

UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT



A-29B, T/N 13-2015

**81ST FIGHTER SQUADRON
14TH FLYING TRAINING WING
MOODY AIR FORCE BASE, GEORGIA**



LOCATION: MOODY AIR FORCE BASE, GEORGIA

DATE OF ACCIDENT: 6 MARCH 2017

BOARD PRESIDENT: COLONEL MICHAEL G. SNELL

Conducted IAW Air Force Instruction 51-503

**EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION**

**A-29, T/N 13-2015
MOODY AFB, GA
6 MARCH 2017**

On 6 March 2017, at approximately 1432 hours local time (L) the Mishap Aircraft (MA), an A-29B, T/N 13-2015, assigned to the 81st Fighter Squadron, 14th Flying Training Wing, Moody Air Force Base, Georgia, crashed during a close air attack (CAA) student flight and impacted the ground approximately 1.5 nautical miles (NM) northwest of the Homerville Airport. The Mishap Instructor Pilot (MIP) and Mishap Student Pilot (MSP) ejected safely, with the MIP sustaining injury during the ejection. The MA was destroyed on impact with minor damage to approximately one acre of private property. Damage to government property is estimated at \$17,772,729.

The mishap occurred during a CAA syllabus sortie (flight) as part of the Afghan A-29B training course. The MA was number two of a two-ship formation with the MSP in the front seat and the MIP in the back seat. The MA experienced a Power Management System (PMS) fault early in the sortie profile, and after consultation with Top-3 leadership, the mission proceeded. Approximately one hour later, the propulsion system suddenly malfunctioned, significantly reducing propeller speed (Np), driving the propeller blades toward the feathered position, and increasing engine torque above limits. The MIP immediately initiated the Compressor Stall checklist; however, he exited that checklist after he established aircraft control and assessed the engine was not stalled. The MIP then took action to trouble shoot the propulsion system malfunction and restore normal operation; cycling the PMS system from Auto to Manual, then back to Auto, and later placing it in Manual for the remainder of the flight without any apparent effect on aircraft performance. The MIP quickly decided to divert to the nearest field at Homerville in an attempt to make a straight-in landing. The MIP continued to balance throttle inputs with engine limits seeking maximum performance from the aircraft until he commanded ejection at approximately 300 feet above ground level. The MA crashed approximately 1.5 NM from the Homerville airport, 5 minutes and 26 seconds after the propulsion system malfunction.

The Accident Investigation Board (AIB) found by a preponderance of the evidence the MA loss was caused by a propulsion system malfunction that dramatically reduced thrust. The MA retained some degree of thrust, but was incapable of sustaining level flight. It additionally found visibility restrictions from the rear cockpit and task oversaturation to be substantially contributing factors. The initial heading flown to allow the MIP to visually acquire Homerville and the ensuing task saturation resulted in a longer ground track than intended. Although analysis of recorded flight data and subsequent flight simulation is not conclusive, it suggests it was possible to reach the field for a very limited period of time if the aircraft flew on a straight line to Homerville.

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
A-29B, T/N 13-2015
6 March 2017

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ACRONYMS AND ABBREVIATIONS

°	Degrees		Advisory Frequency
'	Feet	DCU	Data Collection Unit
14 FTW	14th Flying Training Wing	DME	Distance Measuring Equipment
19 AF	19th Air Force	DoD	Department of Defense
1st Lt	First Lieutenant	DR	Deficiency Report
81 FS	81st Fighter Squadron	EGI	Embedded GPS INS
AD	Airworthiness Directive	EICAS	Engine Indications and Crew Alerting System
ADO	Assistant Director of Operations	FAA	Federal Aviation Agency
AETC	Air Education and Training Command	FADEC	Full Authority Digital Engine Control
AETCI	Air Education and Training Command Instruction	FENCE	Fuel, Engine, NAVAIDs, Communication, Equipment
AF	Air Force	FL	Flight Lead
AFB	Air Force Base	FM	Field Manager
AFE	Aircrew Flight Equipment	FMC	Fully Mission Capable
AFI	Air Force Instruction	FPM	Feet Per Minute
AFPET	Air Force Petroleum Agency	G	Gravitational Force
AFRL	Air Force Research Laboratory	GA	Georgia
AFSEC	Air Force Safety Center	GB	Gear Box
AGL	Above Ground Level	GBS	Ground Based Software
AIB	Accident Investigation Board	GMT	Greenwich Mean Time
AIBLA	AIB Legal Advisor	GPS	Global Positioning System
AIBMD	AIB Medical Member	GS	General Schedule
AIBMX	AIB Maintenance Member	GSIP	Civilian Instructor Pilot
AIBPM	AIB Pilot Member	HOTAS	Hands-On Throttle and Stick
AIBR	AIB Recorder	HUD	Heads-Up Display
AM2	Aircraft Maintenance Manager	IAW	In Accordance With
AoA	Angle of Attack	ICAWS	Integrated Caution, Advisory, and Warning System
AUTO	Automatic	IMDB	Integrated Management Database
CAA	Close Air Attack	IMIS	Integrated Maintenance Information System
Capt	Captain	inHg	Inches of Mercury
CAMS	Computerized Aircraft Maintenance System	INS	Internal Navigation System
CAS	Close Air Support	IO	Investigating Officer
CC	Commander	IP	Instructor Pilot
Cc'd	Courtesy Copied	IQT	Initial Qualification Training
CLS	Contracted Logistical Support	ISB	Interim Safety Board
CMFD	Color Multi-Function Display	ISB1	ISB Investigator #1
CMSgt	Chief Master Sergeant	ISB2	ISB Investigator #2
Col	Colonel	ISBIO	ISB Investigating Officer
CRM	Crew Risk Management	ISBP	ISB President
CT	Continuation Training		
CTAF	Common Traffic		

ISBR	ISB Recorder	P&W	Pratt and Whitney
ITT	Interturbine Temperature	PFL	Pilot Fault List
JA	Judge Advocate	PIF	Pilot Information File
JTAC	Joint Terminal Attack Controller	PIU	Propeller Interface Unit
K	Thousand	PMS	Power Management System
KCAS	Knots Calibrated Airspeed	PMO	Program Management Office
KHOE	Homerville Airport	PMU	Power Management Unit
KIO	Knock It Off	PR	Pre-flight Inspection
kts	Knots	Prop	Propeller
L	Local Time	PROP ENG	Hartzell Propeller Engineer
LAS	Light Air Support	PSI	Pounds per Square Inch
Lt Col	Lieutenant Colonel	PSI	Pounds per Square Inch Gauge
MA	Mishap Aircraft	PWC	Pratt & Whitney Canada
MAFB	Moody Air Force Base	QA	Quality Assurance
Maj	Major	Reg	Regulation
MAJCOM	Major Command	RPM	Revolutions per Minute
MAN	Manual	RTB	Return-To-Base
MDP	Mission and Display Processor	SB	Service Bulletin
MEL	Minimum Equipment Listing	Sec	Seconds
MESL	Minimum Essential Subsystem List	SEPT	Simulated Emergency Procedure Trainer
MF	Mishap Flight Lead	SGP	Chief of Aerospace Medicine
MFL	Maintenance Fault List	Sgt	Sergeant
MFL	Mishap Flight Lead	SHP	Shaft Horse Power
Min	Minutes	SIB	Safety Investigation Board
MIP	Mishap Instructor Pilot	SIBMED	SIB Medical Member
MOA	Military Operating Area	SIBIO	SIB Investigating Officer
MP	Mishap Pilot	SIBP	SIB President
MQT	Mission Qualification Training	SIBPT	SIB Pilot Member
MR	Maintenance Release	SIBR	SIB Recorder
MSgt	Master Sergeant	SII	Special Interest Item
MSL	Mean Sea Level	SIM	Simulator
MSP	Mishap Student Pilot	SME	Subject Matter Expert
NAVAIDs	Navigation Aids	SNC	Sierra Nevada Corporation
NCDC	Net-Centric Data Cartridge	SNC AV	SNC Avionics
Ng	Gas Generator Speed	SNCMX	SNC Chief of Maintenance
NM	Nautical Miles	SOAP	Spectrum Oil Analysis Program
NOTAMs	Notices to Airmen	SP	Student Pilot
Np	Propeller Speed	SPO	Special Programs Office
NV	Non-Volatile	SSgt	Staff Sergeant
OEM	Original Equipment Manufacturer	SVREP	Customer Service Representative
Ops	Operations	T/N	Tail Number
Ops Sup	Operations Superintendent	T5	Interturbine Temperature
Ops Tempo	Operations Tempo	TCTO	Time Compliance Technical Order
ORM	Operational Risk Management	TEZ	Target Engagement Zone
OS	Operations Superintendent	TH	Thru-flight Inspection
OSB	Option Select Button		

TOD	Tech Order Data	VTR	Video Tape Recorder
TSgt	Technical Sergeant	VVI	Vertical Velocity Indication
VADR	Voice and Data Recorder	Z	Zulu
VFR	Visual Flight Rules		

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

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 29 June 2017, Major General Mark Anthony Brown, Vice Commander, Air Education and Training Command (AETC), appointed Colonel Michael G. Snell to conduct an aircraft accident investigation of a mishap that occurred on 6 March 2017 involving an A-29B aircraft, tail number (T/N) 13-2015, in the vicinity of Moody Air Force Base (MAFB), Georgia (GA) (Tab Y-2). The aircraft accident investigation was conducted in accordance with (IAW) Air Force Instruction (AFI) 51-503, *Aerospace and Ground Accident Investigations*, at MAFB, GA, from 10 August 2017 through 29 December 2017. The following Accident Investigation Board (AIB) members were appointed: Pilot Member (Major); Legal Advisor (Captain); Medical Member (First Lieutenant); Maintenance Member (Master Sergeant); and Recorder (Staff Sergeant) (Tab Y-4 to Y-7). Additional non-board member appointments included: Subject Matter Expert (SME) on the A-29B (Major) and representative (Major) from International Affairs, Office of the Under Secretary of the Air Force to observe on behalf of Afghanistan (Tab Y-8 to Y-10).

b. Purpose

IAW AFI 51-503, *Aerospace and Ground Accident Investigations*, this accident investigation board conducted a legal investigation to inquire into all the facts and circumstances surrounding this Air Force aerospace accident, prepare a publicly releasable report, and obtain and preserve all available evidence for use in litigation, claims, disciplinary action, and adverse administrative action.

2. ACCIDENT SUMMARY

On 6 March 2017, at approximately 1432 hours local time (L) the Mishap Aircraft (MA), an A-29B, T/N 13-2015, assigned to the 81st Fighter Squadron, 14th Flying Training Wing, MAFB, GA, crashed during a close air attack (CAA) student flight and impacted the ground approximately 1.5 miles northwest of the Homerville Airport (Tabs D-2, H-2, R-5, and AA-2 to AA-4). The Mishap Instructor Pilot (MIP) and Mishap Student Pilot (MSP) ejected safely, with the MIP sustaining injury during the ejection (Tabs H-2, R-127, and X-2). The MA was destroyed on impact with minor damage to approximately one acre of private property (Tabs H-2 and P-2). Damage to government property is estimated at \$17,772,729 (Tab P-4).

