UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

T-6A, T/N 05-6209

559TH FLYING TRAINING SQUADRON
12TH FLYING TRAINING WING
JOINT BASE SAN ANTONIO (JBSA)-RANDOLPH, TEXAS

LOCATION: 4.8 MILES NW OF JBSA-RANDOLPH, TEXAS

DATE OF ACCIDENT: 18 SEPTEMBER 2018

BOARD PRESIDENT: COLONEL MICHAEL C. BOGER

Conducted IAW Air Force Instruction 51-503

United States Air Force Accident Investigation Board Report

Class A, JBSA-Randolph, Texas

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION

T-6A, T/N 05-6209
JBSA-RANDOLPH, TEXAS
18 September 2018

On 18 September 2018, at 15:40:41 hours, local (L) time, a T-6A Texan II, tail number 05-6209, crashed 4.8 miles northwest of JBSA-Randolph, TX, completely destroying the aircraft. The mishap aircrew (MC) consisted of a mishap instructor pilot (MIP), occupying the front seat, who was supervising the mishap pilot (MP). The MP was conducting an instructor qualification sortie in the Pilot Instructor Training (PIT) course from the rear seat. The MC successfully ejected and sustained minor injuries. The MC and mishap aircraft (MA) were assigned to the 559th Flying Training Squadron, 12th Flying Training Wing (FTW), JBSA-Randolph, TX. During the mishap sortie (MS), the MA crashed while returning to base for local take-off and landing practice. The destroyed aircraft is valued at approximately $5.7 million with minimal damage to civilian property and no casualties.

While being vectored for the approach to runway 15R at Randolph Air Force Base (AFB), at approximately 15:35:00L, the MC noticed the high fuel flow reading, and subsequently decided to continue the approach to a full stop. Slightly over four minutes later, at 15:39:16L, while slowing and configuring to land, the MA's engine failed. At the time of the engine failure, the MA was below the energy profile required to glide to a suitable landing surface. The MIP transmitted the MC's intent to eject over the radio and they did so seconds later.

The Accident Investigation Board (AIB) President, by a preponderance of evidence, determined the cause of the mishap to be a fuel transfer tube locking plate that was improperly installed during the contracted 4500 hour engine overhaul. This resulted in engine failure where the aircraft was not in a position to land safely.

United States Air Force Accident Investigation Board Report

Class A, JBSA-Randolph, Texas

SUMMARY OF FACTS AND STATEMENT OF OPINION
T6-A, T/N 05-6209
18 SEPTEMBER 2018

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

A1C	Airman First Class
ADSB	Automatic Dependent Surveillance-Broadcast
AETC	Air Education and Training Command
AETCSUP	AETC Supplement
ADI	Attitude/Direction Indicator
AF	Air Force
AFB	Air Force Base
AFE	Aircrew Flight Equipment
AFI	Air Force Instruction
AFLCMC	Air Force Life Cycle Management Center
AFMAN	Air Force Manual
AFPET	Air Force Petroleum Office
AFSEC	AF Safety Center
AFTO	Air Force Technical Order
AGL	Above Ground Level
AIB	Aircraft Accident Investigation Board
AIBLA	Aircraft Accident Investigation Board Legal Advisor
AIBMM	Aircraft Accident Investigation Board Medical Member
AIBMXM	Aircraft Accident Investigation Board Maintenance Member
AIBP	Aircraft Accident Investigation Board President
AIBPM	Aircraft Accident Investigation Board Pilot Member
AIBR	Aircraft Accident Investigation Board Recorder
AFLCMC	Air Force Life Cycle Management
ATC	Air Traffic Control Center
PEL	Precautionary Emergency Landing
BOTH “position”	1 of 3 ISS operating options
BPO	Basic Post-Flight
CAD/PAD	Cartridge and Propellant Actuated Devices
Capt	Captain
CES	Civil engineer Squadron
CEF	Civil Engineering Flight
CFES	Canopy Fracturing Explosive System
CFIS	Canopy Fracturing Explosive System
CFS	Canopy Fracturing System
CNR	Could Not Replicate
Col	Colonel
COMBS	Contractor Operated and Managed Base Supply
COR	Contracting Officers Representative
CPO	Contracting Procurement Officer
CT	Continuation Training
DME	Distance Measuring Equipment
DNIF	Duty Not Including Flying
DoD	Department of Defense
EBHJ	Is an office symbol for the Air Force CAD/PAD office
ELP	Emergency Landing Pattern
EOR	End of Runway
ER	Exceptional Release
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FCF	Functional Check Flight
FCIP	Front-Cockpit Instructor Pilot
FCIF	Flight Crew Information File
FDP	Flight Duty Period
FMU	Fuel Management Unit
FTS	Flying Training Squadron
FTW	Flying Training Wing
G	Unit of Measurement (acceleration of gravity)
GPS	Global Positioning System
GS	General Schedule
GSE	Government Support Equipment
HFACS	Human Factors Analysis and Classification
HPO	Hourly Post Flight Inspection
IAW	In Accordance With
ICE	In Case Of Emergency
ILS	Instrument Landing System
IMDS	Integrated Maintenance Data System
IP	Instructor Pilot

