an integrated crew with members from both the 249th and 517th Airlift Squadrons. The mishap crew consisted of the mishap pilot, the mishap copilot, the mishap safety observer and the mishap loadmaster. All four aircrew members died instantly. The mishap aircraft was valued at \$184,570,581. The impact also damaged Alaskan Railroad train tracks that transect the base. There were no civilian casualties.

The board president found clear and convincing evidence that the cause of the mishap was pilot error. The mishap pilot violated regulatory provisions and multiple flight manual procedures, placing the aircraft outside established flight parameters at an attitude and altitude where recovery was not possible. Furthermore, the mishap copilot and mishap safety observer did not realize the developing dangerous situation and failed to make appropriate inputs. In addition to multiple procedural errors, the board president found sufficient evidence that the crew on the flight deck ignored cautions and warnings and failed to respond to various challenge and reply items. The board also found channelized attention, overconfidence, expectancy, misplaced motivation, procedural guidance, and program oversight substantially contributed to the mishap.

Under 10 U.S.C. 2254(d), any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report, 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
C-17A, T/N 00-0173
28 JULY 2010

TABLE OF CONTENTS

SUMMARY OF FACTS	1
1. AUTHORITY and PURPOSE.....	1
a. Authority	1
b. Purpose.....	1
2. ACCIDENT SUMMARY.....	1
3. BACKGROUND	1
a. Pacific Air Forces.....	2
b. Air National Guard	2
c. Alaska Air National Guard.....	2
d. Unit Information	2
(1) 11th Air Force, Joint Base Elmendorf-Richardson, Alaska	2
(2) 3rd Wing, Joint Base Elmendorf-Richardson, Alaska	3
(3) 176th Wing, Joint Base Elmendorf-Richardson, Alaska.....	3
(4) 517th Airlift Squadron	3
(5) 249th Airlift Squadron	3
e. C-17A – Globemaster III	4
4. SEQUENCE OF EVENTS	4
a. Mission.....	4
(1) Aerial Demonstration Profile – Profile 3 (12-minute Profile)	4
(2) C-17 Aircrew Positions	5
(3) Airspace Considerations.....	6
b. Planning	6
c. Preflight.....	6
d. Summary of Accident	7
(1) Weather Observation Flight	7
(2) Aerial Demonstration Practice Flight (Mishap Sortie)	7
e. Impact.....	9
f. Egress and Aircrew Flight Equipment.....	9
g. Search and Rescue (SAR).....	9
h. Recovery of Remains	9
5. MAINTENANCE	9
a. Forms Documentation.....	9
b. Inspections	10
(1) Mishap Aircraft	10
(2) Mishap Engines	11
c. Maintenance Procedures	11
d. Maintenance Personnel and Supervision	11
e. Fuel, Hydraulic and Oil Inspection Analyses	11

f. Unscheduled Maintenance.....	12
6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS	12
a. Structures and Systems	12
b. Evaluations and Analyses	12
(1) Engine Performance	12
(2) Hydraulic Systems Performance	13
(3) Flight Control Systems Performance	13
(4) Stall Protection System: Stall Warning System and Angle of Attack Limiter System (ALS).....	15
7. WEATHER	16
a. Forecast Weather.....	16
b. Observed Weather.....	16
c. Space Environment	16
d. Operations	16
8. CREW QUALIFICATIONS.....	16
a. Mishap Aircraft Commander (MP).....	16
b. Mishap Copilot (MCP)	17
c. Mishap Safety Observer (MSO).....	17
d. Mishap Loadmaster (MLM)	18
9. MEDICAL	18
a. Qualifications	18
(1) Mishap Pilot	18
(2) Mishap Co-Pilot	18
(3) Mishap Safety Observer	18
(4) Mishap Load Master.....	19
b. Health.....	19
c. Pathology.....	19
d. Lifestyle	19
e. Crew Rest and Crew Duty Time	19
10. OPERATIONS AND SUPERVISION	20
a. Operations	20
(1) Total Force Integration (TFI)	20
(2) Operations Tempo	20
b. Supervision	20
11. HUMAN FACTORS	20
a. Introduction	20
b. Causal.....	21
(1) AE103 Procedural Error.....	21
(2) PC211 Overaggressive	23
c. Contributory	23
(1) AE205 Caution/Warning – Ignored and PP108 Challenge and Reply.....	23
(2) PC102 Channelized Attention.....	24
(3) PC206 Overconfidence	24
(4) PC210 Misplaced Motivation.....	25
(5) PC506 Expectancy	25

(6) OP003 Procedural Guidance/Publications	25
(7) OP006 Program Oversight/Program Management	26
12. GOVERNING DIRECTIVES AND PUBLICATIONS	27
a. Available Directives and Publications Relevant to the Mishap	27
b. Other Directives and Publications Relevant to the Mishap	27
c. Known or Suspected Deviations from Directives or Publications.....	28
13. ADDITIONAL AREAS OF CONCERN	28
a. 3 WG Aerial Demonstration Checklist	28
b. AFI 11-246, Vol. 6, Chp. 3, <i>Standard Profiles</i>	28
STATEMENT OF OPINION	30
1. OPINION SUMMARY	30
2. DISCUSSION OF OPINION	31
a. Cause: Pilot Error.....	31
(1) Procedural Error and Overaggressive.	31
(2) MP Failed To Employ Proper Stall Recovery Procedure.	32
b. Contributing Factors.	32
(1) Caution and Warning Ignored/Challenge and Reply.	32
(2) Channelized Attention.....	32
(3) Overconfidence and Expectancy	32
(4) Misplaced Motivation	33
(5) Procedural Guidance/Publications	33
(6) Program Oversight/Program Management.....	33
INDEX OF TABS.....	35

COMMONLY USED ACRONYMS AND ABBREVIATIONS

3 WG	3rd Wing	ERCC	Engine Running Crew Change
623	Air Force Form 623, On-the-Job Training Record	FAR	Federal Aviation Regulation
797	Air Force Form 797, Job Qualification Standard Continuation	FCC	Flight Control Computer
A1	Alpha One	FDP	Flight Duty Period
ADC	Air Data Computer	FDR	Flight Data Recorder
AETC	Air Education and Training Command	FEF	Flight Evaluation Folder
AF	Air Force	FS	Flight Surgeon
AFB	Air Force Base	FTU	Flying Training Unit
AFH	Air Force Handbook	G	Force of Gravity
AFI	Air Force Instruction	GO81	CAMS For Mobility
AFIP	Air Force Institute of Pathology	GRIP	Global Reach Improvement Plan
AFPAM	Air Force Pamphlet	HSC	Home Station Check
AFPET	Air Force Petroleum Office	HUD	Heads up Display
AFTO	Air Force Technical Order	IAW	In Accordance With
AFTTP	Air Force Tactics, Techniques and Procedures	IFE	In-Flight Emergency
AGL	Above Ground Level	IMDS	Integrated Maintenance Data System
AGE	Aerospace Ground Equipment	IP	Instructor Pilot
AIB	Aircraft Investigation Board	JBER	Joint Base Elmendorf-Richardson
AK	Alaska	K	Thousand
ALS	Angle of Attack Limiter System	kts	Knots
AMU	Aircraft Maintenance Unit	L	Local
AMXS	Aircraft Maintenance Squadron	LACM	Left Additional Crewmember
ANG	Air National Guard	Lt Col	Lieutenant Colonel
AOA	Angle of Attack	MA	Mishap Aircraft
APDMC	Air Propulsion Data Management Computer	Maj	Major
AS	Airlift Squadron	MAJCOM	Major Command
ATC	Air Traffic Controller	MC	Mishap Crew
AUX	Auxiliary	MCP	Mishap Co-Pilot
AWACS	Airborne Warning and Control System	MDG	Medical Group
BETTY	Computer Generated Voice	MISCAP	Mission Capability
C2	Command and Control	MLM	Mishap Loadmaster
CAMS	Computer Automated Maintenance System	MOC	Maintenance Operations Center
Capt	Captain	MP	Mishap Pilot
CIP	Core Integrated Processor	MS	Mishap Sortie
CMSgt	Chief Master Sergeant	MSL	Mean Sea Level
Col	Colonel	MSO	Mishap Safety Officer
COMMS	Communications	MXG	Maintenance Group
CRACM	Crew Rest Additional Crew Member	NCO	Noncommissioned Officer
CVR	Cockpit Voice Recorder	NCOIC	Noncommissioned Officer in Charge
Dash-1	A.F.T.O. 1C-17A-1 Flight Manual	NM	Nautical Miles
DO	Director of Operations	NOTAMS	Notices to Airmen
DoD	Department of Defense	OG	Operations Group
DSN	Defense Switch Network	OH	Ohio
EDP	Engine Driven Hydraulic Pump	“On Speed”	At a certain speed
EP	Emergency Procedures	OPR	Officer Performance Report
EPE	Emergency Procedures Evaluation	Ops Tempo	Operations Tempo
EPR	Engine Pressure Ratio	ORM	Operational Risk Management
ER	Exceptional Release	P&W	Pratt & Whitney
		PA	Public Affairs
		PACAF	Pacific Air Forces
		PACOM	Pacific Command
		PCS	Permanent Change of Station

PF	Pilot Flying	SOF	Supervisor of Flying
PHA	Physical Health Assessment	Sortie	Flight
PIT	Pilot Instructor Training	STAN EVAL	Standardization and Evaluation
PM	Pilot Monitoring	TACAN	Tactical Air Navigation
PR	Preflight Inspection	TCTO	Time Compliance Technical Order
PRO SUPER	Production Supervisor	TDY	Temporary Duty
PSI	Pounds Per Square Inch	Tech School	Technical School
PT	Physical Training	TFI	Total Force Integration
QA	Quality Assurance	TH	Thru-Flight
QC	Quality Check	T/N	Tail Number
QUAL	Qualification	TO	Technical Order
RACM	Right Additional Crewmember	TMS	Training Management System
RAP	Ready Aircrew Program	TSgt	Technical Sergeant
RED X	Safety of Flight	U.S.	United States
RPM	Revolutions per Minute	USAF	United States Air Force
SAR	Search and Rescue	VFR	Visual Flight Rules
SCEFC	Spoiler Controller/Electronic Flap Computer	V _{mco}	Minimum Climbout Speed
SEFE	Standardization Evaluation Flight Examiner	V _{mfr}	Minimum Flap Retract Speed
SFDR	Standard Flight Data Recorder	V _{msr}	Minimum Slat Retract Speed
SIM	Simulator	Vol.	Volume
S/N	Serial Number	WCC	Warning & Caution Computer
		Z	Zulu or 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 4 August 2010, General Gary L. North, Commander, Pacific Air Forces (PACAF), appointed Brigadier General Carlton D. Everhart II, to conduct an aircraft accident investigation of a mishap that occurred on 28 July 2010, involving a C-17A Globemaster III aircraft, tail number (T/N) 00-0173, at Joint Base Elmendorf-Richardson (JBER), Alaska (AK). The investigation was conducted at JBER, from 28 August 2010 through 27 September 2010. Technical advisors were [AIB Pilot Member], [AIB Maintenance Officer Member], [AIB Legal Advisor], [AIB Medical Advisor], [AIB Maintenance Enlisted Member], [AIB Recorder], and [AIB Court Reporter]. (Tab Y)

b. Purpose

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

2. ACCIDENT SUMMARY

At 1822 hours local time (L), 28 July 2010, the mishap aircraft (MA), a C-17A, T/N 00-0173, departed JBER to practice for the upcoming Arctic Thunder Airshow. The mishap crew (MC) consisted of the mishap pilot (MP), the mishap copilot (MCP), the mishap safety officer (MSO), and the mishap loadmaster (MLM). The MP performed a maximum power takeoff at 40 degrees nose high attitude. The MA leveled off at approximately 850 feet above ground level (AGL). The MP then executed a left-hand 80-degree turn, continued outbound for seven seconds, and then initiated a right 260-degree reversal turn. Five seconds into the right turn, the stall warning system activated. As the MP continued the maneuver, the MA's bank angle increased to 62 degrees. The MP utilized full right rudder and pulled the control stick aft, which stalled the aircraft. The aircraft ultimately reached a bank angle of 82 degrees and a descent rate of 9,000 feet per minute. The MA impacted wooded terrain northwest of the airfield and was destroyed. Additional damage occurred to Alaskan Railroad train tracks. The MA was valued at \$184,570,581. All four aircrew members died instantly. There were no civilian casualties.