3. BACKGROUND

a. Air Education and Training Command (AETC)

AETC's primary mission is to recruit, train and educate Airmen to deliver airpower for America (Tab CC-2). It was established and activated in January 1942, making it the second oldest major command in the Air Force (AF) and its training mission makes it the first command to touch the lives of nearly every AF member (Tab CC-2). The command's vision is to forge innovative Airmen to power the world's greatest AF (Tab CC-2). The command's organization includes the AF Recruiting Service, two numbered air forces, and the Air University (Tab CC-2). AETC, headquartered at Joint Base San Antonio-Randolph, Texas, has more than 29,000 active duty members, 6,000 Air National Guard and AF Reserve personnel, and 15,000 civilian personnel (Tab CC-2). The command also has more than 11,000 contractors assigned (Tab CC-2). AETC flies approximately 1,300 aircraft (Tab CC-2).



b. 19th Air Force (19 AF)

The 19 AF, headquartered at Joint Base San Antonio-Randolph, Texas, executes operational-level command and control of all formal aircrew flying training missions within AETC (Tab CC-11). 19 AF consist of more than 32,000 personnel and operates over 1,350 aircraft of 29 different models across 19 training locations, with 16 Total Force wings: 10 active duty, one Air Force Reserve, and five Air National Guard units (Tab CC-11). 19 AF accounts for more than 490,000 flying hours annually, 44 percent of the Air Force's total flying hours (Tab CC-11 to CC-12).



c. 14th Flying Training Wing (14 FTW)

The 14 FTW, headquartered at Columbus Air Force Base, Mississippi, is responsible for specialized undergraduate pilot training in the T-6 Texan II, T-38C Talon, and T-1A Jayhawk aircraft (Tab CC-13). The wing successfully trains an average of 475 officers per year, and is composed of 2,744 active duty and civilian members (Tab CC-13 to CC-14).



d. 81st Fighter Squadron (81 FS)

The 81 FS, headquartered at MAFB, GA, was reactivated on 15 January 2015 (Tab CC-15 to CC-16). The 81 FS conducts combat training for Afghan Air Force pilots and maintainers in the A-29B Super Tucano (Tab CC-15 to CC-16). The 81 FS executes an annual flying program of 3,000 sorties (flights) and 4,500 hours (Tab CC-15). The squadron is composed of Air Advisor Pilots and Air Advisor Maintainers who conduct Continental United States and Outside the Continental United States based training for the Afghan Air Force (Tab CC-15). This training includes basic and advanced tactical employment of the A-29B to Afghan pilots, maintainers training, and support mission training (Tab CC-15). The 81 FS is the only combat mission ready fighter squadron in AETC and is composed of 65 officer and enlisted members (Tab CC-15).



e. A-29B – Super Tucano

The A-29B Super Tucano is a single-engine, stepped tandem, multi-purpose military turboprop designed for both training and operational use (Tab CC-20). The A-29B is equipped with Martin-Baker ejection seats, a 1,600 SHP Pratt & Whitney PT6A-68/3 turboprop engine that incorporates Full Authority Digital Engine Control and Engine Indication and Crew Alerting System powers the aircraft (Tab CC-21). The aircraft also features two .50 caliber machine guns in the wings and five hard points under the wing and fuselage allow up to 1,500 kg of weapons (Tab CC-23). The aircraft's inboard stations, as well as its ventral one, are capable of carrying external fuel tanks (Tab CC-23).



4. SEQUENCE OF EVENTS

a. Mission

The mishap sortie was scheduled, briefed, and executed with the MSP and MIP flying as number two of a two-ship CAA mission, call sign “Bronco 91/92”, to the Moody 2 North Military Operating Area (MOA) (Tab K-4). The mission was flown IAW AETC Syllabus F-V5A-Q (A-29B MQ), dated June 2016 (Tabs V-2.1 and BB-3). The sortie events included a departure to assigned airspace, formation flying, FENCE check (Fuel, Engine, Navigation aids, Communication, and Equipment), and simulated weapons employment during a CAA scenario (Tabs R-6, R-11, V-2.1, V-3.1, and BB-12). “Bronco” flight was the last two-ship scheduled 6 March 2017 (Tabs K-4 and V-2.1). This was the MSP’s mission checkride, which serves as the culminating event in Mission Qualification Training (Tabs R-5 and BB-3). The squadron Top-3 (Operations Supervisor) authorized the mission (Tab V-2.2).

b. Planning

The mission was planned IAW the A-29B student training syllabus, applicable flying regulations, and local flying standards (Tabs V-2.1, V-3.1, and BB-3). The MIP arrived at the squadron at approximately 0630L, and the MSP arrived at approximately 0720L (Tab V-2.1 and V-3.1). Both attended the mass brief, which took place at 0730L (Tab V-2.1 and V-3.1). The MIP was Top-3 from 0730-1130L and administered the mass brief (Tab V-2.1). At 1145L, the mishap flight lead (MFL) conducted a two-ship flight briefing with the MIP and MSP that discussed specific details related to the MSP’s CAA mission checkride (Tabs R-5, R-33, and BB-3). The briefing covered all required items IAW Air Education and Training Command Instruction (AETCI) 11-2A-29v3 including Notices to Airmen (NOTAMs), Special Interest Items (SIIs), forecast weather, emergency divert airfields, and planned flying events (Tab V-2.2).

c. Preflight

After the flight briefing, the MFL, MIP, and MSP received a final step-briefing from the Top-3 before proceeding (stepping) to the flightline (Tabs R-5 and V-2.2). The step-briefing from the Top-3 included an update on aircraft status, weather, NOTAMs, and flying conditions (Tab V-2.2). The Top-3 also reviewed the Mishap Formation’s (MF) operational risk assessment (ORM) status and provided final approval to fly (Tabs R-65 to R-67, and V-2.2). The MSP and MIP arrived at their assigned aircraft, reviewed the maintenance forms, accomplished an external aircraft inspection, and started the aircraft engine and required systems (Tabs R-5 to R-6, V-2.2, and V-3.1). No maintenance discrepancies were noted before or after engine start or during any other ground operations (Tabs R-5 to R-6, R-12 to R-13, R-34, R-44 to R-45, and V-2.2).

d. Summary of Accident

(1) Taxi, Takeoff, Departure, and Training Set-up

The MF’s taxi, takeoff (1328L), and departure were all uneventful and IAW local standards, procedures, and requirements (Tabs R-5 to R-6, R-34 to R-35, V-2.2, and BB-3). Upon entering the airspace, the MFL directed the formation to “FENCE-in” and initiated the simulated CAA

scenario (Tab N-4). Shortly after checking into the airspace and while the MFL was still doing the simulated coordination for the CAA scenario, the MA received a Pilot Fault List (PFL) code “ENG_PMS 001” in the cockpit, indicating the “PMU accommodates a detected fault and retains control of the engine” (Tabs N-5 to N-7, R-11 to R-12, R-34, and V-2.2). After discussing the indications within the formation and with the Top-3, the MF elected to continue the mission, at which point the MFL resumed coordination for the simulated CAA scenario (Tabs N-6 to N-7, R-12, R-34 to R-35, and V-2.2).

(2) Close Air Attack (CAA) Scenario

During the CAA scenario, the MF was operating in the Moody 2 North MOA, which lies just north east of MAFB (Tabs R-5, R-33 to R-34, R-39, R-45, V-2.1, and AA-9). The Moody 2 North MOA confines extend east/west approximately 19 nautical miles (NM) and north/south approximately 21 NM (Tab AA-9). The vertical portion of the MOA being used extended from 500’ above ground level (AGL) to up to but not including 8,000’ mean sea level (MSL) (Tab AA-18).



Tab AA-9

The CAA scenario involved the MFL coordinating with a simulated Terminal Attack Controller on the ground to engage targets in the vicinity (Tab V-1.4 and V-2.1 to V-2.2). Two-ship tactics employed by the A-29B routinely involve the flight lead and the wingman operating “detached” from one another in separate altitude blocks (Tab V-1.3, and V-5.4). Initially, the MFL directed

the MA into the “high block” while the MFL stayed in the “low block” (Tab V-1.3 and V-5.4). This put the MA above the MFL separated by a 1,000’ altitude block for deconfliction (Tab V-1.3 and V-5.4).

The weather forecast on 6 March 2017 predicted broken clouds from 5,000’ to 6,000’ (Tabs F-5 and R-6). This weather was initially not a factor, and the MSP was able to conduct a simulated bomb attack on the first target from 7,000’ (Tab R-6). Following the MSP’s attack from 7,000’, the clouds became a factor, which required the MFL and MA to swap altitude blocks so the MSP could tactically maneuver as required (Tabs R-6 to R-7, R-35, and V-5.4). The MA was now in the “low block” (6,000’ and below) with the MFL in the “high block” (7,000’ and above) (Tabs R-7, R-35, and V-2.2). The MFL continued the training scenario and guided the MSP’s eyes onto the next target (Tabs L-3 to L-4 and V-2.2). The MSP located the new target and maneuvered the MA to attack the target from a 5,000’ bomb pass (Tab V-1.3, V-1.6, and V-2.2). The MSP made two bomb passes on the new target but was unable to “drop” simulated ordinance on either due to not being within +/- 5° of the desired dive angle as required (Tabs R-7 and V-1.6 to V-1.7). The MSP transmitted he was “off dry” (indicating no simulated ordinance was released) on each of these two passes and started a climb back up to 5,000’ to re-attack the target (Tabs R-7, V-1.6 to V-1.7).