IPI	In-processing Inspection
ISS	Inter-seat Sequencing System
ITT	Inter-stage Turbine Temperature
JBSA	Joint Base San Antonio-Randolph
KNOTS	Unit of Speed (one nautical mile per hour)
KTL	Key Task Listing
L	Local Time
Lt	Lieutenant
Lt Col	Lieutenant Colonel
Ltd	Limited
MA	Mishap Aircrew
Maj	Major
MC	Mishap Crew
ME	Mishap Engine
METAR	Meteorological Aerodrome Report
MIP	Mishap Instructor Pilot
MOA	Military Operating Area
MP	Mishap Pilot
MS	Mishap Sortie
MSgt	Master Sergeant
MSL	Mean Sea level
MSU	Maintenance Support Unit
MXM	Maintenance Member
N	North
NOTAMS	Notices to Airmen
OBOGS	On-Board Oxygen Generation System
OBS	Omni-bearing Selector
OCF	Out of Controlled Flight
OG	Operations Group
OGV	Operations Group standards/ Evaluation
ORM	Operational Risk Management
OSS	Operation Support Squadron
PA	Public Affairs
PCL	Power Control Lever
PDR	Pilot Discrepancy Reports
PIT	Pilot Instructor Training
PHA	Preventive Health Assessment
PLF	Parachute Landing Fall
PMU	Power Management Unit
PPH	Pounds Per Hour
PR	Preflight
PRD	Pilot Related Discrepancy
PTP	Product Support Division
PTPLA	This is just a five-letter designator of the Wright-Patterson Area Laboratory
P&W	Pratt and Whitney
QA	Quality Assurance
QVI	Quality Verification Inspection
QC	Quality Control
QEC	Quick Engine Change Kit
QRC	Quick Response Checklist
ROD	Report Of Deficiency
RSS	Regional Supply Services
TCI	Time Change Interval- or - Time Change Item
UI	Undergraduate Instructor
SA	Situational Awareness
SAR	Search and Rescue
SFL's	Simulated Forced Landing
SIBAFSEC	Safety Investigation Board AFSEC Member
SIBAFE	Safety Investigation Board AFE Member
SIB	Safety Investigation board
PIF?	Pilot Information File
SMSgt	Senior Master Sergeant
SOF	Supervisor of Flying
SPO	System Program Officer
SrA	Senior Airman
SSgt	Staff Sergeant
SUP	Operations Supervisor
SUPM	Supervisor of Maintenance
SUPT	Specialized Undergraduate Pilot Training
SWIT	Safety Investigation Board Witness
6T's	Turn, Time, Throttle, Twist, Track, Talk
TCTO	Time Change Technical Orders
TDY	Temporary Duty
TO	Technical Order
TP Stalls	Traffic Pattern Stalls
TSgt	Technical Sergeant
U.S.	United States
USAF	United States Air Force
USAFA	United States Air Force Academy
VFR	Visual Flight Rules
W	West

WG	Wage Grade	Z	Zulu
WIT	Witness		

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).

United States Air Force Accident Investigation Board Report

Class A, JBSA-Randolph, Texas

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 13 November 2018, Major General Mark E. Weatherington, the Air Education and Training Command (AETC) Deputy Commander, appointed Colonel Michael C. Boger as president to conduct an aircraft accident investigation, under the provisions of AFI 51-503 to investigate the subject mishap (Tab Y-2). Appointed to this board as members on 16 November 2018, were a Lieutenant Colonel Legal Advisor, a Major Medical Advisor, a Captain Pilot Advisor, a Civilian Maintenance Member, and a Staff Sergeant Recorder (Tab Y-4). They conducted this investigation at Joint Base San Antonio (JBSA) Randolph, Texas from 26 November 2018 through 21 December 2018.