3. BACKGROUND

The MA belonged to the 3rd Wing at JBER. It was operated by both the 517th Airlift Squadron (AS) and the Alaska Air National Guard (AK ANG) squadron, the 249th AS. The mishap crew (MC) included three Air National Guard (ANG) members, the MP, MLM, and

MSO, and one active duty member, the MCP. The MA took off from the JBER airfield and impacted approximately two miles north of the runway.

a. Pacific Air Forces

Pacific Air Forces' (PACAF) primary mission is to provide ready air and space power to promote US interests in the Asia-Pacific region during peacetime, through crisis and war. The command's vision is to be the most respected air warrior team employing the full spectrum of air and space power, with our Asia-Pacific partners, to ensure peace and advance freedom. PACAF's area of responsibility extends from the west coast of the United States to the east coast of Africa and from the Arctic to the Antarctic, more than 100 million square miles. The area is home to nearly two billion people who live in 44 countries. PACAF maintains a forward presence to help ensure stability in the region. (Tab FF-3)



b. Air National Guard



As provided under the United States Constitution, the ANG has a federal and state mission. Its federal mission is to provide a well-trained, well-equipped force available for prompt mobilization during national emergencies as well as supporting contingency operations. The Air National Guard provides almost half of the Air Force's tactical airlift support, combat communications functions, aeromedical evacuations, and aerial refueling, as well as being responsible for providing the total air defense of the entire United States. (Tab FF-6)

c. Alaska Air National Guard



The AK ANG has two flying wings, which includes the 176th Wing at Joint Reserve Base Elmendorf-Richardson, as well as a Space Warning Squadron. It has 1,900 members, and the headquarters is located at Camp Denali in Anchorage, AK. Most of the units are gained by PACAF when performing their federal missions. (Tab FF-9)

d. Unit Information

(1) 11th Air Force, Joint Base Elmendorf-Richardson, Alaska

The 11th Air Force plans, conducts, controls and coordinates air operations in accordance with (IAW) the tasks assigned by the PACAF commander, and is the force provider for Alaskan Command, the Alaskan Aerospace Defense Command Region, and other unified commands. Its units provide a network of critical air surveillance and command, control



and communications functions necessary to perform tactical warning and attack assessment in defense of Alaska. (Tab FF-12)

(2) 3rd Wing, Joint Base Elmendorf-Richardson, Alaska

The 3rd Wing is a composite wing composed of two groups and five flying squadrons operating the C-12, C-17, E-3, and F-22. It is located on JBER in Anchorage, AK. Its mission is to support and defend U.S. interests in the Asia Pacific region and around the world by providing units who are ready for worldwide air power projection and a base that is capable of meeting the Pacific Command's theater staging and throughput requirements. (Tab FF-14)



(3) 176th Wing, Joint Base Elmendorf-Richardson, Alaska



The 176th Wing is part of the AK ANG, and is also a composite wing composed of four groups and five flying squadrons operating the C-17, HC-130, HH-60, and E-3. Its units are located on Kulis Air National Guard Base and JBER, both of which are in Anchorage, AK, as well as Eielson Air Force Base (AFB) outside of Fairbanks, AK. Its mission includes search and rescue, tactical and strategic airlift, air control, and rescue coordination. (Tab FF-18)

(4) 517th Airlift Squadron

The 517 AS is part of the 3rd Wing, and it operates the C-17 and C-12 out of JBER. The squadron's primary missions are to support worldwide airlift, airdrop, and airland requirements while providing airlift for theater deployed forces and resupply of remote Alaskan long-range radar sites in support of the U.S. Pacific Command, the North American Aerospace Defense Command, and the U.S. Transportation Command. Its associate unit is the 249 AS, meaning that the two units utilize the same aircraft and mix aircrews for missions. The two units keep independent chains of command but share resources. (Tab FF-21)



(5) 249th Airlift Squadron



In September 2009 the 249 AS was officially activated by the Department of Defense as a squadron of the 176th Wing of the AK ANG. It is the associate unit of the 517 AS on JBER, and its members operate the C-17 inter-mixed with members of the 517 AS. Specifically, the 249 AS's mission is to recruit, train and provide combat-ready C-17 aircrews for global mobility missions that supply and sustain America's armed forces. (Tab FF-23)

e. C-17A – Globemaster III

The C-17 is capable of rapid strategic delivery of troops and all types of cargo to main operating bases or directly to forward bases in the deployment area. The aircraft can perform tactical airlift and airdrop missions and can also transport litters and ambulatory patients during aeromedical evacuations when required. (Tab FF-24)



The C-17 is approximately 174 feet long and has a wingspan of 169 feet, 10 inches, and its maximum takeoff weight is 585,000 pounds. It is powered by four, fully reversible F117-PW-100 (Pratt & Whitney PW2040) engines, each producing 40,440 pounds of thrust. The C-17 can cruise at 450 knots (kts), and its range is global with in-flight refueling.

The C-17 is crewed by a pilot, copilot, and loadmaster. The aircraft can perform missions as diverse as airdrop of 102 paratroopers or aeromedical transport of 54 patients. (Tab FF-24)

4. SEQUENCE OF EVENTS

a. Mission

The mishap sortie (MS) was a practice flight for the JBER Arctic Thunder Airshow, scheduled for the weekend of 31 July 2010. (Tab AA-5, AA-6) The sortie was authorized by the 176th Wing, in coordination with the 3rd Wing, and involved ANG and active duty Airmen from JBER. It was planned and briefed as an aerial demonstration proficiency and currency flight, involving one C-17A aircraft, Callsign Sitka 43. (Tab K-4) C-17 aerial demonstration flights typically consists of a single aircraft, which conducts a series of practice demonstration maneuvers, defined by Air Force Instruction (AFI) 11-246, Vol. 6, as “profiles”. There are four distinct profiles, the first three ranging from six to twelve minutes in length. The fourth incorporates an airdrop demonstration, where personnel or cargo are released from the aircraft via parachutes. For this particular flight, the mishap crew (MC) planned to fly the Profile 3, known as the 12-minute profile. (Tab BB-4 through BB-12)

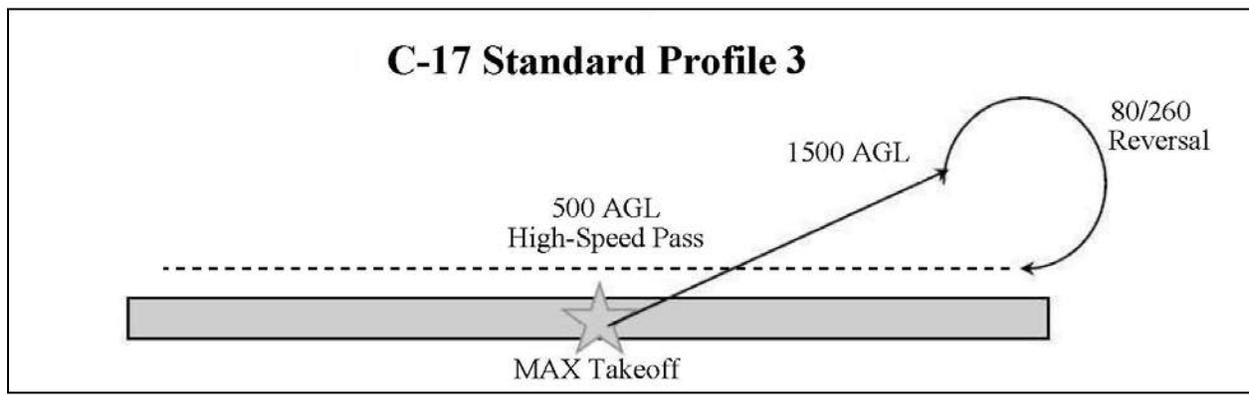
(1) Aerial Demonstration Profile – Profile 3 (12-minute Profile)

The relevant components of Profile 3 as related to this mishap were: maximum performance climb to 1,500 feet AGL, 80/260-degree reversal turn, and the 500-foot AGL high-speed pass. (Tab BB-6)

The maximum performance climb requires the pilot to pitch the aircraft nose upward to achieve minimum climbout speed, defined as V_{mco} . V_{mco} is the speed required to clear an

obstacle if the C-17 only has three of the four engines operating. This speed demonstrates the climb-capability of the aircraft. (Tab BB-6)

After climbout, the aircraft utilizes an 80/260-degree reversal turn to transition the aircraft from the original outbound direction in order to align with the runway and perform a high-speed pass. The demonstration pilot will perform the reversal turn in three segments. First, an 80-degree turn away from the initial heading establishes an outbound leg. Second, the aircraft flies to a safe distance from the runway. Third, a 260-degree reversal turn towards the runway. (Tab BB-4 through BB-12)



Profile 3 (Abbreviated)

The 500-foot AGL high-speed pass is accomplished by descending from 1,500 feet to 500 feet AGL during the 80/260-degree reversal turn. Upon reaching 500 feet, the aircraft accelerates to 250 kts, flying past the spectators at “show center” (the center of the viewing area; represented by the star in the diagram). (Tab BB-6)

(2) C-17 Aircrew Positions

The MP was the aircraft commander, and the pilot flying (PF) during the flight. He was in the left front seat during the MS. The MCP, also known as the pilot monitoring (PM), was in the right front seat. The MSO was in the right additional crew member (RACM) seat, and had a view of most of the flight deck displays and switches. (Tab N-5) The MLM was seated in the right-rear area of the cargo compartment. (Tab N-12)