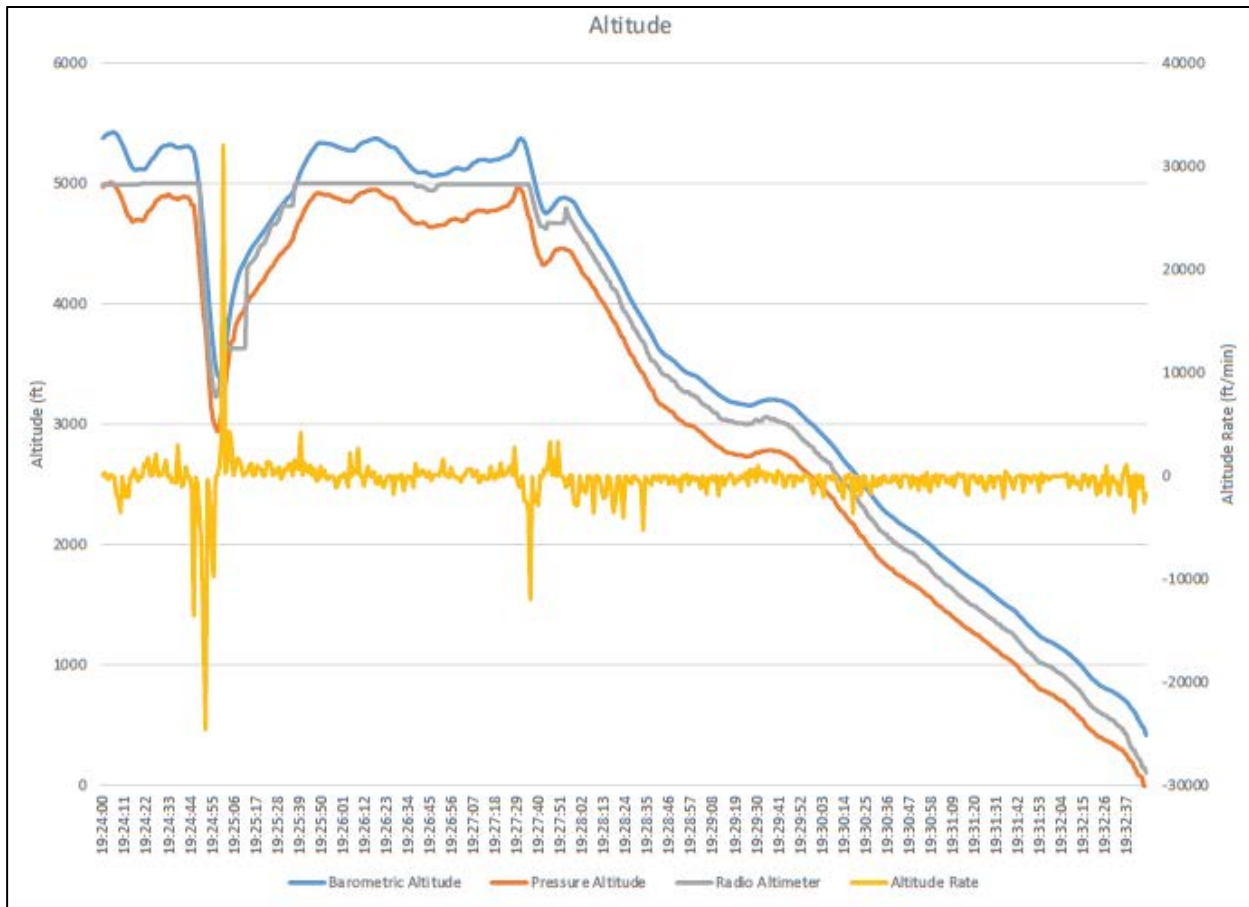
(3) Propulsion System Malfunction and Divert

Note: (0+00) Represents the moment the propulsion system malfunction occurred (Min+Sec). All subsequent times represent the elapsed time from that moment. Zulu (Z) time is Greenwich Mean Time (GMT).

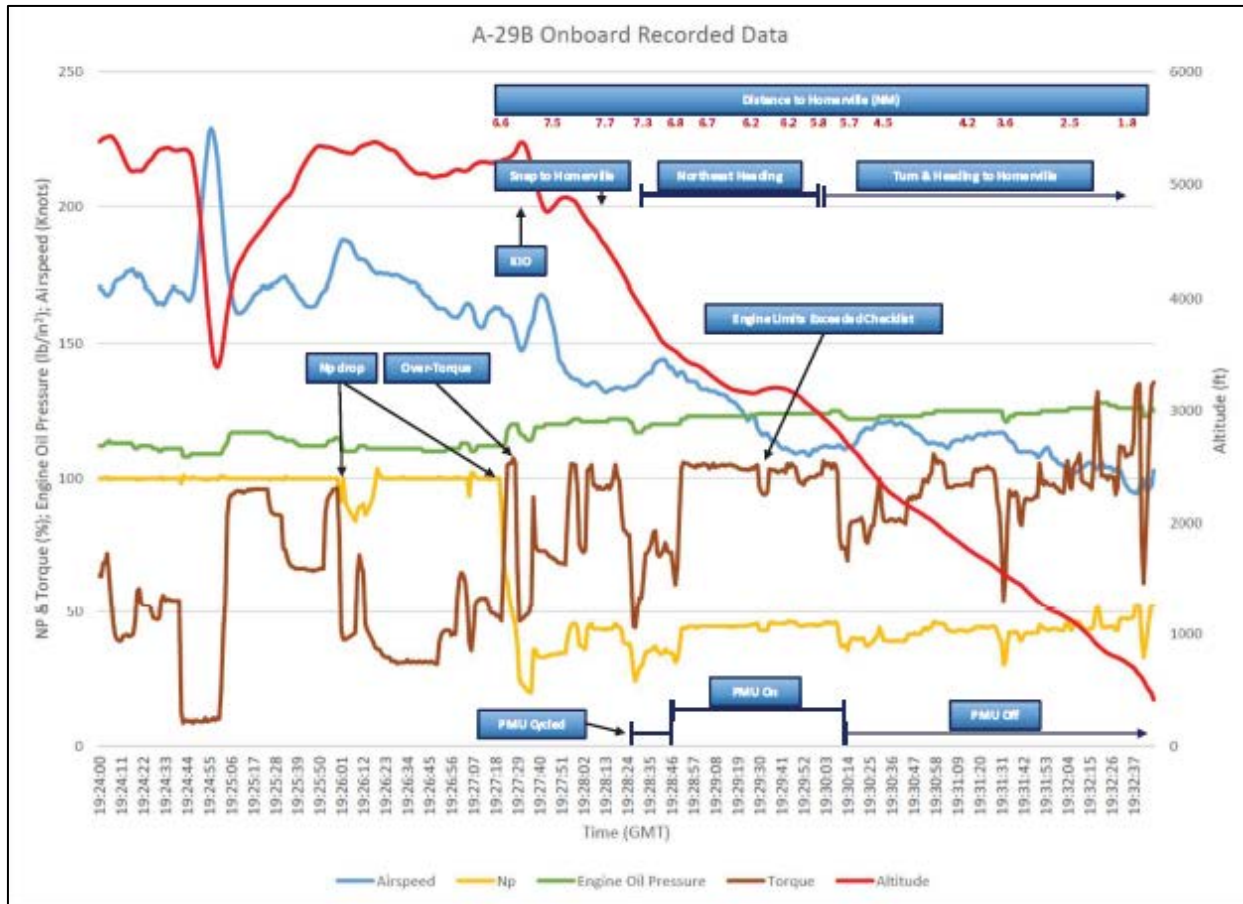
At 19:27:22Z (0+00), approximately 1427L, while the MSP maneuvered the aircraft to initiate the next attack, the MA experienced a decrease in thrust and a noticeable change in engine noise (Tabs R-7, V-3.2, and AA-2 to AA-4). The MIP initially perceived the decrease in thrust and change in engine noise as a compressor stall, immediately taking control of the aircraft from the MSP and performing the initial steps of the Compressor Stall emergency procedure checklist while simultaneously starting a left hand 30° bank turn (Tabs R-7, V-2.2, and AA-2 to AA-4). As the MIP analyzed the situation, he determined the malfunction was not a compressor stall and discontinued that checklist (Tab V-2.2 to V-2.3). The MIP spent the remainder of the sortie analyzing the emergency while continuously manipulating the throttle to obtain maximum thrust without exceeding engine limitations (Tabs V-2.3 and AA-2 to AA-6). At the moment the MA experienced the propulsion system malfunction, the MA was at 162 knots calibrated airspeed (KCAS), 5,209’ MSL (4,995’ AGL), on a heading of 334°, 7 NM west of Homerville Airport (KHOE) and 15 NM east northeast of MAFB (Tab AA-2).

At 19:27:45Z (0+23), the MIP initiated a knock-it-off (KIO) call over the radio and told the MFL “I think we’ve got an engine issue here” (Tab AA-12). The MFL then asked if the MIP planned to recover the MA to “Homer or home” (Tab AA-12). “Homer” referenced Homerville Airport (KHOE) with a single runway oriented 140° / 320°, and “Home” referenced MAFB (Tabs N-9 and AA-2 to AA-4). At 19:28:09Z (0+47), the MIP stated “snapping towards Homerville” on the radio while still in a left turn passing through heading 154° and descending through 4,584’ MSL (4,393’ AGL) (Tab AA-2 to AA-12). During the entire mishap, the MFL was not visual with the MA (Tabs R-36 and V-5.5). Once the MIP stated the intention to land at Homerville, the MFL began

coordinating on the Common Traffic Advisory Frequency (CTAF) for the MA's arrival in the Homerville traffic pattern (Tabs R-36 and AA-13). At 19:28:21Z (0+59), the MIP said "I'm gonna go PMU Man" to the MSP, indicating the intent to switch the Power Management Unit (PMU) from the AUTO (Automatic) mode to MAN (Manual) mode (Tabs V-2.3 and AA-13). The PMU is responsible for the main functions of the Power Management System and receives signals from sensors on the engine and the airframe for the automatic control of the engine and propeller (Tab AA-16). In switching the PMU to the manual mode, the MIP's intent was to reset the engine or get more thrust (Tab V-2.3). However, according to the MIP aircraft performance did not improve and at 19:28:45Z (1+23) the MIP stated over the intercom "Reset back to AUTO here" indicating the PMU switch was moved back to the AUTO position (Tabs R-10, V-2.3, and AA-13). At this time, the MA rolled out of the left hand turn on an approximate heading of 052°, bearing 280° and approximately 6.7 NM from Homerville Airport (Tab AA-3). This heading allowed the MIP to keep KHOE in sight as he analyzed the malfunction (Tab V-2.3). At 19:28:58Z (1+36), the MIP began a conversation with the MFL and described the MA's engine parameters, stating, "We're getting a little bit of thrust" (Tabs R-9, R-36, and AA-12). At 19:29:46Z (2+24), the MFL requested the MA switch to Homerville's frequency of 122.9 and then soon thereafter told the MA to "Squawk emergency" (Tabs R-36 and AA-13). At 19:30:00Z (2+38), the MIP began to read the Engine Limits Exceeded checklist over the intercom (Tab AA-13)



Tab AA-7



Tab AA-6

At that time, the MA was at 111 KCAS, 2,987' MSL (2,805' AGL), in a 15-20° bank right hand turn passing through a heading of 065°, on a 300° bearing approximately 6 NM from KHOE (Tab AA-3).