b. Purpose

In accordance with 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 18 September 2018, at 15:40:41 hours, local (L) time, a T-6A Texan II, tail number 05-6209, crashed 4.8 miles northwest of JBSA-Randolph, TX, completely destroying the aircraft (Tab Q-12). The mishap aircrew (MC) consisted of a mishap instructor pilot (MIP), occupying the front seat, who was supervising the mishap pilot (MP) (Tab AA-5). The MP was conducting an instructor qualification sortie in the Pilot Instructor Training (PIT) course from the rear seat. The MC and mishap aircraft (MA) were assigned to the 559th Flying Training Squadron (FTS), 12th Flying Training Wing (FTW), JBSA-Randolph, TX (Tab AA-5). While on approach, the MC recognized abnormally high fuel flow readings and elected to conduct a full stop landing to Randolph Air Force Base. Minutes later, while slowing to configure for landing, the MA experienced engine failure and crashed (Tabs L-19 and R-26). The MC ejected safely from the aircraft sustaining minor injuries. The destroyed aircraft is valued at approximately $5.7 million with no loss of civilian property or casualties (Tab Q-12).

3. BACKGROUND

a. Air Education and Training Command's (AETC)

AETC's mission is to recruit, train and educate Airmen to deliver 21st Century Airpower. AETC, with headquarters at JBSA-Randolph, Texas, was established and activated in January 1942, making it the second oldest major command in the Air Force. AETC includes Air Force Recruiting Service, two numbered air forces and the Air University (Tab CC-2).

The command has more than 29,000 active-duty members, 6,000 Air National Guard and Air Force Reserve personnel, and 14,000 civilian personnel. The command also has more than 9,000 contractors assigned. AETC flies approximately 1,400 aircraft and operates at 12 major installations and supports tenant units on numerous bases across the globe, encompassing 16 active-duty and 7 Reserve wings (Tab CC-2).

b. The 12th Flying Training Wing (12 FTW)

The 12th FTW is the source of America's airpower, training Airmen in the fundamentals of Airmanship, Instruction and Leadership. The wing, which is headquartered at JBSA-Randolph, Texas, consists of three flying groups and a maintenance directorate spanning more than 1,600 miles (Tab CC-13).

The 12th FTW is responsible for four-single source aviation pipelines - Pilot Instructor Training, Combat Systems Officer Training, Remotely Piloted Aircraft Pilot Indoctrination, and Basic Sensor Operator Qualification. The wing manages all airmanship programs for the United States Air Force Academy (USAFA) cadets and Introductory Flight Training for all Air Force Airmen scheduled to enter pilot, combat systems officer or remotely piloted aircraft training. The wing also hosts an introduction to Fighter Fundamentals program and conducts Electronic Warfare Training for the U.S. Air Force and multi-national forces (Tab CC-13).

c. The 559th Flying Training Squadron (559 FTS)

The 559th FTS provides T-6A Pilot Instructor Training. The squadron flies more than 16,000 hours annually in a fleet of 38 T-6A aircraft and qualifies more than 200 U.S. Air Force, Navy, Marine and allied pilots annually (Tab CC-14).

d. The T-6A Texan II

The T-6A Texan II is a single-engine, two seat primary trainer designed to train Joint Primary Pilot Training students in basic flying skills common to U.S. Air Force and Navy pilots (Tab CC-17).

Produced by Raytheon Aircraft, the T-6A Texan II is a military trainer version of Raytheon's Beech/Pilatus PC-9 Mk II (Tab CC-17).

Stepped-tandem seating in the single cockpit places one crewmember in front of the other, with the student and instructor positions being interchangeable. A pilot may also fly the aircraft alone from the front seat. Pilots enter the T-6A cockpit through a side-opening, one-piece canopy that has demonstrated resistance to bird strikes at speeds up to 270 knots. (Tab CC-17).

The T-6A has a Pratt & Whitney Canada PT6A-68 turbo-prop engine that delivers 1,100 horsepower. Because of its excellent thrust-to-weight ratio, the aircraft can perform an initial climb of 3,100 feet (944.8 meters) per minute and can reach 18,000 feet (5,486.4 meters) in less than six minutes (Tab CC-17).

4. SEQUENCE OF EVENTS

a. Pre-Mission Maintenance

On 11 December 2017, Standard Aero Ltd overhauled the Mishap Engine (ME), serial number PWV-RA0325. During the overhaul, the fuel manifold set and the fuel flow divider unit were removed, overhauled separately, and reinstalled (Tabs U-2 and U-67). The ME was stored until 7 August 2018 when it was returned to, and accepted by, the Contractor Operated and Maintained Base Supply (COMBS) facility at JBSA-Randolph, TX (Tab U-17 to U-27). On 8 August 2018, COMBS personnel completed and signed off the installation of the Quick Engine Change (QEC) kit (Tab U-17 to U-27).