(3) Airspace Considerations

The MS was flown in airspace controlled by Elmendorf Air Traffic Control Tower. The MC maintained radio contact with, and remained in sight of the tower throughout the flight. For safety purposes, Elmendorf airspace was only open to Sitka 43. (Tab N-21) Airfield operations published a Notice to Airman (NOTAM), to inform all aircraft operators of the planned demonstration practice. (Tab K-7)

b. Planning

The day prior to the mishap, between 0930 and 1100L, the MP, MCP, and MSO utilized the simulator (sim) to practice several aerial demonstration profiles, including Profile 3. (Tab V-77) Afterwards, the crewmembers completed their mission planning for the next day's aerial demonstration practice.

c. Preflight

On 28 July 2010, the MC arrived at the consolidated 517 / 249 AS building. The MP arrived at 0800, the MCP at 0901L, and the MSO and MLM at 1430L. The crew used Operational Risk Management (ORM) to evaluate mission risk. ORM is a decision-making process to systematically evaluate possible courses of action, identify risks and benefits, and determine the best course of action for any given situation. The ORM category for the mission was in the "Caution" range based on aircraft commander and squadron assessments. The "Caution" score was due to the complex and demanding nature of the mission. All crewmembers determined they were safe and prepared to fly the planned mission. (Tab AA-8)

Prior to the mission briefing, the Assistant Director of Operations informed the MC that they would accomplish an Engine Running Crew Change (ERCC) due to unscheduled maintenance on their originally assigned aircraft. (Tab V-44) During an ERCC, the incoming crew boards the aircraft and receives an aircraft status brief from the outgoing crew. The pilot and copilot positions are swapped-out one at a time, to ensure a qualified pilot is always at the controls. This is a commonly practiced procedure.

The MC briefed for the practice flight from approximately 1515 to 1615L. (Tabs V-400, AA-10, AA-11) Based on recovered documents, the crew reviewed and discussed NOTAMS, the weather forecast, and other pertinent safety of flight information. (Tabs F-7, K-6) The MP filed a Visual Flight Rules (VFR) flight plan, and planned to remain within 20 nautical miles of the airfield. (Tab K-3)

The crew arrived at the MA at approximately 1720L, and took control of the aircraft from the outgoing crew. During the ERCC, the outgoing crew briefed the aircraft had no malfunctions. (Tab V-401 through V-429)

d. Summary of Accident

(1) Weather Observation Flight

Thirty minutes prior to the mishap sortie, the MC flew the MA in the local area to observe the weather. The purpose of this flight was to determine if the weather was acceptable for their demonstration practice. During the nine-minute flight, the MC evaluated winds and observed flight conditions around the airfield. The MA flew normally and the weather was within limits. (Tab V-401 through V-429)

(2) Aerial Demonstration Practice Flight (Mishap Sortie)

After the weather observation flight, the MC landed and waited approximately 30 minutes to begin their aerial demonstration practice. (Tab V-401 through V-429) Once they received clearance, the MP aligned the aircraft on the runway and released brakes at 1821:31L. During the takeoff sequence, the MP “rotated” (raised the nose of the aircraft) and attained a maximum pitch angle of 40 degrees nose-high. (Tab L-3)

The target climbout airspeed was 133 kts. The highest airspeed attained during the climbout was 107 kts. As the aircraft passed 800 feet AGL, the MP initiated the first segment of the 80/260-degree reversal turn. He turned the aircraft left at 57 degrees of bank to a heading of 340 degrees and leveled-off at 852 feet AGL. After completing the turn, the MCP initiated flap retraction when the airspeed reached 151 kts. The minimum flap retraction speed (V_{mfr}) was 150 kts. The MP continued outbound for seven seconds as the flaps completed retraction. (Tab L-3)

The MP turned right at an initial bank angle of 53 degrees to begin the third segment of the 80/260-degree reversal turn. The MCP initiated slat retraction when the airspeed reached 188 kts. The minimum slat retraction speed (V_{msr}) was 193 kts. Five seconds into the right turn, the stall warning system activated. At this time, the MA’s configuration was full right rudder, the control stick aft, and slats retracting. The airspeed was 199 kts, 6 kts below stall airspeed. (Tabs L-3, CC-3 through CC-27, CC-60 through CC-68, DD-21)

When the stall warning occurred, the MCP responded “acknowledged crew . . . temperature, altitude lookin’ good.” (Tabs L-3, N-18, CC-3 through CC-27) The MP continued the turn using full right rudder, which increased the MA’s bank angle to 62 degrees. The maximum allowable bank angle for the C-17 is 60 degrees. (Tab BB-3) The MP also continued

to apply control stick pressure, which increased the force of gravity on the aircraft to a factor of 2.4. (Tabs L-3, CC-3 through CC-27)

Approximately 62 seconds into the mishap sortie, the MA stalled. By this time, the deep stall protection system (the Angle of Attack Limiter System (ALS)) was active, but was overcome by the MP's rapid and aggressive maneuvers. (Tabs L-3, BB-3, CC-3 through CC-27) Within seconds, the MA's bank angle increased to a maximum of 82 degrees. The aircraft began to descend and ultimately reached a descent rate of 9,000 feet per minute, as airspeed decayed to 184 kts. (Tabs L-3, CC-3 through CC-27, CC-60 through CC-68, DD-21)

One-and-a-half seconds into the stall, several events occurred simultaneously: the MCP said "not so tight, brother"; the MSO said "watch your bank" three times; and the MP moved the control stick full left, applied left rudder, but maintained constant control stick pressure. (Tabs L-3, N-18, CC-3 through CC-27)

Five seconds prior to impact, the slats fully retracted. Approximately two seconds prior to impact, the MP was able to initiate a left roll of the aircraft, however, the roll rate was minimal due to the stall. (Tab L-3, CC-3 through CC-27) The stall protection system remained active until impact.



e. Impact

The MA impacted wooded terrain northwest of the airfield at 63.6 degrees of right bank, 16.9 degrees nose-low at 184 kts on 28 July 2010 at 1822L. (Tabs L-3, CC-15) The MA exploded, burned for approximately 36 hours and was destroyed. (Tab H-4)

f. Egress and Aircrew Flight Equipment

All life support equipment on board the MA was inspected prior to takeoff and deemed serviceable by both aircrews. (Tab V-401) Due to the immediate destruction of the aircraft upon impact, there was no opportunity for the MC to use survival gear or life support equipment. (Tab H-6)

g. Search and Rescue (SAR)

At 1822L, JBER Fire Dispatch Center received notification of a C-17 crash. Emergency vehicles responded immediately. Battalion 2 (Command & Control Vehicle) and Engine 3 were the first units to arrive. Access to the site was extremely limited, with debris and fire scattered over a large area. Battalion 2 took initial command and directed other arriving vehicles into the crash area. Rescue personnel arrived in seven minutes and immediately began searching for potential survivors. No survivors were found. (Tab DD-8)

h. Recovery of Remains

Crash, fire, and rescue personnel were pivotal to recovery efforts. Remains were recovered from 30 July 2010 to 1 August 2010 and transferred to JBER Mortuary Affairs. (Tab DD-8 through DD-20)

5. MAINTENANCE

a. Forms Documentation

The 3rd Maintenance Group, 703rd Aircraft Maintenance Squadron, JBER, maintained the aircraft forms for the MA. All maintenance was documented on Air Force Technical Order (AFTO) 781 forms and in GO81 (Core Automated Maintenance System for Mobility). The purpose of AFTO 781 series forms is to document various maintenance actions. They are maintained in a binder specifically assigned to each aircraft. GO81 is an automated database of aircraft discrepancies, maintenance repair actions and flying history. The current AFTO 781 series forms were aboard the MA and destroyed in the crash. The historical AFTO 781 series forms revealed minor documentation errors, commonly found in maintenance forms. These minor errors were previously reconciled. A detailed 90-day review of records and forms revealed no evidence of mechanical, structural or electrical failure, which could have contributed to the mishap. (Tabs D-3, U-8 through U-82, U-111)

A comprehensive review of all AFTO 781 series forms and GO81 was accomplished to determine airworthiness of the MA. (Tab EE-3)

Time Compliance Technical Orders (TCTOs) are inspections or maintenance procedures required before specific dates or flight. The AFTO 781 series forms and GO81 track compliance times and dates. No TCTO's restricted the MA from flying. Historical records showed all TCTOs were accomplished IAW applicable guidance. TCTO non-compliance did not contribute to the accident. (Tabs D-3, U-8 through U-82, U-116)

Prior to the mishap sortie, the MA's total aircraft time was 13,361.6 hours. All four engines were Pratt and Whitney (P&W) F117-PW-100 turbofan engines. The #1 engine (left outboard engine), serial number (S/N) 00PW170316, had 11,619.7 hours total engine operating time with 9,836 operating cycles. The #2 engine (left inboard engine), S/N 00PW170333, had 9,523.6 hours total engine operating time with 7,883 operating cycles. The #3 engine (right inboard engine), S/N 00PW170049, had 14,300.2 hours total engine operating time with 10,627 operating cycles. The #4 engine (right outboard engine), S/N 00PW170348, had 11,276.7 hours total engine operating time with 5,875 operating cycles. (Tabs D-3, U-93, U-110)

The MA flew 126 flights, for a total of 302.9 hours, within 90 days of the mishap. There were no major maintenance discrepancies that would have prevented the MA from accomplishing the aerial demonstration mission on 28 July 2010. Also, historical records did not reveal any recurring maintenance problems. (Tabs D-3, U-3 through U-82)

b. Inspections

(1) Mishap Aircraft

Global Reach Improvement Program / Heavy Fleet Maintenance (GRIP) is a periodic cycle of in-depth inspections. These inspections usually coincide with the paint cycle of the aircraft. The C-17A GRIP cycle is every five years. The GRIP inspections are performed IAW Technical Order (TO) 00-20-1. The most recent GRIP inspection was completed 21 September 2007. The next inspection was due in 2012. (Tab D-3) The GRIP inspection was current and not contributory to the mishap. (Tab EE-3)

Home Station Checks (HSC) are periodic inspections performed in 180-day increments, encompassing a 720-day cycle. The HSC inspections are performed IAW TO 00-20-1. These on-site inspections are performed to ensure the airworthiness of the aircraft. The most recent HSC performed was completed on 15 April 2010. The next scheduled HSC was due on 12 October 2010. (Tab D-3) The HSC inspection was current and not contributory to the mishap. (Tab EE-3)

A Pre-Flight (PR) is a flight preparedness inspection performed prior to flight and is a valid inspection for 72 hours once completed. The PR inspections are performed IAW TO 00-20-1. The purpose of this inspection is to visually inspect and operationally checkout various areas and systems of the aircraft in preparation for a flying period. The most recent PR was performed on 26 July 2010, at 2200L, approximately 45 hours and 30 minutes prior to the incident. (Tab D-3) The PR inspection was current and not contributory to the mishap. (Tab EE-3)