Shortly after starting to read this checklist aloud, the MIP said, "Go back to MAN" to the MSP (Tab AA-13). 10 seconds after beginning to read the Engine Limits Exceeded checklist, the MIP said, "I'm going to go ahead and jettison..." while the MSP simultaneously said "You're in MAN" indicating the PMU was switched to the Manual mode where it stayed the rest of the flight (Tabs V-3.2 and AA-13). At 19:30:30Z (3+08), the MIP stated, "We've got a stagnated engine here", and 14 seconds later, the MFL said, "Two, are you up 122.9?" (Tab AA-13). The MIP responded, "We are up 122.9" (Tab AA-12). At 19:31:09Z (3+47), the MIP stated "All right. So far, I have not jettisoned my tanks yet. I still got a decent amount of thrust. I'm not going to configure until the last minute." (Tab AA-13). At 19:31:42Z (4+20), the MFL said, "Two, are you going to land this?" to which the MIP responded, "Yeah, I'm showing the winds at 15. Landing pointed towards the south, so..." (Tab AA-13). The MFL asked 30 seconds later, "How you doing, two?" however, the MIP did not respond (Tab AA-13). At that point, the MA was at 104 KCAS, 1,054' MSL (833' AGL), on a heading of 137° approximately 2.5 NM from KHOE (Tab AA-3). At 19:32:16Z (4+54), the MIP stated "Might have to jettison the tanks here" while the MFL simultaneously asked "Two, how are you doing?" (Tab AA-13). Then, at 19:32:43Z (5+21), the MIP stated "All

right, we're going to have to eject” and 1 second later, the MIP commanded, “Eject, Eject” (Tab AA-14). At ejection (19:32:45Z), the MA was at 95 KCAS, 518’ MSL (215’ AGL), with the vertical velocity indicator (VVI) showing a 2,334 feet per minute (FPM) descent on a 138 heading approximately 1.5 NM from KHOE (Tab AA-3).

(4) Recorded Transcript of Mishap Events and Radio Transmissions

Recording Medium: MA Net-Centric Data Cartridge (NCDC) (Tabs AA-10 to AA-14).

Abbreviations/Key: BO 91: Bronco 91 (MFL’s callsign)
 BO 92: Bronco 92 (MSP’s callsign)
 BO 92B: MIP in rear cockpit of Bronco 92
 MA: Mishap aircraft
 UNK: Unknown
 ALERTING MESSAGE: Aircraft generated audible message
 Feet (ft); mean sea level (MSL); knots (kts)

GMT (Z) Time	Radio Transmission
18:35:03	ALERTING MESSAGE: Avionics. Avionics.
18:35:09	BO 92: 1, 2.
18:35:10	BO 91: Go.
18:35:13	BO 92: Two got engine PMS caution.
18:35:17	BO 91: Copy all. And can you look at which PMS it is?
18:35:22	BO 92: 001, it says fail.
18:35:26	BO 91: Copy that, go to the PFL page and see if you can clear it.
18:35:30	BO 92: I tried, I cannot. Should I -- reset PMU and then clear or no?
18:35:40	BO 91: I would not reset the PMU. I would leave that one there.
18:35:44	BO 92: Two.
18:35:45	BO 91: Stand by one. 1, 2-Bravo, 1.
18:35:49	BO 92B: Go ahead.
18:35:50	BO 91: What I would like to do is see if we can get an attack in before we RTB. Just a nuisance but I don't want to prolong this.
18:35:58	BO 92B: Did we ever come up with, come out with, that list of faults that we could press with?
18:36:05	BO 91: Say again?
18:36:06	BO 92B: Does the Top 3 have a list? I thought they were going to come out with a list of nuisance faults that we could continue with or try to clear with a PMU reset. Did they ever do that?

18:36:15	BO 91: Negative, they never did. I've seen this one go both ways, where sometimes we'll come home right away and sometimes we'll stay out for a little while. I don't want to reset it, just maybe because it's already on a fault that says it's got it.
18:36:30	BO 91: Tell you what, standby. Let's push aux 316.225.
18:36:46	BO 91: Bronco 91, check.
18:36:48	BO 92: Two. Two.
18:36:53	BO 91: Ops, Bronco 91.
18:36:55	TOP 3: Go ahead.
18:36:56	BRONCO 91: Yeah. (Inaudible.) We had a PMS 01 on number two. It won't clear, but we haven't done a PMU reset. I'm inclined to continue the mission of a shorter duration, if you got any updates on that.
18:37:11	TOP 3: Please confirm 01 is the engine might not be monitored.
18:37:16	BRONCO 91: Negative. I'll get one to read it to you, but I think this one says it had a fault and it's taken over and it's not a problem. Two, what does it actually say in the conversation there?
18:37:25	MIP: I'll talk to him.
18:37:26	BO 92B: It's Engine PMS caution, this message indicates that the PMU accommodates a detected fault and maintains control of the engine.
18:37:33	TOP 3: Yeah. You should be good to go to press. Full mission. No need to curtail at this time.
18:37:40	BO 91: Concur. Copy all. Push, 251.725 aux.
18:37:58	ALERTING MESSAGE: Avionics. Avionics.
18:38:01	BO 91: Bronco 91, check aux.
18:38:03	BO 92: Two.
18:38:04	BO 91: Copy all. Do you have any questions? Basically, it's saying it had a fault, but it recovered the fault with no problem. We will continue as normal but if it comes to more faults, let me know.
18:38:13	BO 92: Two.
18:38:21	BO 91: OKAB, Bronco. OKAB, go with update.
18:38:25	OKAB 11: Copy. Situation update as briefed.
19:25:51	BO 91: Confirm established.
19:25:52	BO 92: Stand by.
19:26:01	BO 92: Two's established.
19:26:02	BO 91: Say position.
19:26:04	BO 92: Two's... 110, for 2.9.

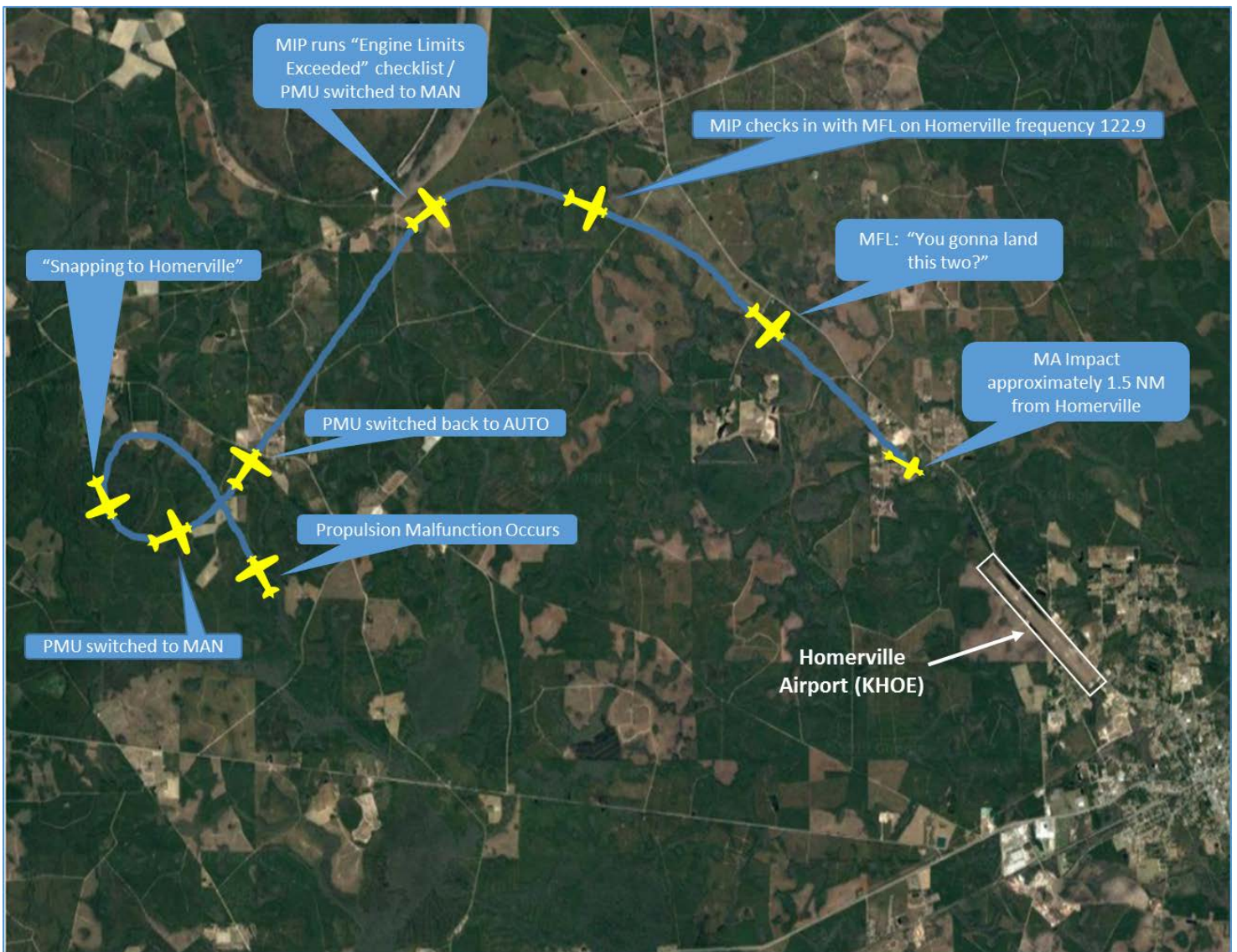
19:26:10	BO 91: Copy that. Are you going to go right-hand turn for this attack or left-hand?	
19:26:13	BO 92: Right-hand.	
19:26:14	BO 91: Copy that. This will be cover, shooter, bomb. In from the west on a clear avenue. Bomb, off right, to the south, back to the wheel sorting waypoint 12.	
19:26:28	BO 92: Two.	
19:26:30	BO 91: Two set sim. Tape on. Waypoint 12, CCIP, Mark 81, single. Release pulse one. Fuse, nose tail.	
19:26:39	BO 92: Two's sim. Tape on. Waypoint 12, CCIP, Mark 81, single. Release pulse one. Nose and tail.	
19:26:44	BO 91: One is ready, 480.	
19:26:47	BO 92: Two is ready, 480.	
19:26:49	BO 91: HAAMLA.	
19:26:50	BO 92: Two.	
19:26:52	BO 91: (Inaudible.) All right. So on the south side, make sure you can look at the target area and get a good reference on the east/west road, and the T-road so that you can set up, a good two-mile point. Actually, a 1.4-mile point for your 5K.	
19:27:15	BO 92: Two.	
Elapsed time (Min:Sec)	GMT (Z) Time	Radio Transmission
00:00	19:27:22	<i>PROPULSION MALFUNCTION</i>
00:06	19:27:28	MIP: I have the aircraft.
00:07	19:27:29	MSP: You have the aircraft.
00:18	19:27:40	MIP: Alright, looks like we got a compressor stall or something.
00:21	19:27:43	MSP: Okay.
00:22	19:27:44	BO 92B: Knock-it-off, 1, knock-it-off.
00:24	19:27:46	BO 91: Two, knock-it-off.
00:27	19:27:49	BO 91: Bronco 91, knock-it-off.
00:29	19:27:51	BO 92B: I think we have an engine issue here.
00:33	19:27:55	BO 91: Copy. You snapping to Homer or home?
00:38	19:28:00	MIP: I'm gonna go -- (Overlapping chatter.)
00:39	19:28:01	MIP: All right. I'm going to go to PMU man.
00:40	19:28:02	ALERTING MESSAGE: Stall.
00:47	19:28:09	BO 92B: Snapping towards Homerville.
00:49	19:28:11	BO 91: Copy all.
00:54	19:28:16	BO 91: When able, if able, push one. Say posit. Push 128.9, or I'll relay.