On 20 July 2018, the Maintenance Support Unit (MSU) inducted the Mishap Aircraft (MA) to accomplish a 150 Hourly Post Flight Inspection (HPO) (Tabs BB-44 and U-30 to U-66). During this inspection, on 24 July 2018, mechanics discovered the lower right oil filler cap stud was damaged on the installed engine, serial number PWV-RA0161, rendering it unserviceable (Tab U-44). Work cards A through 6-004 were accomplished prior to identifying damage on that engine (Tab BB-44). It was subsequently removed from the MA (Tab U-44).

On 13 August 2018, MSU mechanics accepted the ME and installed into the MA (Tab U-44). Work cards 6-005 through 6-013 were accomplished on the ME and MA (Tab BB-44). Remaining maintenance and performance runs were conducted on the MA between 13 and 21 August 2018 (Tab U-30 to U-66).

On 30 August 2018, a Functional Check Flight (FCF) was accomplished with no discrepancies noted, thereby releasing the aircraft back to flying status (Tab U-64). The MA then flew 17 sorties between 30 August and 17 September 2018 (Tab U-68 and U-75).

b. Mission

The 559 FTS scheduled and authorized the MC's mission sequence (Tab AA-5). On Tuesday, 18 September 2018, the MP was to fly a day, single-ship, front-cockpit sortie as part of the Pilot

Instructor Training (PIT) program (Tab G-90 to G-140). The MIP, scheduled as the Instructor Pilot (IP) and pilot in command of the mission, was tasked with conducting the required training for the MP on the sortie (Tab AA-5). The MS was the fourth scheduled mission in the MP's syllabus. The MP previously completed three sorties in the PIT syllabus (Tab G-90 to G-140). The MP had also flown two "incomplete" sorties, in the preceding 30 days, which did not count towards his syllabus progression (Tab G-90 to G-140). The planned profile for the sortie included a departure to the Military Operating Area (MOA) for basic air work followed by an approach into Kelly Field, TX and finished with a visual flight rules (VFR) recovery to Randolph Air Force Base (AFB) for patterns (Tabs R-5, U-25 and AA-5).

c. Planning

On 18 September 2018, the MIP reported for work at 08:30L followed by the MP at 12:30L (Tab R-15 and R-37). The MIP met with the MP at approximately 13:40L to brief the sortie in accordance with Air Force Instruction (AFI) 11-2T-6v3, Air Force Manual (AFMAN) 11-248, and Squadron Standards, along with Notices to Airmen (NOTAMs), forecast weather, and planned flying events (Tabs O-2 and BB-41 and BB-42). Per normal procedures, no squadron supervisory personnel attended the brief. The MP also completed an Operational Risk Management (ORM) assessment (Tab R-24). The ORM form is a checklist of risk factors, designed to codify all identifiable risks associated with the planned mission (Tab AA-14). Each factor, such as weather, briefing time, or lack of sleep, has an associated point value. The MP compiled the total of all identified risks (Tab AA-14). The following scale quantifies the sortie risk: Low (0-5 points), Moderate (6-12 points), High (13-15 points), Severe (16+ points). The missions quantifiable risk assessment was 6 points, equating to a planned moderate-risk mission (Tab AA-14). Both the MIP and MP checked the NOTAMs and weather (Tab R-25). The MP planned the sortie to conduct a takeoff and departure towards the Tweet MOA west of the field (Tab R-25). Once in the MOA the MP planned to accomplish a unit-of-gravity (G) exercise, traffic-pattern stalls, power-on stalls, slow-flight, aerobatics, and multiple out of controlled flight (OCF) recoveries (Tab R-5 and R-25). Following the maneuvers in the MOA, the MP planned to fly an instrument landing system (ILS) approach into Kelly Field, TX (Tab R-5 and R-25). Finally, the plan was then to return to Randolph AFB under VFR and conduct traffic-pattern training (Tab R-5 and R-26).

d. Preflight

At approximately 1405L, the MIP and MP travelled to Aircrew Flight Equipment (AFE) to don their flight gear (Tab R-25). At approximately 1410L, the MIP and MP travelled from AFE to the T-6 Operations Supervisor's desk for the step-brief and aircraft assignment (Tab R-25). The step-brief included an updated weather forecast, NOTAMs, and an airfield status update (Tab AA-2). The T-6 Operations Supervisor, SWIT 42, reviewed the MC's ORM sheet and approved the mission's risk assessment (Tab AA-14). At approximately 1415L, the MIP and MP walked to the MA. The MIP and MP reviewed the forms, followed by the MIP completing the walk-around inspection of the MA (Tab R-5 and R-25). Neither the MIP nor MP discovered any abnormalities prior to operating the MA (Tab R-5 and R-25). The MIP noted no abnormalities during engine start or preflight operations (Tab R-25).

e. Summary of Accident

The MIP taxied out of parking at 14:36:30L and then to the end of runway (EOR) area. While in the EOR, the MIP conducted the over-speed governor check along with all other items listed in the checklist (Tab L-8). Neither the MIP nor MP noted any anomalies. Take-off occurred at 14:43:20L (Tab L-5).