A Thru-Flight (TH) inspection is a flight preparedness inspection performed between scheduled flights, when a new PR is not required. A TH is not required unless there is more than 6 hours ground time between scheduled flights. TH inspections are performed IAW TO 00-20-1. A TH was performed at 0430L, 28 July 2010, approximately 14 hours prior to the mishap. (Tab U-3) The TH inspection was current and not contributory to the mishap. (Tab EE-3)

(2) Mishap Engines

A bore scope inspection is a thorough inspection of the internal portions of each engine, using a flexible or rigid precision optical instrument. This procedure allows an inspection of the internal components without engine removal or disassembly. The #1, 2 and 3 engine bore scopes were performed 15 April 2010, with no defects noted. The number 4 engine, installed on the aircraft 25 June 2010, was disassembled, inspected, repaired, reassembled and tested per Pratt & Whitney specification on 28 October 2009. (Tab U-93 through U-110) The inspection cycles for all four engines were current and not contributory to the mishap.

c. Maintenance Procedures

The most-recent significant procedure performed on the MA was the exchange of the #4 engine on 25 June 2010. The engine had accumulated 99.1 hours since installation. Minor maintenance actions were performed on the aircraft prior to the mishap. There were no maintenance-related issues that contributed to the mishap. (Tabs U-8 through U-82, EE-3)

The MA flew a mission the morning of the mishap. At 1317L, the MA landed with no discrepancies. (Tabs U-3 through U-7, Tab V-21, V-110) The day-shift crew recovered the aircraft, refueled it according to second scheduled mission requirements, and subsequently launched the aircraft. No TH inspection was required. The second mission departed at 1537 hours. (Tab U-3 through U-7) When the MA landed, the second mission crew and the MC performed an ERCC. During the ERCC, no maintenance was required. (Tab V-19, V-20, V-401)

d. Maintenance Personnel and Supervision

All pre-mission activities were normal and all personnel involved in the recovery, refuel and launch of the MA were highly experienced and competent. A thorough review of maintenance training records (AF Form 623's and AF Form 797's) revealed all involved personnel were properly trained and qualified. (Tab V-16, V-17, V-109, V-110)

e. Fuel, Hydraulic and Oil Inspection Analyses

The 673rd Logistics Readiness Squadron, Fuels Laboratory, sent fuel samples from the two trucks that refueled the MA to the Air Force Petroleum Agency, Wright-Patterson AFB, OH for testing IAW TO 42B-1-1. All fuel samples were within limits and free of contamination. An additional sample was taken from the crash site and also tested by the Air Force Petroleum Agency. The results were inconclusive due to post-mishap contamination from clay particles. (Tab CC-29 though CC-41, CC-43 through CC-47)

The interim safety board collected hydraulic fluid samples from the wreckage, which Boeing analyzed. Boeing determined the fluid samples were “fairly typical for a sample of in-service fluid.” They also noted water contamination in the samples due to exposure to the environment and fire fighting measures. (Tab CC-42)

Engine oil samples were not obtained from the MA post-impact. The impact destroyed all four engine oil reservoirs and gearboxes. No viable samples were obtained. All four engines were performing properly throughout the flight, warranting no further investigation. (Tab L-3)

f. Unscheduled Maintenance

There was no unscheduled maintenance. (Tab V-21, V-112)

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

The AIB performed a thorough inspection of all aircraft systems and concluded all systems performed normally up to the time of impact. Analysis was verified by both Boeing and flight test experts. Various systems and aircraft computers were recovered, including: engines, flight control surfaces (portions of the right aileron surface, rudder surfaces, elevator surfaces, and their respective actuators), two Flight Control Computers (FCC), one Warning & Caution Computer (WCC), one Air Data Computer (ADC), one Spoiler Control / Electronic Flight Control Computer (SCEFC), one Core Integrated Processor (CIP) and one Air Propulsion Data Management Computer (APDMC). Inspection by component manufacturers and Boeing, as well as the Standard Flight Data Recorder (SFDR), confirmed each unit functioned normally prior to impact. (Tab CC-3 through CC-27, CC-48)

b. Evaluations and Analyses

(1) Engine Performance

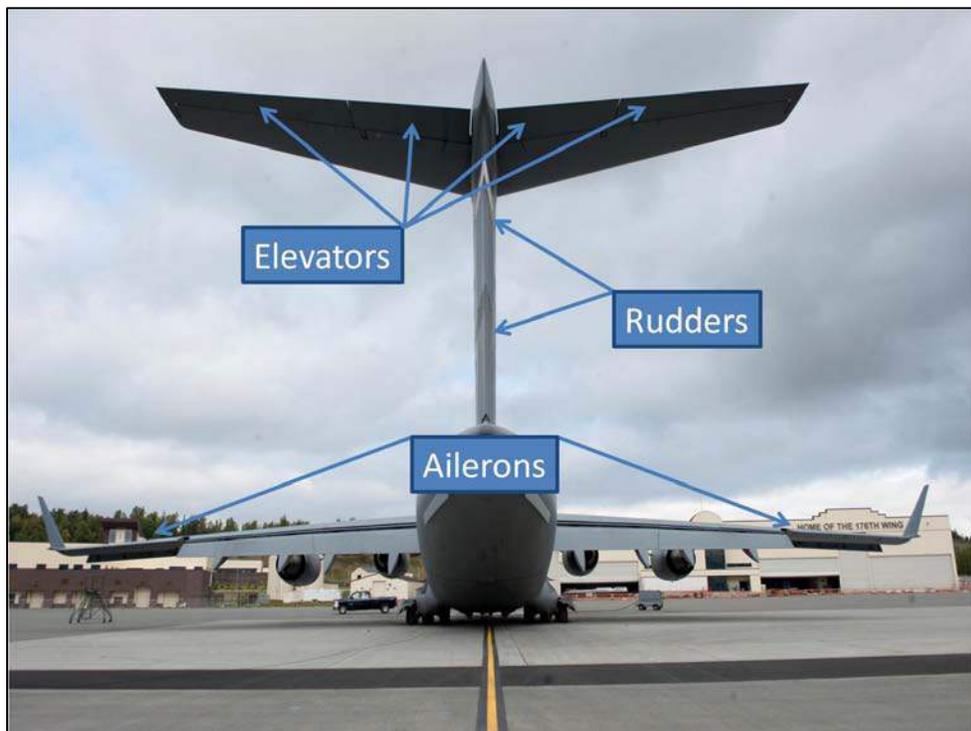
During the mishap sortie, all four engines were set to maximum thrust and remained so throughout the flight. All four engines maintained 92.5% High Pressure Compressor Revolutions per Minute (N2 RPM). This is the typical indication expected from a maximum thrust setting. The Engine Pressure Ratio (EPR) is an indication of the pressure of air exiting engine compared to the pressure of air entering the engine. This is an indication of the performance levels of each engine. EPR indications may vary in small levels due to atmospheric conditions, altitudes and the angle of attack (AOA) of the aircraft, limiting the amount of air available for utilization. The EPR indications of the MA were all stable throughout the flight, indicating there was no measureable lack of propulsion from the engines. All other temperature and fuel flow indications also support the viability of all four engines installed on the MA. A visual inspection of all engines was performed, indicating substantial damage from impact. There were no visual indications of engine malfunctions. (Tabs L-3, EE-3)

(2) Hydraulic Systems Performance

The C-17A has four independent hydraulic systems operating at 4,000 pounds per square inch (PSI). Each system is powered by engine driven hydraulic pumps (EDP). For redundancy, there is a primary and a secondary EDP installed on each respective engine. If primary EDP pressure drops below 3,400 PSI, the secondary EDP will engage to augment system pressure. A third electrically driven hydraulic pump augments each system, if needed. These pumps provide triple redundancy in each respective hydraulic system. All four hydraulic systems operating pressures were tracked and recorded on the SFDR. The data was analyzed to ensure proper systems operation. Pressures varied due to demand, but never fell below 3,536 PSI. This is well within the typical operating parameters. All four systems properly performed throughout the flight. (Tabs L-3, EE-3)

(3) Flight Control Systems Performance

The flight control system of the C-17A are separated into two categories: primary and secondary flight control surfaces. The primary flight control surfaces include the ailerons, elevators and rudders. (Tab EE-3)

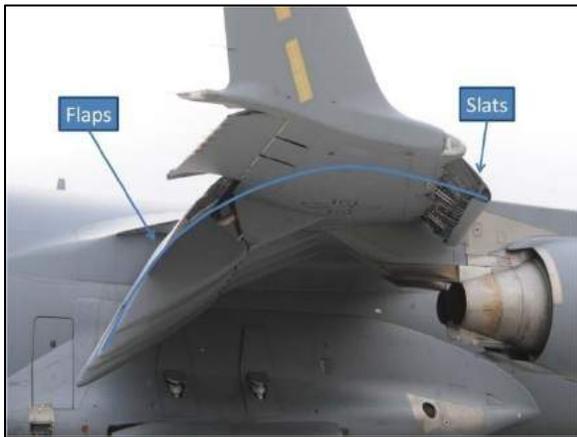


Primary Flight Controls

The ailerons control roll around the longitudinal axis (a theoretical line running from the nose to the tail of the aircraft). There are two ailerons, each one located towards the end of each wing. The elevators control rotation around the pitch axis (a theoretical line running from wingtip to wingtip), to raise and lower the nose of the aircraft. There are four elevators located

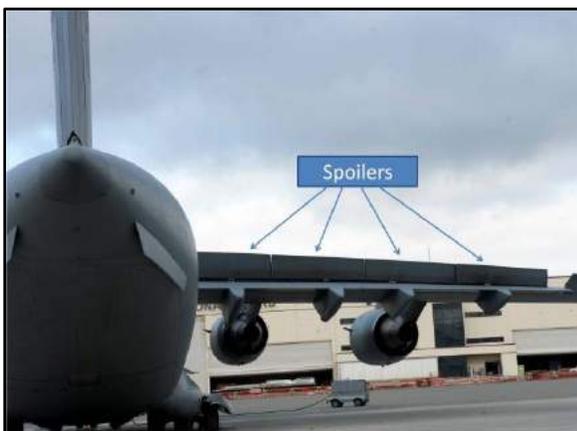
on the aft edge of the horizontal portion of the T-tail. The rudders control rotation around the vertical axis (a theoretical line running vertically through the center of the fuselage of the aircraft), moving the nose of the aircraft left or right. There are two rudders attached to the aft edge of the vertical stabilizer (the bottom or I portion of the T-tail). (Tab EE-3)

The secondary flight control surfaces assist the primary flight controls, and include the flaps, slats and spoilers. The purpose of the flaps and slats is to increase the surface area of the wing, forward to aft. The increased wing surface area provides substantially more lift. The additional surface area allows for slower airspeeds during takeoff and landing. (Tab EE-3)