00:59	19:28:21	MIP: Okay. I'm going to go to man, PMU man.
01:02	19:28:24	MSP: Okay.
01:05	19:28:27	MSP: Now you're in man.
01:06	19:28:28	ALERTING MESSAGE: Engine. Engine.
01:14	19:28:36	BO 91: Homerville, Homerville, Bronco 91, inbound emergency.
01:22	19:28:44	BO 91: One's above 8,000 feet.
01:23	19:28:45	MIP: Reset back to auto here.
01:25	19:28:47	MSP: Okay.
01:36	19:28:58	MIP: All right, I'm showing an Np of like 44 percent. My torque is up above a hundred.
01:42	19:29:04	MSP: Yeah. The same for me.
01:46	19:29:08	BO 91: Copy that. You still getting good thrust?
01:47	19:29:09	BO 92: We're getting a little bit of thrust. 44 percent.
01:51	19:29:13	ALERTING MESSAGE: Engine limits.
01:52	19:29:14	BO 91: I don't know where you are. I can't see you. So I can relay everything and put you in at Homerville or you can head for home. Your call.
01:59	19:29:21	BO 92: I'm going to head to Homerville.
02:01	19:29:23	BO 91: Copy that, I'm going to be off... I'll be on this frequency. I'm going to Homerville. Say your angels.
02:07	19:29:29	BO 92B: Currently at 3,000 feet.
02:09	19:29:31	BO 91: You can have anything you want. I'm above eight and I'm not going to descend below about four or five, unless I can find you. I'll be off for a couple frequencies. I'm on Homerville 122.9.
02:21	19:29:43	BO 92B: Copy that.
02:24	19:29:46	BO 91: Recommend you come up that freq.
02:26	19:29:48	MIP: Push 122.9.
02:29	19:29:51	MSP: 122.9.
02:33	19:29:55	BRONCO 91: Two, squawk emergency.
02:35	19:29:57	MIP: Squawk emergency for me.
02:36	19:29:58	MSP: Okay.
02:38	19:30:00	MIP: Throttle as required, engine parameters monitor, if parameters remain within limits, land as soon as possible.
02:42	19:30:04	MSP: 7700.
02:43	19:30:05	ALERTING MESSAGE: Stall.
02:44	19:30:06	MIP: Go back to man.
02:46	19:30:08	MSP: Okay.
02:47	19:30:09	ALERTING MESSAGE: Engine.

		MSP: You want me to go back?
02:48	19:30:10	MIP: I'm going to go ahead and jettison...
02:49	19:30:11	ALERTING MESSAGE: Engine. MSP: You're in man.
02:51	19:30:13	ALERTING MESSAGE: Engine.
02:56	19:30:18	MIP: All right. So we went throttle as required, engine parameters monitor. All right. Go to the like. Let's go through the, uh...
03:05	19:30:27	MSP: The engine limited checklist. What do you want me?
03:08	19:30:30	MIP: We got a stagnated engine here.
03:17	19:30:39	MIP: We're 122.9?
03:19	19:30:41	MSP: 122 point 9.
03:22	19:30:44	BO 91: Two, you up 122.9?
03:24	19:30:46	BO 92B: I am. We are up 122.9. Up 122.9 now. How you read?
03:29	19:30:51	BO 91: Loud and clear. (Inaudible.) Loud and clear, I'm talking to Homerville.
03:39	19:31:01	BO 92B: Copy. Confirm you're talking to them?
03:41	19:31:03	BO 91: Yeah, I'm talking to MOA monitor. Declared an emergency. They'll just relay.
03:47	19:31:09	MIP: All right. So far, I have not jettisoned my tanks yet. I still got a decent amount of thrust. I'm not going to configure until the last minute here.
03:54	19:31:16	UNKNOWN ALERTING: Somebody declare an emergency?
03:59	19:31:21	BO 91: Homerville, Bronco 92, inbound emergency. Recommend -- cease pattern ops for the next 10 minutes.
04:12	19:31:34	BO 91: One is over the top at five.
04:20	19:31:42	BO 91: Two, are you going to land this?
04:22	19:31:44	BO 92B: Yeah.
04:23	19:31:45	BO 91: Are you going to land to the south, two?
04:24	19:31:46	ALERTING MESSAGE: Stall. BO 92B: Yeah, I'm showing the winds at 15. Landing pointed towards the south, so...
04:37	19:31:59	ALERTING MESSAGE: Stall. Caution. Caution.
04:40	19:32:02	MIP: Go ahead and turn off the external tanks.
04:43	19:32:05	MSP: Okay, off.
04:50	19:32:12	BO 91: How you doing, two?
04:51	19:32:13	ALERTING MESSAGE: Stall. Decision altitude.
04:54	19:32:16	MIP: Might have to jettison the tanks here.

04:55	19:32:17	BO 91: Two, how are you doing?
04:57	19:32:19	ALERTING MESSAGE: Stall. Engine limits. Engine limits.
05:06	19:32:28	MIP: Come on, you b-----.
05:10	19:32:32	ALERTING MESSAGE: Stall. Stall. Engine limits. Engine limits. Landing gear.
05:21	19:32:43	MIP: All right, we're going to have to eject.
05:22	19:32:44	MIP: Eject, Eject!
05:23	19:32:45	(ELT Beacon.)
05:26	19:32:48	(End of audio.)

Tab AA-10 to AA-14



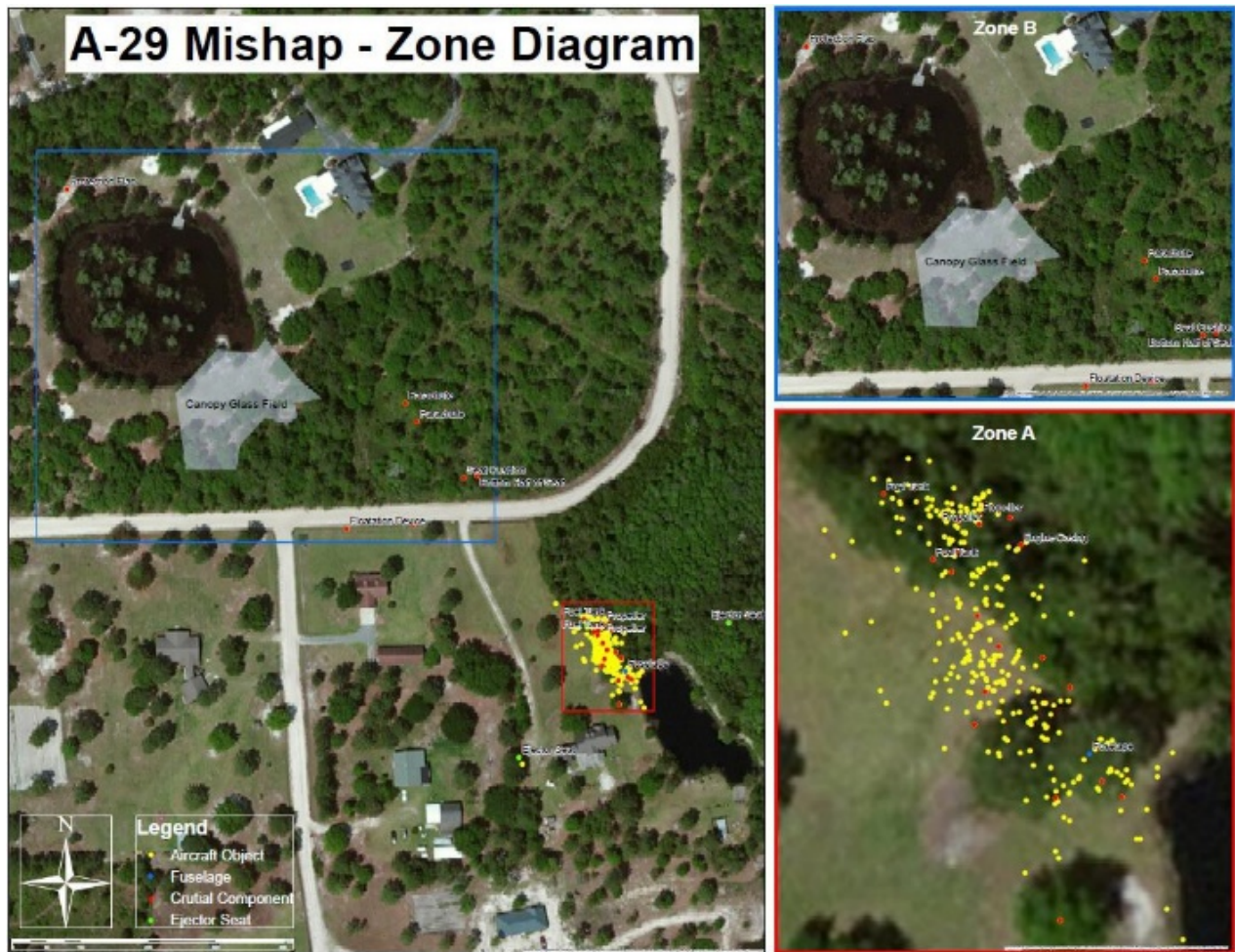
Tab AA-4

e. Impact

At 19:32:48Z, the MA crashed approximately 1.5 miles northwest of KHOE at an elevation of approximately 200 feet MSL (Tab AA-4 and AA-14). The MA was configured with two external fuel tanks on stations two and four (Tab V-2.2). The MA struck trees on the way down and impacted the ground at an approximate 133° magnetic heading (Tab AA-3). The MA struck the ground in approximately 60° of left bank, with a pitch attitude 30° nose low at 100 KCAS (Tab AA-3). The MA came to rest after striking a tree approximately 75 feet from the impact site and was mostly intact with the exception of the tail section and a portion of the right wing, both of which separated from the main aircraft during its descent and impact (Tab S-4 and S-9 to S-10).



Tabs S-2, S-4 to S-5, and S-10



Tab S-15

f. Egress and Aircrew Flight Equipment (AFE)

At 19:32:44Z, the MIP and MSP initiated ejection (Tab AA-14). Both parachutes opened successfully, and each crewmember recalls approximately two swings under the parachute prior to landing in trees (Tab H-13). The ejection seats were recovered mostly intact, but one was severely damaged by ground impact (Tab H-5 to H-7). Post ejection analysis determined both ejection seat subsystems functioned as intended (Tab H-11).

A post-ejection analysis of both MIP and MSP Aircrew Flight Equipment (AFE) gear showed they were in serviceable condition, except for the parachute fabric and suspension line cords, which had been damaged upon tree entanglement (Tab H-15).