The MA reached the MOA at approximately 14:48:00L and remained in the MOA until requesting vectors for the approach at Kelly Field at 15:28:40L (Tab L-14). After the MC made the approach request, the Houston Air Traffic Control Center informed them that it would be roughly a 15-minute wait before it could clear them for the approach due to other air traffic (Tab R-25). The MC opted to forego the approach at Kelly Field and return directly to Randolph AFB for the ILS and traffic-pattern work (Tab R-25).

At approximately 15:35:30L, while being vectored for the approach, the MP noticed a slight and momentary, un-commanded increase in torque (Tabs L-19 to L-21, R-6 and V-11.2). This drew the MPs attention to the fuel flow display, which indicated a roughly 735 pounds per hour (pph) flow (Tabs L-19, R-6 and V-11.2). Parametric data indicates that the torque anomaly occurred concurrently with displacement of the fuel transfer tubes and excessive fuel flow rates (Tab L-19 to L-21). The MP brought the increased fuel flow to the attention of the MIP. The MP did not communicate, nor was the MIP ever made aware of, the torque anomaly (Tabs R-6 and Tab V-10.10). The MIP acknowledged the fuel flow anomaly but did not take control of the aircraft to analyze further until 30 seconds later at roughly 15:36:30L (Tabs L-16, R-4 and R-26).

At 15:37:30L, San Antonio Approach instructed the MC to contact the JBSA-Randolph Tower. (Tabs L-25 and N-3). At approximately the same time, the MIP returned control of the MA to the MP in order to complete the approach (Tab V-10.3, V-10.4). The MC, upon confirming the abnormal fuel flow indications, elected to make this landing a full-stop and forego any further traffic-pattern work (Tab R-6). The MP intercepted the final-approach course and lined up with runway 15R at 15:37:55L (Tabs M-3 and N-3).

Approximately a minute later, at 15:38:36L, the MP reports having reached the final-approach-fix (FAF) configured for landing (Tabs L-17, N-3, and R-6). This, however, was not the case, as the MP had not yet configured the aircraft for landing (Tab R-6 and R-26). The aircraft was 10 knots above maximum configuration speed (Tabs L-17 and R-6). The MIP took control of the MA to slow down and properly configure the aircraft for the approach and landing (Tab R-26).

The MIP initiated a descent from the FAF at 15:39:06L and was cleared to land 6 seconds later (Tabs L-16 and N-3).

At 15:39:15L, the MIP moved the power control lever (PCL) to the idle position to expedite slowing the aircraft below 150 knots in order to lower the gear and flaps (Tab L-19). Upon selecting idle, engine operation immediately fell to a sub-idle state that was no longer capable of producing useable thrust (Tabs J-25 to J-26 and L-19 to L-20).

15 seconds later, the MIP lowered the gear and flaps for the approach (Tab S-4). Upon pushing up the PCL to maintain airspeed following aircraft configuration, the MC recognized the engine failure (Tab R-26). The MIP pushes the PCL back and forth several times in an attempt to confirm loss of useable thrust (Tabs L-19 and S-4).

20 seconds after the MIP lowered the gear and flaps, both the gear and flap handles are raised to the UP positon (Tab S-4).

At 15:40:02L, the MIP moved the PCL to the cut-off position (Tab L-19). Parametric data shows the engine shut down and the propeller feathered (Tabs L-19 to L-24 and S-4).

At 15:40:18L, the MIP makes the radio transmission: “Fangs 99, ejecting on short final” (Tab N-3).

Three seconds later, the MIP makes a slight left turn to align the aircraft with the impact field and avoid a school directly ahead (Tabs L-18 and S-4).