Secondary Flight Controls (front and side views)

Slats extend from the leading edge (front) of the wing surfaces. Flaps extend from the aft edge of the wing surfaces. The spoilers are attached to the top of the wing surfaces, immediately forward of the flaps. One function of the spoilers in flight is to assist the ailerons in rotating the aircraft around the roll axis. (Tab EE-3)



Secondary Flight Controls (rear views)

All primary and secondary flight controls, except the spoilers, have two hydraulic actuators per surface. For redundancy, each actuator receives hydraulic pressure from separate systems. The system can sustain a complete hydraulic system failure with no noticeable effect upon flight characteristics. Additionally, each actuator is independently, mechanically linked to the flight control surfaces. (Tab EE-3)

Portions of the right aileron surface and actuator, both rudder surfaces, and all four elevator surfaces were recovered. The AIB maintenance advisors inspected all surfaces and verified the integrity of the actuators and actuator/surface attachment points. Various pictures of the actuators and attachment points are attached in this report. (Tab Z-4 through Z-9) There was no indication of structural or mechanical failure in any areas reviewed. (Tab EE-3)

A combination of visual verification of the integrity of the flight control surfaces, actuators and attachment points, SFDR data validating the flight control actuator positions throughout the flight, and video footage of the incident provide overwhelming evidence that all flight control systems were operating properly throughout the entire flight. (Tabs CC-3 through CC-27, EE-3)

(4) Stall Protection System: Stall Warning System and Angle of Attack Limiter System (ALS)

The stall warning system is designed to alert aircrew of an impending stall. It receives inputs from the engines and various aircraft sensors. The aircraft computer systems analyze these inputs, including: engine thrust settings, the number of engines running, AOA, sideslip angle, flap position, slat position, airspeed, altitude, pitch/roll rates and other parameters to determine the current stall speed. (Tab BB-3)

The stall warning system provides stick shaker and aural "STALL" alerts to the pilots. This system is continuously active and provides stall warning to the pilot when flight conditions approach a predetermined speed range, which is a function of flight conditions and aircraft configuration. In the event of invalid aircraft angle of attack (AOA) and/or aircraft configuration signals, a warning message is displayed in the cockpit when stall warning is not fully functional. (Tab BB-3)

The aircraft also has a deep stall protection system called the ALS. The purpose of the ALS is to preclude the aircraft from attaining AOA attitudes that could result in a deep stall from which the aircraft is not recoverable. ALS operates by limiting commanded nose up elevator position. A warning message is displayed in the cockpit when the ALS is not fully functional. (Tab BB-3)

As the ALS system became active, elevator surface outputs decreased, lessening the results from the MP's full aft stick inputs. This output, combined with a full left stick input resulted in an indicated return towards level flight, prior to impact.

A combination of SFDR data validating the flight control positions, video footage of the incident and the CVR provided overwhelming evidence that the stall protection system was

operating properly throughout the entire flight. (Tabs V-401 through V-429, CC-60 through CC-68, DD-21)

7. WEATHER

a. Forecast Weather

The weather requirement for a 3rd Wing aerial demonstration flight is a ceiling of 2,500 feet and visibility of five miles. (Tab O-7) The weather forecast for 28 July, 2010 predicted a broken cloud layer at 2,500 feet, and an overcast cloud layer at 5,000 feet. (Tab F-7) The term “broken” means clouds cover more than 62% to 87% of the sky, and “overcast” means the sky is totally covered with clouds. (Tab EE-16) The forecasted weather was as follows: visibility at six miles with light showers and rain; winds from 240 degrees at nine 9 kts; minimum altimeter setting 29.99 inches of mercury, and flight-level winds were not a factor. (Tab F-7)

b. Observed Weather

Observed weather prior to mishap sortie was within demonstration limits. (Tab F-5) Just prior to takeoff, the winds were 240 degrees at 4 kts, temperature 55 degrees Fahrenheit, and ceiling broken at 2,500 feet AGL with 10 miles of visibility and remained unchanged after the mishap. (Tabs N-20)

c. Space Environment

Not applicable.

d. Operations

Based on the forecast, the weather was within limits for the MS. (Tabs F-7, O-7) Weather did not contribute to the mishap.

8. CREW QUALIFICATIONS

a. Mishap Aircraft Commander (MP)

The MP was a current and qualified Evaluator Pilot with 3,251.6 total C-17 hours, including 974 instructor hours, and 124 evaluator hours. (Tab G-52)

Regulations require certification paperwork to be included in a member’s Flight Evaluation Folder (FEF). The FEF is a permanent record of aircrew qualifications. The MP’s FEF did not contain a certification letter, however the board was able to verify that proper training was accomplished. The MP completed initial demonstration training as a safety officer in December 2007. Subsequently, the MP completed demonstration pilot upgrade training in April 2008. (Tab G-3 through G-62, T-3 through T-6)

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

	Hours
Last 30 Days	16.7
Last 60 Days	19.2
Last 90 Days	26.8

(Tab G-53)

b. Mishap Copilot (MCP)

The MCP was a current and qualified Instructor Pilot (IP) with 1,913 total hours. These hours include 865.6 C-17 hours, and 1,048 hours in the T-1 training aircraft. He had 750 instructor hours, 49 of which were in the C-17. (Tab G-152)

The MCP completed demonstration training on 13 July 2010. The MCP's FEF did not contain a certification letter, however the board was able to verify that proper training was accomplished. (Tab G-125 through G-165, T-7).

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

	Hours
Last 30 Days	26.1
Last 60 Days	26.1
Last 90 Days	41.6

(Tab G-153)

c. Mishap Safety Observer (MSO)

The MSO was a current and qualified IP with 1,874 total hours. These hours include 862.9 C-17 hours, 923 F-16 hours, and 25 AT-38 hours. (Tab G-109, G-110)

The MSO completed initial demonstration training on 21 September 2009. He was qualified as a demonstration safety observer and copilot. He completed demonstration pilot upgrade training on 13 July 2010. The MSO's FEF did not contain a certification letter, however the board was able to verify that proper training was accomplished. (Tab G-64 through G-124, T-8)

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

	Hours
Last 30 Days	5.4
Last 60 Days	22.2
Last 90 Days	44.5

(Tab G-111)

d. Mishap Loadmaster (MLM)

The MLM was a current and qualified evaluator loadmaster with 5,398 total hours. These hours consisted of 1,163.7 C-17 hours, 2,868 hours in multiple C-130 variants, and 1,366 hours in the C-141B. As a C-17 loadmaster, he had 99 instructor hours, and 91 evaluator hours. (Tab G-210)

The MLM completed demonstration training on 9 July 2010. The MLM's FEF did not contain a certification letter, and no training was documented in the Training Management System (TMS). However, the board was able to determine that proper training was received. (Tab DD-5 through DD-7)

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

	Hours
Last 30 Days	2.0
Last 60 Days	54.0
Last 90 Days	144.3

(Tab G-211)

Crew qualifications were not a factor in this mishap.

9. MEDICAL

a. Qualifications

(1) Mishap Pilot

The MP was medically qualified for flight and worldwide duty per review of his medical record. His most recent annual flight physical and Periodic Health Assessment (PHA) were both performed on 17 July 2010. He also possessed a waiver for a minor medical condition. This waiver had an expiration date of 31 July 2013. (Tab EE-14, EE-15)

(2) Mishap Co-Pilot

The MCP was medically qualified for flight and limited worldwide duty. On 24 May 2010 the MCP presented to his local Flight Medicine Clinic for his annual flight physical and PHA. The PHA was completed, but due to a minor illness (for which he held a waiver) he was temporarily grounded. On 7 July 2010, he was returned to flying status. (Tab EE-14, EE-15)

(3) Mishap Safety Observer

The MSO was medically qualified for flight and worldwide duty per review of his medical record. His most recent annual flight physical was performed on 25 March 2010 and his most recent PHA was performed on 22 March 2010. No waivers were identified. (Tab EE-14, EE-15)

(4) Mishap Load Master

The MLM was medically qualified for flight and worldwide duty per review of his medical record. His most recent annual flight physical and PHA were performed on 7 December 2009. No waivers were identified. (Tab EE-14, EE-15)

b. Health

Medical records and individual histories revealed all individuals were in good health and had no recent performance-limiting illnesses prior to the mishap. After thoroughly reviewing the material described above, there was no evidence that any medical condition contributed to this mishap. (Tab EE-14, EE-15)

c. Pathology

The remains of the MC were recovered and positively identified. Injuries sustained by the MC were consistent with the nature of the mishap. All four crewmembers died instantly upon impact.

Toxicology testing was performed on the MC and 18 ground support personnel. Samples were submitted to the Armed Services Institute of Pathology for analysis. All results were negative with the exception of one maintenance member who tested positive for one substance. Further investigation revealed that this individual held a valid prescription and appropriate diagnosis for the medication detected during testing and was not a factor in the mishap. (Tab EE-15)

d. Lifestyle

No lifestyle factors were found to be relevant to the mishap.

e. Crew Rest and Crew Duty Time

All Air Force pilots are required to have “crew rest” IAW AFI 11-202, Vol. 3, prior to performing in-flight duties. AFI 11-202 states, in part, “Air Force aircrews require at least 10 hours of continuous restful activities including an opportunity for at least 8 hours of uninterrupted sleep during the 12 hours immediately prior to the FDP [(Flight Duty Period)]”. “The crew rest period is normally a minimum 12-hour non-duty period before the FDP begins. Its purpose is to ensure the aircrew member is adequately rested before performing flight or flight related duties. Crew rest is free time, which includes time for meals, transportation, and rest. Rest is defined as a condition that allows an individual the opportunity to sleep”.

There is no evidence to suggest that inadequate crew rest was a factor in this mishap.

10. OPERATIONS AND SUPERVISION

a. Operations

(1) Total Force Integration (TFI)

JBER units practice TFI, which encourages cooperation and enhances efficiency between active duty and guard units. Both 249 AS and 517 AS execute the TFI concept to its fullest, regularly integrating aircraft and crew. The MC was a TFI crew. The MP, MSO and MLM were members of 249 AS, and the MCP was a member of 517 AS. At JBER, TFI has a positive influence on mission and people. (Tabs R-26, R-44, V-302)

(2) Operations Tempo

Personnel demonstrated exceptional commitment to the mobility mission. Although both squadrons maintain a relatively high operations tempo, overtasking was not a factor in this mishap. (Tab R-13, R-21, R-66)

b. Supervision

The primary responsibility for supervision and execution of the aerial demonstration program at JBER is the 3 OG/OGV. (Tab O-5, O-6) There was confusion among demonstration program managers regarding the certification process and procedural guidance, and proper use of checklists. (Tab V-117, V-118, V-346)

The mishap crew utilized an unapproved document, which closely resembled the actual Technical Order checklist, but included several major modifications. Unapproved checklist use was widespread among 3rd Wing demonstration crewmembers in direct violation of Air Force regulations. The deviation did not contribute to the mishap. (Tabs AA-4, EE-7)

11. HUMAN FACTORS

a. Introduction

Human Factors contributing to this mishap were evaluated using the Department of Defense (DoD) Human Factors Analysis and Classification System (DoD-HFACS). (Tab BB-14 through BB-48) This guide is designed for use as a comprehensive event/mishap, human error investigation, data identification, analysis and classification tool. It is designed for use by *all members* of an investigation board in order to accurately capture and recreate the complex layers of human error in context with the individual, environment, team and mishap or event.