The MIP and MSP were current for AFE Continuation Training requirements (Tab H-13). There were no overdue inspections or time changes due on the AFE equipment (Tab H-13).

g. Search and Rescue (SAR)

The MIP and MSP landed in trees approximately 420 feet from the main impact site (Tab S-3 and S-15). The MIP released his harness, dropped approximately 4 feet to the ground, and then assisted the MSP who was about 20-30 feet away in a tree about 20 feet above the ground (Tabs H-20, R-13, and V-2.3). Local responders and civilians arrived and began assisting within five minutes of the crash (Tabs R-115 and V-2.3). The MIP and MSP were transported to the local hospital in Homerville, GA (Tabs R-13 to R-14, and V-2.3). The MIP sustained compression fracture of the spine during ejection, and the MSP sustained minor injuries (Tab X-2).



Tab S-3

h. Recovery of Remains

Not applicable.

i. Flight Simulator Analysis

On 16 August 2017, the AIB attempted to replicate the conditions present during the mishap and flew seven different scenarios to determine if it was possible to land the aircraft at the recovery airfield (Tab AA-15). During simulation, the AIB positioned the aircraft at various altitudes,

airspeeds, headings, and distances from the airfield to recreate specific points on the MA's ground track (Tab AA-15). The simulation evidence was informative but not conclusive, as it was impossible to precisely replicate the malfunction, residual thrust, and pilot handling technique on 6 March 2017 (AA-15).

Three of the seven scenarios were flown from the approximate location where the malfunction first occurred (AA-15). In the first scenario, the actual MA ground track was followed as closely as possible while attempting to land at the divert field (Tab AA-15). Results from this simulation suggest the MA was likely producing some thrust (Tab AA-15). Subsequent scenarios attempted to land the A-29B at the divert airfield from specific locations along the actual MA ground track using the same energy state the MA had on the day of the mishap at those locations (AA-15). The AIB was able to successfully land the aircraft from only one of the seven simulated scenarios (AA-15). In this scenario, the aircraft immediately executed a hard right hand turn direct to the divert airfield at the moment the malfunction occurred (Tab AA-15). All other simulated scenarios failed to reach the divert airfield (Tab AA-15).

5. MAINTENANCE

a. Forms Documentation

The Sierra Nevada Corporation (SNC), MAFB, maintained the aircraft forms for the MA (Tab V-7.1 and V-7.9). SNC tracked aircraft maintenance utilizing the Aircraft Maintenance Manager (AM2) program and the Light Air Support (LAS) Forms (Tabs D-3 to D-14 and U-3). AM2 is the central electronic database for maintenance data collection and documentation (Tab U-3). LAS Forms are the hardcopy forms used to collect and document all aircraft maintenance actions (Tabs D-3 to D-14 and U-3). A review of the MA's AM2 and LAS Form records revealed no maintenance discrepancies prior to the mishap (Tabs D-3 to D-14 and U-3).

Service Bulletin's (SB) are inspections or maintenance procedures requiring action to document all permanent modifications, update changes, and retrofit changes to the aircraft by date or flight hours (Tab V-7.10 and V-7.19). All SBs were accomplished and current (Tab U-3). The MA had no SBs restricting it from flight prior to the mishap sortie (Tab U-3). Historical records did not reveal any critical recurring maintenance problems (Tab U-3).

b. Inspections

All scheduled calendar and hourly inspections were current and satisfactorily completed (Tabs D-5, D-6 and U-3).

A Pre-flight (PR) is a flight preparedness inspection performed by maintenance personnel before the first flight of the day and remains valid for 72 hours from the time of completion (Tab U-4). The last PR inspection on the MA was completed and signed off on the LAS Form LAS Flight Log by the assigned technician on 6 March 2017 at 0600L (Tab D-3). A Thru-flight (TH) inspection was also performed after the MA's first flight of the day by the assigned technician on 6 March 2017 at 1230L and documented on the LAS Form LAS Flight Log (Tab D-3). A TH inspection is required after every flight in between the first and last flight of the day (Tab U-4).

A Maintenance Release (MR) is an inspection of the forms required before flight and certifies an authorized individual reviewed the active forms to ensure the aircraft is safe for flight (Tab U-4). The Maintenance Release technician completed the MR prior to the first flight of the day on 6 March 2017 at 0700L, and no discrepancies were noted during the inspection (Tab D-3).

c. Maintenance Procedures

In the 24 hours prior to the mishap, pre-flight and thru-flight inspections were performed, to include servicing of aircraft fuel (Tab D-3). All maintenance servicing and inspection procedures required on the day of the flight were completed with no discrepancies noted (Tab D-3).

d. Maintenance Personnel and Supervision

SNC, consisting of all contracted personnel, performed all base-level maintenance on the MA (Tab U-5 to U-7). Maintenance personnel involved in servicing or inspecting the MA within 24 hours of the mishap were qualified and trained to complete their assigned tasks (Tab U-5 to U-7).

e. Fuel, Hydraulic, Oil, and Oxygen Inspection Analyses

The Air Force Petroleum Agency (AFPET) at Wright-Patterson AFB, Ohio, analyzed fuel samples taken from the MA's right wing tip, right wing, both external fuel tanks, and the fuel truck that serviced the MA (Tab U-12 to U-21). AFPET analysis results indicated there was no contamination in any of the samples (Tab U-12 to U-21). Post-mishap Spectrometric Oil Analysis Program (SOAP) sample from the MA was analyzed at MAFB, GA; results indicated no contamination (Tab D-2).

f. Unscheduled Maintenance

The MA flew 35.3 hours following its last 300-hour inspection accomplished on 20 December 2016 (Tab D-2). A 300 Hour inspection consolidates a group of inspections into one event to minimize the length of time that the aircraft is off flying status (Tab U-3).

On 28 February and 1 March 2017, the MA reported an ENG_PMS 001 Fail (Tab U-8 to U-11). On both occasions, the discrepancies cleared and no other engine discrepancies were reported thereafter (Tab U-3 and U-8 to U-11). A 60-day history report revealed, with the exception of two ENG_PMS 001 Fails noted above, the MA had a 0% repeat and recur rate between 5 January 2017 and 6 March 2017 (Tab U-3).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Propulsion System

The MA is powered with a Pratt & Whitney PT6A engine that turns a Hartzell Propeller (Tab AA-16). Oil pressure from the propeller governor to a hydraulic chamber within the propeller piston moves the blades to the low pitch direction (Tabs J1.2.2-5 and AA-16). Blade mounted counterweights and feathering springs actuate the blades towards the high pitch (feathered or

streamlined with respect to the flight path) direction in the absence of governor oil pressure (Tabs J1.2.2-5 and AA-16).

The Power Management System controls the engine power by modulating the propeller blade angle and by fuel flow scheduling (Tab AA-16). Components of the PMS include the PMU, the Fuel Metering Unit (FMU), and the Propeller Interface Unit (PIU) (Tab AA-16). The PMU is responsible for the main functions of the PMS and receives signals from sensors on the engine and the airframe for the automatic control of the engine and propeller (Tab AA-16). The PIU controls the oil pressure and flow in order to reduce or increase the blade pitch over the entire operation range (Tab AA-16). It provides propeller speed governing, blade angle management, and overspeed limiting (Tab AA-16).

b. Technical Information and Analysis

(1) Engine

The engine was destroyed upon impact with the ground (Tab S-7). A technical evaluation of the Voice and Data Recorder (VADR) data was performed (Tabs L-2 and U-2). Engine parameter data was recovered directly from the Data Collection Unit (DCU) and evaluated with Pratt & Whitney Canada (PWC) Ground Based Software (GBS) Lite; no abnormal data was observed prior to the mishap (Tab U-3).

The MA engine, model PT6A-68C with serial number PCE-RS0222, had not yet reached an overhaul requirement (Tab D-2). All scheduled inspections were accomplished, and no inspections or maintenance actions were due on the date of the mishap (Tab D2 and D-4 to D-5). The engine was originally installed in the MA on 20 October 2015 and had accumulated 335.3 flying hours (Tab D-2). According to a 60-day AM2 records review, the engine did not experience any notable malfunctions or require significant maintenance actions prior to the mishap (Tab U-3).

Based on data recorded onboard the aircraft, just prior to 19:27:22Z the MA was maneuvering at approximately 160 KCAS, 5,000' MSL and 50% torque when propeller RPM rapidly dropped with a corresponding increase in torque (Tab AA-6). Engine oil pressure increased steadily throughout the event and eventually stabilized above the acceptable range (Tab AA-6). Thrust deteriorated to the point where the aircraft could no longer maintain sufficient speed and altitude to recover at MAFB (Tab AA-6).

The engine responded to throttle commands; however, the Np never again reached its normal operating parameters and operated between Np of 20-52.5 % depending on throttle settings (Tabs U-2 and AA-6). All other engine parameters were within specified limits with the exception of two (Tab U-2). The oil pressure varied between 120-125 Pounds per Square Inch Gauge (PSIG), slightly higher than normal parameters (Tabs U-2 and AA-5). Torque was also abnormal varying between 42-136% (Tabs U-2 and AA-6).

(2) Propeller

The aircraft is equipped with a Hartzell five-bladed, metallic, aerobatic, constant-speed, and featherable propeller (Tab AA-16). All propeller maintenance and inspections were current on the

date of the mishap (Tabs D-4 to D-5 and U-3). The next scheduled maintenance action was a Propeller Lubrication due in 16.2 hours (Tab D-4).

The feathered condition for the propeller assembly occurs when the piston is in the aft most position (at or adjacent to the feathering stop screws) (Tab J1.2.2-5 and J1.2.1-8). Several indicators confirm the MA propeller assembly was at or near the feathered position upon impact (Tab J1.2.1-8).

The strongest indicators are marks (contact damage) on the inner forward surface of the piston from contact with the feathering stop screws (Tab J1.2.1-6 to J1.2.1-13). Other indications include: the lack of marks on the guide collar where the link arms would make contact when the blades are positioned towards low pitch; deformation of the pin holes on the liberated piston pieces and the elongation of the pin hole for link arm one in the aft direction, which would have only occurred if the propeller assembly was at, or near, the feathered position at impact (Tab J1.2.1-8). Lastly, deformation of the first blade making impact with the ground indicates the front face of the blade was parallel with the ground (Tab J1.2.1-8).

(3) Propeller Interface Unit (PIU)

Initial testing suggested the PIU may have malfunctioned in flight; however, subsequent tests strongly indicate the PIU was operational, and damage was the result of impact (Tab J1.2.2-5 to J1.2.2-17).

Functional testing initially showed the PIU servo shifted alignment, or translated, and it did not generate the pressure required to modulate propeller pitch (Tab J1.2.2-2). However, after removing and replacing the mishap two stage servo from the unit, the modified PIU was able to pass all Acceptance Test Procedure requirements (Tab J1.2.2-25). The PIU was disassembled and each of the components examined (Tab J1.2.2-7). No anomalous conditions were identified (Tab J1.2.2-7). An indentation; however, on the cover of the servo valve was noted (J1.2.2-5). Evaluation indicated the direction of translation required to induce low pressure output was consistent with the indentation on the servo cover (Tab J1.2.2-5). The data suggests the suspected misalignment of stage 1 with respect to stage 2 was likely caused by impact or removal, rather than inertial flight loads (Tab J1.2.3-8).