At 15:40:30L, the MIP initiates the ejection (Tab L-19 to L-25). The MC ejected successfully (Tab S-2.2). At the time of ejection, the MA was wings level, 5.5 nautical miles from the runway surface, 700’ above ground level (AGL), 105 knots, and descending at 400 feet per minute (Tab S-4).

f. Impact

The MA crashed 4.8 miles north-northwest of Randolph AFB, TX at N 29.5997436, W 98.3290342, at 750 feet MSL (Tab S-10). The crash site was a flat, lightly corrugated field with grass coverage (Tab S-3). The MA impacted the ground in an estimated 20 degree nose low, 10 degree left bank attitude, at 140 knots (Tabs L-19 to L-24 and S-4). Aircraft ground scarring was consistent with the aircraft hitting at a shallow angle and tumbling (Tab S-4).

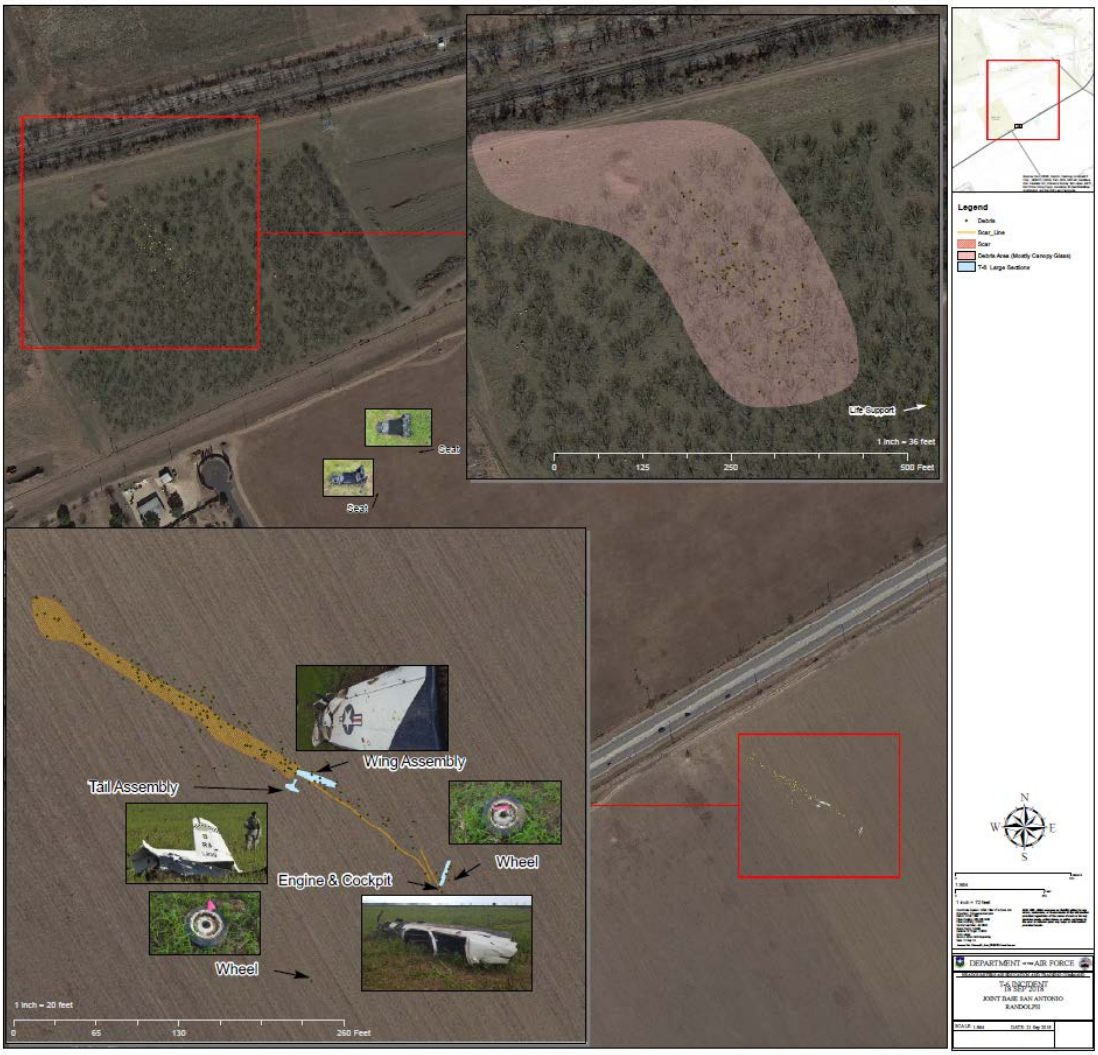

Figure 1: Impact Site Location (Tab S-10)