The DoD-HFACS classification taxonomy describes four main tiers of human factors that may contribute to a mishap. These four divisions include: *Acts, Pre-Conditions, Supervision, and Organizational Influences*. (Tab BB-17)

Acts are those factors that are most closely tied to the mishap, and can be described as active failures or actions committed by the operator that result in human error or unsafe situations. (Tab BB-19)

Preconditions are factors in a mishap if active and/or latent preconditions such as conditions of the operators, environmental or personnel factors affect practices, conditions or actions of individuals and result in human error or an unsafe situation. (Tab BB-20)

Supervision is a factor in a mishap if the methods, decisions or policies of the supervisory chain of command directly affect practices, conditions, or actions of individual and result in human error or an unsafe situation. (Tab BB-23)

Organizational Influences are factors in a mishap if the communications, actions, omissions or policies of upper-level management directly or indirectly affect supervisory practices, conditions or actions of the operator(s) and result in system failure, human error or an unsafe situation. (Tab BB-24)

The Board reviewed a substantial amount of evidence during its proceedings to include, but not limited to, cockpit voice recorder transcripts, flight data recorder information, video recordings, and witness interviews. Numerous human factors were relevant to the mishap, and the MC's actions during the mishap sortie were highly uncharacteristic of their experience level and reputation.

b. Causal

(1) AE103 Procedural Error.

Procedural Error is a factor when a procedure is accomplished in the wrong sequence or using the wrong technique or when the wrong control or switch is used. This also captures errors in navigation, calculation or operation of automated systems. (Tab BB-27)

The MP committed two procedural errors during the mishap sortie. He replaced aerial demonstration procedures with his own techniques; and failed to implement proper stall recovery procedures. (Tabs BB-4 through B-12, EE-16)

(A) Incorrect Combination of Aerial Demonstration Techniques (Energy Management)

The basic concept of energy management (i.e., maintaining sufficient speed and altitude for a specific aircraft configuration in order to sustain controlled flight) is paramount. Without proper energy management, an aircraft can enter a low energy state and depart controlled flight.

The MP committed pilot error by executing the demonstration profile using the following techniques:

- Attempted 60-degree bank turns, instead of the prescribed 45 degrees.

- A climbout to approximately 850 feet AGL instead of the AFI-directed altitude of 1,500 feet AGL.
- A climbout pitch angle of 40 degrees, instead of climbing out at a minimum climbout speed.
- Maintained full right rudder and control stick pressure to facilitate the 80/260 reversal turn.

These actions resulted in a low energy state that was insufficient to sustain controlled flight. Depending on conditions, these techniques, in and of themselves, may not be unsafe. However, when combined, they will diminish flight safety margins.

The stated purpose of the C-17 Aerial Demonstration program is to demonstrate aircraft capabilities, not to achieve maximum performance of the aircraft (“Max Perform”). (Tab BB-4 through BB-12) When flown IAW AFI 11-246, the profile results in an energy state sufficient to sustain safe flight. The MP’s execution of Profile 3 “max performed” the aircraft at the threshold of a stall. Flying at the threshold of a stall is the very definition of a low energy state.

The MP planned an aggressive and unsafe profile based on 60-degree bank turns in an effort to keep the aircraft as close to the show center as possible. (Tabs R-12, V-9, V-54, V-77, V-98, V-99, V-102, V-120, V-148, V-194, V-200, V-208) This plan forced him to minimize his timing on his outbound segments, and left him no alternative but to use 60 degrees of bank, fly through stall warnings, maintain control stick pressure, and use full rudder, in order not to cross the extended show centerline. (Tab V-28, V-29, V-31, V-54, V-79 through V-81, V-130, V-145, V-171, V-180, V-202, V-203, V-211, V-240)

During the mishap sortie, the MP used 40 degrees of pitch angle on initial takeoff without considering the minimum climbout speed (V_{mco}). He leveled-off at approximately 850 feet AGL, 26 kts below V_{mco} . This low altitude and airspeed led to an initially low energy state. Although the MA accelerated during the first and second segments of the 80/260-degree reversal turn, the MA’s overall energy state remained low. The configuration change, coupled with 60 degrees of bank, full right rudder and control stick pressure, further decreased the energy state, which led to the departure from controlled flight. (Tab CC-3 through CC-27, CC-60 through CC-68, CC-69, CC-70)

(B) MP Failed To Employ Proper Stall Recovery Procedure

The C-17 stall recovery procedure is: 1) apply forward stick pressure; 2) apply maximum available thrust; and 3) return to or maintain a level flight attitude. Large rudder inputs should be avoided. (Tab EE-16)

Despite numerous stall warnings during the mishap sortie, the MP continued to aggressively execute the 260-degree reversal turn. The MP failed to employ proper stall recovery procedures. Even when the MA stalled, the MP maintained control stick pressure, which did not sufficiently reduce the angle of attack to recover controlled flight. As a result, the

MA remained in a stall until impact. (Tabs V-401 through V-424, Tab CC-60 through CC-68, CC-69, CC-70)

(2) PC211 Overaggressive

Overaggressive is a factor when an individual or crew is excessive in the manner in which they conduct a mission.

The MC planned, briefed, and flew the mishap sortie Air Show Demonstration Profile with bank angles, altitudes, timing, and use of rudder beyond the procedures in AFI 11-246. (Tabs V-28, V-29, V-31, V-54, V-79 through V-81, V-92, V-94, V-98, v-102, V-120, V-130, V-142, V-145, V-171, V-175, V-180, V-200 through V-203, V-208, V-210, V-240, AA-12, AA-13, BB-14 through BB-23, CC-60 through CC-68, CC-69, CC-70, EE-9 through EE-12). Once certified as a demonstration pilot, the MP manipulated the standard profile to enhance the airshow performance. He planned and regularly flew 60 degrees of bank for the 80/260-degree maneuver with full rudder to minimize the turn radius and displacement from crowd. (Tabs V-9, V-29, V-31, V-54, V-77, V-98, V-99, V-102, V-120, V-148, V-194, V-200, V-202, V-208, V-210, V-240, AA-12, AA-13) During his upgrade training, an instructor counseled him for being “aggressive” to keep the turns “tighter to the runway”. (Tab V-148) The MP “was also very intent on crisp turns, roll in, roll out efficiently . . . providing a good show to the spectators”. (Tab V-208) In previous performances, the MP continued to execute his 260-degree reversal turn despite lengthy stall warnings. (Tabs O-44, V-55, V-68, V-71, V-97, V-188, V-277, EE-9 through EE-12)

On the day of the mishap sortie, the MP’s techniques diminished flight safety margins, and caused the aircraft to stall. Specifically, he planned for an initial climbout altitude range of 1,000 to 1,500 feet AGL at 35 to 40-degree nose high attitude, while disregarding minimum climbout speed. During climbout, the MP achieved a 40-degree nose-high attitude, and flew 26 kts below a safe climbout speed. (Tabs AA-12, AA-13, CC-60 through CC-68) An average nose-high attitude for the initial climbout is 25-35 degrees. (Tab V-33, V-236) Executing maneuvers below the minimum climbout speed is a safety-of-flight issue, and is not advised. Additionally, the MP disregarded the stall warning when it activated during the 260-degree reversal turn. It remained active until impact; a total of 12 seconds. (Tab CC-3 through CC-27) The MP’s overaggressive actions also caused the mishap.

c. Contributory

(1) AE205 Caution/Warning – Ignored and PP108 Challenge and Reply.

Caution/Warning – Ignored is a factor when a caution or warning is perceived and understood by the individual but is ignored by the individual leading to an unsafe situation.

Challenge and reply is a factor when communications did not include supportive feedback or acknowledgement to ensure that personnel correctly understood announcements or directives.

As the lead C-17 aerial demonstration pilot for JBER, the MP routinely instructed and planned to ignore stall warnings during aerial demonstrations. Five seconds into 260-degree reversal turn, the stall warning system activated. In response, the MCP said “Acknowledged Crew . . . Temperature, altitude lookin’ good.” Although the warnings continued, the MP neither replied nor adjusted his control inputs, and continued the turn. The MP made no attempt to implement stall recovery procedures, and neither MCP nor MSO directed recovery until the MA stalled. (Tabs V-401 through 429, CC-60 through CC-68)

The MP also routinely instructed demonstration co-pilots to retract flaps and slats “on speed” automatically, without a challenge or reply. (Tab V-33, V-95, V-171, V-240, V-344) During this mishap sortie, the MCP automatically retracted flaps and slats, as trained. This resulted in the MCP retracting the slats five kts below V_{msr} . There is no indication that the MP or MSO understood the configuration of the MA. (Tabs V-401 through V-429, CC-60 through CC-68) Automatically configuring the aircraft does not provide supportive feedback or acknowledgement to ensure situational awareness.

(2) PC102 Channelized Attention

Channelized Attention is a factor when the individual is focusing all conscious attention on a limited number of environmental cues to the **exclusion** of others of a subjectively equal or higher or more immediate priority, leading to an unsafe situation. May be described as a tight focus of attention that leads to the exclusion of comprehensive situational information.

The MP displayed two instances of channelized attention. First, the MP continued to aggressively turn the MA in a low energy state, while ignoring the stall warning system. The MP intended to fly crisp, tight, aggressive maneuvers, in an attempt to keep the aircraft close to show center. (Tabs V-9, V-29, V-31, V-54, V-77, V-98, V-99, V-102, V-120, V-148, V-194, V-200, V-202, V-208, V-210, V-240, AA-12, AA-13) Second, when the stall occurred, the MP moved the control stick full left. However, the MP maintained control stick pressure and applied left rudder. Maintaining these control inputs did not sufficiently reduce the angle of attack to recover controlled flight. As a result, the MA remained in a stall until impact. (Tabs V-401 through V-429, CC-60 through CC-70)

(3) PC206 Overconfidence

Overconfidence is a factor when the individual overvalues or overestimates personal capability, the capability of others or the capability of aircraft/vehicles or equipment and this creates an unsafe situation.