(4) Power Management Unit (PMU) and Throttle

Analysis of the PMU suggests it would not be expected to spontaneously precipitate an event such as the mishap observed (Tab J1.2.3-8). Analysis of the throttle quadrant microswitches showed fracture of some housings, but the observations were consistent with impact damage (Tab J1.2.3-8).

c. Technical Analysis Conclusion

Often measurements performed on components separated from the system are not as informative as measurements performed while the system is still intact (J1.2.3-8). While analysis compellingly shows the propeller was feathered at impact, none of the individually analyzed hardware revealed compelling evidence regarding the root cause of the improper propeller pitch (Tab J1.2.3-8).

7. WEATHER

a. Forecast Weather

The weather forecast at MAFB at the time of departure predicted winds 140° at 10 knots gusting to 15 knots, 7 statute miles visibility, few clouds from 5,000' to 6,000', and scattered clouds from 12,000' to 16,000' (Tab F-5). The weather forecast for the MOA predicted broken clouds from 5,000' to 6,000', scattered clouds from 12,000' to 16,000', and scattered clouds from 21,000' to 22,000' (Tab F-5). MOA winds at 5,000' were forecast to be 150° at 19 knots with surface winds of 140° at 10 knots gusting to 15 knots with a visibility of 7 statute miles (Tab F-5).

b. Observed Weather

The observed weather matched the forecast weather (Tab F-5 and F-10). An observation taken at 1435L at Homerville airport reported scattered clouds at 5,000' and broken clouds at 6,500' (Tab F-10). Winds were recorded 120° at 8 knots gusting to 15 knots, variable from 080° to 160° (Tab F-10). The temperature was 24° Celsius (75° Fahrenheit), altimeter was 30.36 inHg, and the runway was dry (Tab F-10).

c. Space Environment

Not applicable.

d. Operations

There is no evidence to suggest weather was a factor in this mishap.

8. CREW QUALIFICATIONS

a. Mishap Instructor Pilot

The MIP was a current and qualified A-29B Instructor Pilot with a current Form 8 flying evaluation (certificate of aircrew qualification), dated 22 December 2016 (Tab G-42). The MIP was current and qualified in all aspects of the planned mission (Tab G-15 to G-24). The MIP was classified as Mission Ready (Tabs G-25). Mission ready is a term used to identify the qualification, currency, and proficiency of an aircrew member (Tab AA-19). The MIP had a total of 1,911.6 flight hours at the time of the mishap, of which 339.9 hours was in the A-29B (Tab G-25). The MIP had a total of 316.2 hours as an Instructor Pilot in the A-10, 211.2 hours as an Instructor Pilot in the A-29B, and 8.4 hours as an Evaluator Pilot in the A-29B (Tab G-25).

Flight time prior to the mishap is as follows (Tab G-27)

	Hours	Sorties
30 days	8.9	7
60 days	13.1	10
90 days	29.2	21

b. Mishap Student Pilot

The MSP was a current A-29B Student Pilot in Mission Qualification Training (MQT) with a current Instrument Qualification Form 8 flying evaluation (certificate of aircrew qualification), dated 9 September 2016 (Tab G-38). The MSP had a Basic Aircraft Qualification in the A-29B and was flying the last sortie in the MQT course (mission checkride) to become Mission Qualified (Tabs G-6, R-5, and BB-3). A Basic Aircraft Qualification identifies an aircrew member has satisfactorily completed Initial Qualification Training and is qualified to perform aircrew duties in the aircraft (Tab BB-3). The MSP had a total of 157.3 flight hours at the time of the mishap, all of which were in the A-29B (Tab G-6).

Flight time prior to the mishap is as follows (Tab G-7):

	Hours	Sorties
30 days	14.1	9
60 days	28.2	19
90 days	50.4	31

9. MEDICAL

a. Qualifications

(1) Mishap Instructor Pilot

The MIP was medically qualified for flying duties at the time of the mishap (Tab X-2). The MIP had a current annual military Preventative Health Assessment (Tab X-2). Medical records for the MIP contained a current DD2992, *Medical Recommendation for Flying or Special Operational Duty*, dated 23 February 2016 (Tab X-2). A review of the Aeromedical Information Management Waiver Tracking System (AIMWTS) database, did not show any medical waiver requirement for the MIP at the time of the mishap (Tab X-2).

(2) Mishap Student Pilot

The MSP was medically qualified for flying duties at the time of the mishap (Tab X-2). Medical records for the MSP contained a current DD2992 dated 16 December 2015 (Tab X-2). A review of the AIMWTS database did not show any medical waiver requirement for the MSP at the time of the mishap (Tab X-2).

b. Health

All medical histories and records of the MIP and MSP were reviewed (Tab X-2). Both the MIP and MSP successfully ejected from the MA (Tab H-13). During ejection the MIP sustained compression fracture of the spine and the MSP sustained minor injuries (Tab X-2).

c. Pathology

Blood and urine samples were collected from the MIP, MSP, and maintenance personnel (Tab X-2). The samples were submitted to the Forensic Toxicology Laboratory of the Armed Forces Medical Examiner System, the Department of Defense's (DoD) primary forensic laboratory for performing full spectrum toxicological analysis (Tab X-2). All samples tested negative for carbon monoxide, ethanol, amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, opioids, phencyclidine, and sympathomimetic amines (Tab X-2).

d. Lifestyle

The AIB reviewed 72 hour/7 day histories of the MIP, MSP, and maintenance personnel (Tab X-2). There is no evidence to suggest lifestyle factors were a factor in this mishap (Tab X-2).

e. Crew Rest and Crew Duty Time

AFI 11-202, Volume 3, *General Flight Rules*, dated 10 August 2016, states crew rest is required for aircrew members prior to performing any duties involving aircraft operations and is a minimum of 12 non-duty hours before the flight duty period begins (Tab BB-5). There is no evidence to suggest crew rest and crew duty time were a factor in the mishap (Tabs X-2 and AA-18).

10. OPERATIONS AND SUPERVISION

a. Operations

The 81 FS was reactivated at MAFB on 15 January 2015 (Tab CC-16). The initial cadre of active duty and contract SNC IPs was assembled from a variety of operational backgrounds and Mission Design Series (MDS) aircraft and were selected for their experience and ability to instruct close air support operations (Tab V-8.1). Not long after squadron reactivation, the unit began instructing its first class of Afghan students in the spring of 2015 (Tab V-2.1 and V-8.1). The MAFB assigned A-29B aircraft are acquired under a program that transfers ownership to the Government of the Islamic Republic of Afghanistan and are maintained per contract by SNC while at MAFB (Tabs V-8.1 and CC-16).

In October 2015, IPs and SNC maintenance members established a deployed presence in Afghanistan to assist the Afghan Air Force in A-29B training, operations, and employment. (Tab V-8.1). Originally comprised of active duty and contract SNC instructor pilots, the squadron added its first General Schedule (GS) civilian IP in May 2016 (Tab V-2.1 and V-8.1). Currently, the squadron has 16 active duty IPs, 1 GS IP, and 9 SNC IPs (Tab V-2.1). By March 2017, the 81 FS had graduated 15 Afghan pilots (Tab V-2.1).

b. Supervision

The mission was authorized by the squadron Top-3 (Tabs K-4, V-2.2, V-3.1, and V-8.1). The MIP and MSP attended the mass briefing on 6 March 2017 and received a step briefing from the Top-3 prior to departing the squadron for the sortie (Tabs R-34, V-2.1, V-3.1, and V-8.1). All ORM factors were addressed and approved by the MIP and Top-3 (Tabs R-34, V-2.2, V-3.1, and V-8.1). Additionally, the flight lead and MIP consulted the Top-3 for recommendation and approval to

proceed with the mission after the ENG_PMS 001 fail PFL appeared in the MA (Tabs R-12, R-35, V-2.2, and V-8.1).

11. HUMAN FACTORS ANALYSIS

a. Introduction

Human factors relevant to the mishap were evaluated using the analysis and classification model established by the DoD Human Factors Analysis and Classification System (DoD HFACS) Version 7.0, implemented by AFI 91-204, *USAF Safety Investigations and Reports*, dated 10 April 2014 (Tab BB-15). A factor is any deviation, out-of-the-ordinary or deficient action, or condition discovered in the course of a mishap investigation that in the board's opinion contributed to the eventual outcome (Tab BB-7). Multiple sources of data were reviewed, including but not limited to: witness testimony, medical records, toxicology results, audio and video recordings, and flight reconstructions (Tabs X-2 and AA-5 to AA-15). The human factors relevant to this mishap are described below.

b. Visibility Restrictions (not weather related) (PE203)

Visibility restrictions are a factor when the lighting system, windshield/windscreen/canopy design, or other obstructions prevent necessary visibility; this includes glare or reflections on the windshield/windscreen/canopy (Tab BB-9).

The MIP was positioned in the back seat of the MA during the flight, limiting forward field of view (Tab V-2.3). As a result, the MIP's ability to visually acquire Homerville for the emergency divert landing was degraded (Tab V-2.3).

c. Task Oversaturation (PC103)

Task over-saturation is a factor when the quantity of information an individual must process exceeds their mental resources in the amount of time available to process the information (Tab BB-10).

At 19:27:28Z, the MIP assumed control of the aircraft, analyzed the situation, took the actions perceived as necessary, and attempted to land as soon as conditions permitted (Tab AA-12). The MIP encountered challenges initially establishing a direct heading to Homerville, which was in part related to the visibility restrictions, but additionally compounded by numerous factors (e.g., instrument crosscheck, communication, coordination) significantly increasing cognitive workload, contributing to task over-saturation (Tab AA-12).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

- (1) AETCI 11-2A-29, Volume 3, *A-29 Operations Procedures*, dated DRAFT
- (2) AETCI 11-2A-29, Volume 3 CONOP, *A-29 Flying Operations*, dated 28 May 2015
- (3) AFI 48-123, *Medical Examination and Standards*, Dated 19 September 2016

- (4) AFI 11-202v3, *General Flight Rules*, Dated 10 August 2016
- (5) AFI 91-204, *Safety Investigation and Reports*, Dated 11 January 2016
- (6) AFI 51-503, *Aerospace and Ground Accident Investigations*, Dated 14 April 2015
- (7) AFI 11-418, *Operations Supervision*, dated 14 October 2015
- (8) AFMAN 11-281 Volume 1, *A-29 Basic Flying Operations*, dated 1 June 2016

NOTICE: All directives and publications listed above are available digitally on the Air Force Departmental Publishing Office website at: <http://www.e-publishing.af.mil>.


b. Other Directives and Publications Relevant to the Mishap

- (1) AMM-4982-PART I, *Aircraft Maintenance Manual Part I – System Description Section*, Dated 22 August 2016
- (2) AMM-4982-PART II, *Aircraft Maintenance Manual Part II – Maintenance Practices and Procedures*, Dated 22 August 2016
- (3) T.O. 1A-29B(LAS)-1, *Flight Manual Embraer A-29*, Dated 07 December 2015
- (4) T.O. 1A-29B(LAS)-1-1, *Flight Manual, Avionics System Supplemental Manual Embraer A-29*, Dated 22 August 2016
- (5) T.O. 1A-29B(LAS)-1-2, *Flight Manual, Performance Data Supplemental Manual Embraer A-29*, Dated 07 December 2015
- (6) T.O. 1A-29B(LAS)-1CL, *Pilot’s Checklist, Normal Procedures*, Dated 07 December 2015
- (7) T.O. 1A-29B(LAS)-5, *Basic Weight Checklist and Loading Data Manual*, Dated 07 December 2015
- (8) T.O. 1A-29B(LAS)-MESL, *Minimum Essential Subsystem List (MESL)*, Dated 25 June 2014
- (9) T.O. 1T-6A-1, *Flight Manual, T-6A*, Dated 1 March 2015
- (10) T.O. 14P3-1-161, *Combined Advanced Technology Enhanced Design “G” Ensemble (Combat Edge Equipment)*, 10 February 2017
- (11) Hartzell Propeller Inc. Manual No. 139, 61-00-39, Revision 14, *Propeller Owner's Manual and Logbook*, Dated October 2016
- (12) AETC Syllabus F-V5A-Q (A-29 MQ), *A-29 Mission Qualification*, dated June 2016

c. Known or Suspected Deviations from Directives or Publications

Not Applicable.