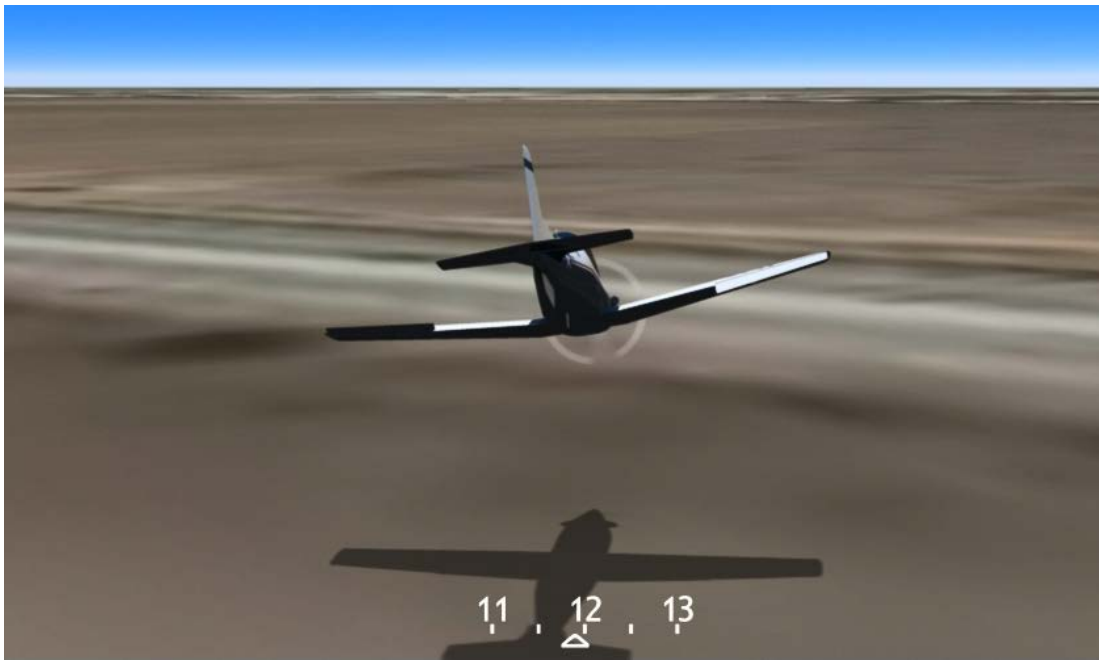

Figure 2: Impact Attitude (Tab S-4)

The majority of the wreckage was located within a few hundred feet of the where the fuselage came to rest. The wings and empennage separated from the fuselage shortly after impact, stopping about 40 yards northwest of the fuselage section (Tab S-10).


Figure 3: Ground View looking southeast (Tab S-5)