During simulator training, the MP taught stall warnings were an “anomaly.” The warnings were considered inaccurate and transitory due to aggressive aerial demonstration maneuvers. The MP “was not concerned” about stalling in the profile. The MP also believed these warnings would cease at completion of the turns and not adversely affect the aircraft. (Tab V-205, V-207) He flew numerous aerial demonstrations in the aircraft with the stall warnings active and without incident. (Tabs V-55, V-68, V-71, V-97, V-188, V-277, EE-9 through EE-12) The MP’s overconfidence in both his abilities and the C-17 capabilities led to the stall.

(4) PC210 Misplaced Motivation

Misplaced Motivation is a factor when an individual or unit replaces the primary goal of a mission with a personal goal.

The MP wanted to “put on a good airshow,” keeping his turns crisp, tight, and aggressive. The MP planned a compressed profile based on timing and 60-degree bank turns. The MP utilized unsafe techniques in an effort to keep the aircraft as close to the airfield as possible, impress the crowd, and improve the airshow. (Tabs V-9, V-29, V-31, V-54, V-77, V-98, V-99, V-102, V-120, V-148, V-194, V-200, V-202, V-208, V-210, V-240, AA-12, AA-13) As previously stated, the purpose of the C-17 Aerial Demonstration program is to demonstrate aircraft capabilities, not to max perform the aircraft. (Tab BB-4 through BB-12) The MP’s enthusiasm “to put on a good show” for the spectators benefit led him to plan an aggressive and unsafe profile.

(5) PC506 Expectancy

Expectancy is a factor when the individual expects to perceive a certain reality and those expectations are strong enough to create a false perception of the expectation.

The MC consistently planned, practiced and flew the profile, with the stall warnings activated during the 260-degree maneuver. (Tabs V-55, V-68, V-71, V-97, V-188, V-277, EE-9 through EE-12) Additionally, the MP taught aerial demonstration pilots that the stall warning was an anomaly or otherwise transient. (Tab V-205, V-207) He believed these warnings would cease at some point during the maneuver and not adversely affect the aircraft. (Tabs V-55, V-68, V-71, V-97, V-188, V-277, EE-9 through EE-12) When the MC experienced the same warnings during the mishap sortie, they responded as trained. The MC falsely perceived the aircraft would not stall.

(6) OP003 Procedural Guidance/Publications

Procedural Guidance/Publications is a factor when written direction, checklists, graphic depictions, tables, charts or other published guidance is inadequate, misleading or inappropriate and this creates an unsafe situation.

Air Force Policy Directive (AFPD) 11-2, *Aircraft Rules and Procedures*, para. 1 states:

*“The Air Force establishes rules and procedures that meet global interoperability requirements for the full range of aircraft operations. **Adherence to prescribed rules and procedures is mandatory for all personnel involved in aircraft operations.**” (Emphasis added.)*

AFI 11-246, Vol. 6, Chp. 3, describes the Air Show Demonstration profiles for the C-17 aircraft. The AFI states in the *General Instructions*:

“Aircrews from all MAJCOMS will adhere to the flying procedures in Profiles 1 through 4. Profiles 1, 2 and 3 are demonstrations of Aircraft High Performance Maneuvering.” (Tabs O-30, BB-4 through BB-12, Emphasis added.)

In or around April 2008, the MP underwent aerial demonstration upgrade training and was recommended as a safety observer. (Tab T-3 through T-6) The MP’s initial instructor taught crews “to start lowering the nose at 1000 feet while continuing to climb to 1500 feet AGL” on the initial take-off. Additionally, he taught to make the initial 80-degree turn at a speed 15 kts above flap retract speed. He taught that the use of rudder was a technique, but “always taught that there was no requirement for use of the rudder on this airplane.” The instructor stressed AFI 11-246, Vol. 6, Chp. 3 is “procedure,” not technique. (Tab V-158 through V-160, V-164)

In or around December 2008, the MP completed upgrade training as a demonstration pilot. (Tab T-3 through T-6) During this training, his upgrade instructor emphasized adherence to AFI 11-246. He also taught MP to “level off at 1500 feet” on the initial climbout; the use of a longer outbound segment allows for greater airspeed and displacement from the runway; the use of bank angles and rudder to avoid overshooting the “extended runway centerline” for safety reasons. (Tab V-141, V-142, V-145)

Once certified as a demonstration pilot, the MP manipulated the standard profile to enhance the airshow performances. Specifically, he planned for an initial climbout altitude range of 1,000 to 1,500 feet AGL at 35 to 40 degree nose high attitude, while disregarding minimum climbout speed. He also planned and regularly flew 60 degrees of bank for the 80/260-degree maneuver with full rudder to minimize the turn radius and displacement from crowd. (Tabs V-9, V-29, V-31, V-54, V-77, V-98, V-99, V-102, V-120, V-148, V-174, V-194, V-200, V-202, V-208, V-210, V-240, AA-12, AA-13, EE-9 through EE-12)

Although the first paragraph on page 3 in AFI 11-246, Vol. 6, Chp. 3 states, “The procedures in these profiles are general guidelines”, it also directs that “Aircrews will not deviate from the mission plan except for safety considerations.” (Tabs O-32, BB-13, Emphasis added) The MP’s aerial demonstration technique violated the intent of the AFI. They are inappropriate and created an unsafe situation.

(7) OP006 Program Oversight/Program Management

Program Oversight/Program Management is a factor when programs are implemented without sufficient support, oversight or planning and this leads to an unsafe situation.

The MP had a reputation in both squadrons of being an extremely precise and knowledgeable aviator. His extensive experience as a simulator instructor and his 3,251 total C-17 hours garnered him the utmost respect from squadron leadership and his peers. (Tabs

R-12, R-27, V-53, V-149, V-222, V-262, V-263, V-298, V-394, DD-3, DD-4) They also held his instructor abilities in the highest of esteem. (Tabs R-12, R-27, R-44, R-45, V-394)

Because he was an accomplished aviator, leadership allowed him to operate independently with little or no oversight. Prior to the mishap, 3 OG Commander took a vested interest in the C-17 aerial demonstration program for the upcoming airshow. He was scheduled to fly onboard the MA in order to evaluate the performance of the MC. However, due to a last minute F-22A fighter aircraft emergency, he could not attend the scheduled flight. (Tab V-220, V-221) 176 OG Commander also intended to observe demonstration flights, but was TDY during the times they practiced. (Tab V-396)

From the time of the MP's certification as a demonstration pilot to this mishap, his supervisors assumed he was within regulatory compliance, and did not inquire or review the MP's techniques or performances. (Tabs R-27, R-45, V-292, V-311 through V-313, V-370) Without checks and balances, the MP's aerial demonstration techniques evolved into an unsafe program.

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Available Directives and Publications Relevant to the Mishap

- (1) Air Force Policy Directive (AFPD) 11-2, *Aircraft Rules and Procedures*, 14 January 2005
- (2) Air Force Instruction (AFI) 90-901, *Command Policy*, 1 April 2000
- (3) AFI 11-202, Volume 3, *General Flight Rules, Flying Operations*, 5 April 2006
- (4) AFI 11-209, *Aerial Event Policy And Procedures, Flying Operations*, 4 May 2006
- (5) AFI 11-209, *Aerial Event Policy And Procedures, Flying Operations*, 4 May 2006, Pacific Air Forces Command, Supplement
- (6) AFI 11-209, *Aerial Event Policy And Procedures, Flying Operations*, 4 May 2006, Air National Guard, Supplement
- (7) AFI 11-246, Volume 6, *Air Force Aircraft Demonstrations (C-17, C-130, C-141, C/KC/NKC-135, UH-1)*, 20 April 2004
- (8) AFI 11-2C-17, Volume 3, *C-17 Operations Procedures, Flying Operations*, 15 December 2005
- (9) AFI 90-901, *Operational Risk Management, Command Policy*, 1 April 2000)
- (10) PACAF Concept of Operations implementing AFI 11-246, Volume 6, *Air Force Aircraft Demonstrations (C-17, C-130, C/KC/NKC-135, UH-1)*, 1 April 2007

b. Other Directives and Publications Relevant to the Mishap

- (1) AETC Handout, *Flying Training, Introduction to Aerodynamics*, January 2002
- (2) Air Force Handbook 203, Volume 1, *Flying Operations, Weather for Aircrews*, 1 March 1997
- (3) AFTTP 3-3.C-17, *Combat Aircraft Fundamentals – C-17, Tactical Doctrine*, 21 May 2007
- (4) TO 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, And Procedures*, 30 April 2003, Change 4 - 1 September 2006

- (5) TO 1C-17A-1, *Flight Manual*, C-17A Aircraft, 15 March 2010
- (6) TO 1C-17A1-1, *Performance Data*, C-17A Aircraft, 15 August 2008
- (7) TO 1C-17A-1CL-1-1, *C-17A Pilot's Fanfold Checklist Rev. 34*, 15 March 2010
- (8) TO 1C-17A-1-2, *Mission Computer*, C-17A Aircraft, 15 March 2010
- (9) TO 1C-17A-2-71GS-00-1, *General Systems, Organizational Maintenance, Power Plant*, 1 June 1995, Change 35 - 29 April 2010
- (10) TO 1C-17A-2-29GS-00-1, *General Systems, Organizational Maintenance, Hydraulic Power*, 1 November 1995, Change 26 - 1 March 2010
- (11) TO 1C-17A-2-27GS-00-1, *General Systems, Organizational Maintenance, Flight Controls*, 1 April 2010
- (12) TO 1C-17A-2-00GV-00-1, *General Systems, Organizational Maintenance, General Vehicle Manual*, 1 November 1995, Change 36 - 4 March 2010
- (13) Department of Defense Human Factors Analysis and Classification System, 11 January 2005

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

c. Known or Suspected Deviations from Directives or Publications

- (1) AFI 11-246, Volume 6, *Flying Operations*, 20 April 2004
- (2) TO 1C-17A-1CL-1-1, *C-17A Pilot's Fanfold Checklist Rev. 34*, 15 March 2010

13. ADDITIONAL AREAS OF CONCERN

a. 3 WG Aerial Demonstration Checklist

The MC utilized an “3 WG Aerial Demonstration Checklist”, which is unapproved. (Tab V-401 through V-429) The document resembled the official Dash-1 Fanfold (TO 1C-17A-1CL-1-1) with the following modifications: inserted sub-checklists, order of precedence and sequencing changes, and reassigned challenge and response items between the MCP and MSO. Although the unapproved document contained some potentially valid aerial demonstration techniques, several steps required by the official Dash-1 Fanfold were minimized or modified.

b. AFI 11-246, Vol. 6, Chp. 3, *Standard Profiles*

When asked whether AFI 11-246 contained guidelines or procedures, most JBER C-17 aerial demonstration aircrews answered that they are “guidelines” or could not remember. (Tab V-96, V-133, V-177, V-203, V-334, V-345) AFI 11-246, Vol. 6, Chp. 1, states “MAJCOMS operating these aircraft to perform aircraft demonstrations **will adhere to the Standard Profiles** in Chp. 3.” (Tabs O-30, BB-4 through BB-12, Emphasis added.) Although the first paragraph

on page 3 states, “The procedures in these profiles are general guidelines”, Air Mobility Command Standardization and Evaluations (AMC/A3V) emphasized that “crews flying demonstration profiles are to follow the mission plan as described, deviating only for safety considerations.” (Tab BB-13)

27 September 2010

CARLTON D. EVERHART II, Brig Gen, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

C-17A, T/N 00-0173 JOINT BASE ELMENDORF-RICHARDSON, ALASKA 28 JULY 2010

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

1. OPINION SUMMARY

By clear and convincing evidence, I find the cause of the mishap was pilot error. The mishap pilot (MP) violated regulatory provisions and multiple flight manual procedures, placing the aircraft outside established flight parameters and capabilities. During the mishap sortie, the MP aggressively flew the aircraft, resulting in a stall. Finally, the MP failed to initiate mandatory stall recovery procedures ultimately leading to the loss of the aircraft and all crewmembers.