29 December 2017


 MICHAEL G. SNELL, Colonel, USAF
 President, Accident Investigation Board

STATEMENT OF OPINION

**A-29B, T/N 13-2015
MOODY AFB, GA
6 MARCH 2017**

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. OPINION SUMMARY

On 6 March 2017, at approximately 1432 hours local time (L) the Mishap Aircraft (MA), an A-29B, T/N 13-2015, assigned to the 81st Fighter Squadron, 14th Flying Training Wing, Moody Air Force Base, Georgia, crashed during a close air attack (CAA) student flight and impacted the ground approximately 1.5 nautical miles (NM) northwest of the Homerville Airport. The Mishap Instructor Pilot (MIP) and Mishap Student Pilot (MSP) ejected safely, with the MIP sustaining injury during the ejection. The MA was destroyed on impact with minor damage to approximately one acre of private property. Damage to government property is estimated at \$17,772,729.

The mishap occurred during a CAA syllabus sortie (flight) as part of the Afghan A-29B training course. The MA was number two of a two-ship formation with the MSP in the front seat and the MIP in the back seat. The MA experienced a Power Management System (PMS) fault early in the sortie profile, and after consultation with Top-3 leadership, the mission proceeded. Approximately one hour later, the propulsion system suddenly malfunctioned, significantly reducing propeller speed (Np), driving the propeller blades toward the feathered position, and increasing engine torque above limits. The MIP immediately initiated the Compressor Stall checklist; however, he exited that checklist after he established aircraft control and assessed the engine was not stalled. The MIP then took action to trouble shoot the propulsion system malfunction and restore normal operation; cycling the PMS system from Auto to Manual, then back to Auto, and later placing it in Manual for the remainder of the flight without any apparent effect on aircraft performance. The MIP quickly decided to divert to the nearest field at Homerville in an attempt to make a straight-in landing. The MIP continued to balance throttle inputs with engine limits seeking maximum performance from the aircraft until he commanded ejection at approximately 300 feet above ground level (AGL). The MA crashed approximately 1.5 NM from the Homerville airport, 5 minutes and 26 seconds after the propulsion system malfunction.

I find by a preponderance of the evidence the MA loss was caused by a propulsion system malfunction that dramatically reduced thrust. The MA retained some degree of thrust, but was incapable of sustaining level flight. I additionally find visibility restrictions from the rear cockpit and task oversaturation to be substantially contributing factors. The initial heading flown to allow the MIP to visually acquire Homerville and the ensuing task saturation resulted in a longer ground track than intended. Although analysis of recorded flight data and subsequent flight simulation is

not conclusive, it suggests it was possible to reach the field for a very limited period of time if the aircraft flew on a straight line to Homerville.

I developed my opinion by analyzing factual data, tangible evidence, engineering analyses, witness testimony, aircraft flight data, flight simulations, animated simulations, information provided by technical experts, Technical Orders (TOs), and applicable Air Force guidance.

2. CAUSE

Propulsion System Malfunction Resulting in Loss of Thrust

The first indication of the propulsion system anomaly occurred at 18:35:03Z, shortly after the aircraft entered the Military Operating Area (MOA), when the aircraft presented an aural Avionics warning accompanied by an ENG_PMS 001 fail caution and Pilot Fault List (PFL) message. The PFL indicated a detected fault in the PMS with the PMS retaining control of the engine. Because the aircraft Technical Order (TO) did not specifically address the implication of the PFL, the formation flight discussed the significance of the PFL and ultimately called the Top-3 for guidance. The Top-3 and the formation pilots agreed the mission could continue with the PFL indicated. Cockpit instrument readings support the assertion the PMS was in control of the engine until the malfunction occurred at 19:27:22Z, almost one hour later.

The Voice and Data Recorder (VADR) shows a Np anomaly occurred at 19:26:00Z, causing it to decrease slightly below normal operating range for a period of 23 seconds. Then, at 19:27:22Z the Np rapidly decreased well below normal operating range and stayed there for the remainder of the flight. Np reduction was simultaneously accompanied by propeller pitch movement toward the feathered position. This had the effect of increasing propeller drag and engine torque, which was observed in pilot testimony and VADR data. By reducing throttle input, the MIP was able to bring engine torque back within limits; however, prop speed never recovered to normal operation.

Due to excessive noise and vibration accompanied with the malfunction, the MIP immediately initiated the Compressor Stall checklist; however, he exited that checklist before completion when he assessed that the engine was not stalled. In an effort to trouble shoot the problem and restore normal propulsion system operation, the MIP cycled the PMS from Auto to Manual then back to Auto. This action was completed at one minute and 23 seconds after the malfunction with no improvement in thrust. In an effort to get maximum engine performance, the MIP pushed engine torque into the caution range, yielding a Np of 44%. Over time, the torque setting triggered an Engine Limits warning from the aircraft. Per the Engine Limits Exceeded checklist, the MIP reduced throttle within torque limits and placed the PMS switch to the Manual position. The PMS remained in Manual for the rest of the flight with no change in aircraft performance.

I was unable to determine why the propulsion system malfunction occurred when it did, or what caused the Np to decay suddenly without recovery. However, the AIB ruled out the following:

(1) Aircraft condition and maintenance: In my opinion, the aircraft was in proper working order and condition at the time the crew accepted it for flight. All aircraft documentation was

complete, and all required maintenance and inspections were accomplished within the guidelines established by the aircraft TO.

(2) Aircrew training and supervision: In my opinion, the MIP was properly trained, certified, and authorized to operate the MA as pilot-in-command while executing this sortie in accordance with (IAW) the A-29B training syllabus. Additionally, the MIP was properly trained, certified and authorized to evaluate and instruct the MSP IAW the syllabus. The mission was authorized, planned, and briefed per squadron standards. The Top-3 performed standard briefings, Go/No-Go, and operational risk management (ORM) reviews prior to flight. Top-3 guidance to proceed with the mission after the ENG_PMS 001 fail PFL was IAW accepted squadron procedure and risk mitigation practice at the time.

Finally, in my opinion, it is worth noting the unique manner in which the propulsion system failed. The mode of failure was without precedent in the A-29B and was inconsistent with any emergency procedure being taught or described in the TO. The severity of the failure rendered the propulsion system critically thrust deficient. The possibility of a link between the ENG_PMS 001 fail PFL experienced early in the sortie and the subsequent propulsion system malfunction almost one hour later could not be substantiated by the evidence available to the AIB.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

a. Substantially Contributing Factor 1 [PE203 Visibility Restrictions]

Although VADR analysis and subsequent flight simulation is not conclusive, it supports the assertion the propulsion system was producing some thrust after the malfunction occurred. Analysis of the MA ground track also suggests it was possible to reach Homerville for a very limited amount of time if the aircraft flew on a straight line to the field from the point where the MIP made the decision to land there. Although the MIP's intent was to fly directly to Homerville, cockpit visibility restrictions from the back seat caused him to initially fly a northeasterly heading as he visually acquired Homerville in the right hand side of his canopy. The MIP maintained this general heading for approximately 90 seconds before turning direct to Homerville. The fact the propulsion system was producing some thrust and the early appearance from the cockpit of a normal glide path angle initially masked the negative impact of the extra distance traveled as the aircraft maneuvered to a five-mile final approach position. From this position, the aircraft energy state and the available thrust from the propulsion system was insufficient to land successfully at Homerville. Flight simulation also revealed the decision to retain the external tanks did not have a significant impact on the aircraft's performance, and alone would not have changed the outcome.

b. Substantially Contributing Factor 2 [PC103 Task Oversaturation]


The low altitude and time-compressed nature of this emergency afforded the MA crew very little time to react in a manner that could have produced a successful outcome. Task oversaturation in the minutes that followed compounded the emergency. Due to wind conditions at the time of the propulsion system malfunction, it was not possible to glide safely to Homerville. Given the extremely limited thrust, it is estimated the MA would have needed to make a divert decision within the first minute of the emergency and then fly directly to the field in order to land safely at

Homerville. The MIP quickly made the decision to proceed to Homerville 47 seconds after the propulsion system malfunction occurred. However, visibility restrictions previously discussed caused the MIP to initially fly a northeasterly heading in order to visually acquire Homerville. Ensuing task oversaturation kept the MIP from changing the heading for approximately 90 seconds before correcting course direct to Homerville. During this time, the MIP attempted to maintain aircraft control and best range airspeed, coordinate actions with the MSP, trouble shoot the propulsion system malfunction by cycling the PMU, assess throttle inputs and manage engine parameters while seeking to obtain maximum aircraft performance, initiate and complete the Engine Limits Exceeded emergency checklist, navigate the aircraft, set the aircraft squawk to emergency, communicate and coordinate intentions with flight lead, switch radios to Homerville Common Traffic Advisory Frequency, and determine whether to jettison the external tanks. Although the MA only deviated heading for 90 seconds, the scenario did not afford any deviation tolerance.

4. CONCLUSION

I find by a preponderance of the evidence the MA loss was caused by a propulsion system malfunction that dramatically reduced thrust. The MA retained some degree of thrust, but was incapable of sustaining level flight. I additionally find visibility restrictions from the rear cockpit and task oversaturation to be significant contributing factors. The initial heading flown to allow the MIP to visually acquire Homerville and the ensuing task saturation resulted in a longer ground track than intended. Although analysis of recorded flight data and subsequent flight simulation is not conclusive, it suggests it was possible to reach the field for a very limited period of time if the aircraft flew on a straight line to Homerville.

29 December 2017


MICHAEL G. SNELL, Colonel, USAF
President, Accident Investigation Board

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