On 28 July 2010, at 1822L, a C-17A, T/N 00-0173, departed JBER Runway 06 to practice for the upcoming Arctic Thunder Airshow. During the takeoff sequence, The MP performed a maximum power takeoff and attained a pitch angle of 40 degrees nose high. The target climb out airspeed was 133 knots (kts); however, the highest airspeed attained during the climb was 107 knots. As the aircraft passed 800 feet above ground level (AGL), the MP initiated an 80/260-degree reversal turn maneuver with 57 degrees left bank and utilized full left rudder. The mishap aircraft (MA) eventually leveled off to approximately 850 feet AGL versus the mandated 1,500 feet AGL. With the turn complete, the mishap copilot (MCP) initiated flap retraction and the MA continued outbound for seven seconds. (Tabs L-3, CC-3 through CC-27, CC-60 through CC-68, DD-21)

During the outbound segment, the flaps completed retraction. The MA then began a right 260-degree reversal turn with an initial bank angle of 53 degrees. Almost immediately, the MCP initiated slat retraction at 188 kts. The minimum slat retraction speed was 193 kts. Five seconds into the turn with the MA's airspeed six kts below stall speed, the stall warning system activated. Despite the warning, the MP continued maneuvering the MA, failing to initiate stall recovery procedures. Bank angle increased to 62 degrees while the MP maintained 2.4Gs with full right rudder. Additionally, the MCP and mishap safety officer (MSO) did not recognize the developing dangerous situation, and allowed the pilot to continue with the flight profile. (Tabs L-3, CC-3 through CC-27, CC-60 through CC-68, DD-21)

Approximately 62 seconds into the mishap sortie, the MA stalled. Throughout the stall condition, the MP failed to relinquish control stick pressure. As the stall deepened, the MA's bank angle increased rapidly to a maximum of 82 degrees causing it to descend as airspeed decayed to 184 kts. The aircraft ultimately reached a descent rate of 9,000 feet per minute.

Although the pilot eventually executed partial stall recovery procedures, there was insufficient altitude to recover controlled flight. The stall protection system remained active until impact. (Tabs L-3, CC-3 through CC-27, CC-60 through CC-68)

The aircraft impacted wooded terrain northwest of the airfield, damaged a portion of the Alaskan Railroad, and was destroyed. All four crewmembers died instantly.

I developed my opinion by analyzing factual data from historical records, Air Force directives and guidance, engineering analysis, witness testimony, and information provided by technical experts. In addition, the AIB obtained an animation provided by an Aeronautical Systems Center Studies & Analysis technician. (Tab DD-21) I used the animation in conjunction with Boeing engineering analysis and Standard Flight Data Recorder (SFDR) data to determine the mishap sequence of events.

2. DISCUSSION OF OPINION

a. Cause: Pilot Error

(1) Procedural Error and Overaggressive.

MP flew the aircraft in a manner that violated regulatory provisions and flight manual guidance. His aggressive flying placed the aircraft outside viable flight parameters at an altitude and attitude where recovery was not possible. The MP applied a series of procedural errors (improper techniques) that, when combined, resulted in a stall beyond the pilot's recovery capability. Additionally, he flew aggressive aerial demonstration profiles while max performing the aircraft. (Tabs L-3, V-401 through V-429, AA-12, AA-13, BB-4 through BB-13, CC-3 through CC-27, CC-60 through CC-68, EE-16)

- Executed climbout to 850 feet AGL instead of 1,500 feet AGL
- The MP focused on a climb pitch angle of 40 degrees instead of a minimum climbout speed
- Exceeded 60-degree bank turns instead of prescribed 45 degrees
- Failed to execute stall recovery procedures
- Maintained control stick pressure and rudder during stall condition

The MP's errors diminished flight safety margins, and caused the aircraft to stall. First, he executed a level off at approximately 850 feet despite Air Force Instruction (AFI) requirements of 1,500 feet. Second, the MP climbed in a 40-degree nose high attitude, and disregarded minimum climbout speed. He flew the climbout 26 kts below the V_{mco} , greatly reducing his safety margin. Third, he planned and executed the profile at 60 degrees of bank in violation of AFI 11-246. Fourth, the MP failed to execute stall recovery procedures when the stall warning activated. Fifth, after the aircraft stalled, the MP maintained control stick pressure and rudder, making recovery impossible. (Tabs L-3, V-401 through V-429, AA-12, AA-13, BB-4 through BB-12, CC-3 through CC-27, CC-60 through CC-68, EE-16)

(2) MP Failed To Employ Proper Stall Recovery Procedure.

IAW the C-17 flight manual, the stall recovery procedure is: 1) apply forward stick pressure 2) apply maximum available thrust; and 3) return to or maintain a level flight attitude. Large rudder inputs should be avoided. (Tab EE-16) Failure to follow flight manual procedures resulted in the loss of the aircraft and crew.

b. Contributing Factors.

Numerous additional factors substantially contributed to this mishap, including:

(1) Caution and Warning Ignored/Challenge and Reply.

As the lead C-17 aerial demonstration pilot for JBER, the MP routinely planned to ignore stall warnings during aerial demonstrations. During the mishap sortie, this became apparent once the stall warning system activated. The MP neither replied nor adjusted his control inputs, continued the turn, and failed to implement stall recovery procedures. Additionally, neither MCP nor MSO directed recovery until the MA actually stalled. (Tab V-401 through V-429)

The MP also instructed demonstration aircrew members to utilize “silent” checklist procedures. Flaps and slats were retracted automatically “on speed,” without a challenge or reply. The use of these procedures eliminates supportive feedback and acknowledgement to ensure situational awareness. (Tabs V-401 through V-429, CC-60 through CC-68) During the mishap sortie, the MCP retracted the slats five kts below V_{msr} . There are no indications the MP or MSO understood the MA’s configuration. (Tabs L-3, V-401 through V-429)

(2) Channelized Attention

The MP displayed two instances of channelized attention. First, during the 260-degree reversal turn, the MP aggressively continued turning the MA and ignored the stall warning system. Second, when the stall occurred, the MP moved the control stick full left and applied left rudder. He never applied forward control stick pressure to reduce the angle of attack and recover controlled flight. The MP channelized his attention on accomplishing the turn rather than stall recovery. (Tabs L-3, V-401 through V-429, CC-3 through CC-27, CC-69, CC-70)

(3) Overconfidence and Expectancy

During simulator training, the MP taught everyone stall warnings were an “anomaly.” He considered the warnings inaccurate and transitory due to aggressive aerial demonstration maneuvers. The MP also believed these warnings would cease at completion of the turns and not adversely affect the aircraft. He flew numerous aerial demonstrations in the aircraft with the stall warnings active and without incident. At times, the MP would even “tickle” in and out of the stall warning during the 80/260 degree maneuver; reinforcing a sense of overconfidence and invulnerability. Finally, the MP’s overconfidence in both his abilities and the capabilities C-17s, as well as his false perception that the aircraft would not stall, contributed to the mishap. (Tabs V-42, V-55, V-68, V-71, V-97, V-188, V-277, V-352, EE-9 through EE-12)

(4) Misplaced Motivation

The MP constantly wanted to “put on a good airshow,” keeping his turns crisp, tight, and as aggressive as possible. In order to achieve this goal, he utilized unsafe techniques in an effort to keep the aircraft as close to the airfield as possible, impress the crowd, and improve the airshow. (Tabs V-9, V-29, V-31, V-54, V-77, V-98, V-99, V-102, V-120, V-148, V-194, V-200, V-202, V-208, V-210, V-240, AA-12, AA-13) The purpose of the C-17 Aerial Demonstration program is to demonstrate aircraft capabilities, not to max perform the aircraft. (Tab BB-4 through BB-12) The MP’s misplaced motivation led to an aggressive behavior endangering both aircraft and crew.

(5) Procedural Guidance/Publications

The prescribed procedures in AFI 11-246, Vol. 6, Chp. 3 for flying the demonstration profiles are clear, and if flown according to those procedures, the demonstration profiles are safe. The General Instructions section in AFI 11-246 clearly states that crews will adhere to the prescribed procedures for the demonstration profiles. AFI 11-246, Vol. 6, Chp. 3 further directs that “Aircrews will not deviate from the mission plan except for safety considerations.” However, AMC/A3V determined the first paragraph on page 3 in AFI 11-246, Vol. 6, Chp. 3 created an ambiguity with the language, “The procedures in these profiles are general guidelines,” and this ambiguity resulted in an unsafe situation. (Tabs O-30 through O-32, BB-4 through BB-13, Emphasis added)

(6) Program Oversight/Program Management

The JBER C-17 Aerial Demonstration program’s office of primary responsibility is the 3 OG/OGV Standardization and Evaluation (Stan/Eval) office. (Tab O-5, O-6) Testimony revealed the Stan/Eval staff lacked an adequate understanding of AFI 11-246, Vol. 6, Chp. 3 regulations concerning airshow profiles execution. This lack of understanding prevented adequate supervision of the program. Without supervision, the MP manipulated Profile 3 and routinely flew outside the prescribed parameters. (Tabs V-28, V-29, V-31, V-54, V-79 through V-81, V-92, V-94, V-98, V-102, V-120, V-130, V-142, V-145, V-171, V-175, V-180, V-200 through V-203, V-208, V-210, V-240, AA-12, AA-13, BB-4 through BB-12, CC-60 through CC-68, CC-69, CC-70, EE-9 through EE-12)

In addition, there was little oversight by 3 OG/OGV regarding the MP’s instruction of crewmembers, and the aerial demonstration training program. (Tab V-117, V-118, V-346) The MP alone trained the MCP and MSO to fly an unsafe profile. (Tab T-7, T-8) As a result, “checks and balances” within this program were insufficient.

I find by clear and convincing evidence pilot error caused mishap. The MP's combination of procedural errors resulted in a departure from controlled flight. These actions ultimately resulted in the destruction of the aircraft and loss of four aircrew members.

27 September 2010

CARLTON D. EVERHART II, Brig Gen, USAF
President, Accident Investigation Board

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