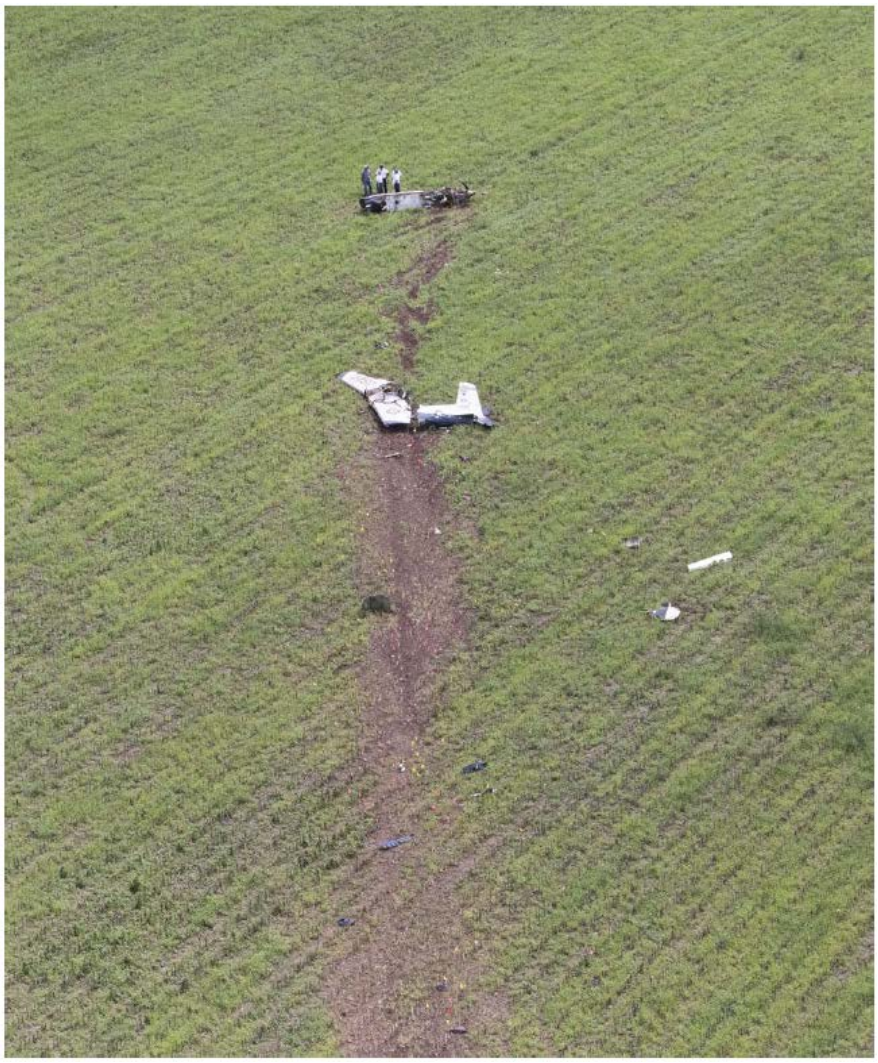

Figure 4: Aerial View looking southeast (Tab S-4)

The MC landed in a small grove of trees about 3,500 feet northwest of the impact site (Tabs R-27 and S-10).

g. Egress and Aircrew Flight Equipment

(1) Egress

The MC ejected successfully, sustaining minor injuries (Tabs R-8, R-27, S-2 and X-2). Both ejection seats were recovered about 2,000 feet northwest of the impact site in an adjacent field (Tab S-10).

(2) AFE

All personal and survival equipment had current inspections and worked as designed (Tab V-7.2, V-8.2 and V-9.2).

h. Search and Rescue (SAR)

(1) Air SAR

The ejections radio call was garbled, causing slight confusion in the control tower (Tab V-5.2). The tower requested another T-6 in the pattern proceed to the straight-in ground track to see if they could see a crash site. The T-6 reported that they did not see anything and were subsequently directed to land (Tab V-4.2).

(2) Ground SAR

At approximately 15:47:00L, the 902nd CES/CEF, SWIT 18, was notified of an inflight emergency heading to runway 15R (Tab V-3.2 to V-3.3). The tower relayed to SWIT 18 that the aircraft might have gone down a few miles short of the field, but it did not see any smoke (Tab V-3.2 to V-3.3). A few minutes later, the tower received word that the MC had ejected successfully and was located near 17253 Nacogdoches Road (Tab V-3.2 to V-3.3). The fire department responded with four fire/emergency response vehicles (Tab V-3.2 to V-3.3). One of the vehicles experienced mechanical issues enroute and returned to base (Tab V-3.2 to V-3.3). The remaining three vehicles arrived on scene at roughly 16:10:00L, following a roughly 20 minute drive from base (Tab V-3.2 to V-3.3). The fire department ensured the MA was safe to approach and completed all necessary checklists (Tab V-3.2 to V-3.3). The MC was transported to the JBSA-Randolph clinic and subsequently discharged with minor injuries (Tab X-2). All fire department members were clear of the scene at 20:05:00L (Tab V-3.2 to V-3.3).

(3) Recovery of Remains

Not applicable.

5. MAINTENANCE

a. Forms Documentation

(1) Summary

The AIB presumes the ME was sent to Standard Aero Ltd. for a scheduled 4500 hour major overhaul in October 2017. The evidence does not have an exact date, but it does reference maintenance actions throughout the month of October 2017 (Tabs U-2 to U-16). During that overhaul, the Fuel Manifold Set and the Fuel Flow Divider Unit were removed, overhauled separately and reinstalled (Tabs U-2 and U-67). On 7 August 2018, the ME was then shipped to COMBS at JBSA-Randolph, TX (Tab U-17 to U-27). On 20 July 2018, the MA was inducted for

a scheduled 150 HPO inspection (Tabs U-30 to U-66). During this inspection, on 24 July 2018, mechanics discovered the lower right oil filler cap stud was damaged on engine PWV-RA0161 rendering it unserviceable (Tab U-30 to U-66). This drove an unscheduled engine change that occurred on 13 August 2018 (Tab U-30 to U-66).

After the ME was installed on the MA, the MA flew 17 sorties for a total of 31.9 hours (Tabs U-68 to U-75). On the mishap day, prior to the MS, the MA flew two training sorties for a total 3.1 hours (Tabs D-6 and D-7). Active Air Force Technical Order (AFTO) Forms 781A series and historical record AFTO Forms 781A for the period of 90 days prior to the MS did not indicate any MA or ME anomalies (Tabs D-4 to D-20, U-30 to U-66 and U-68 to U-122).

(2) Major Maintenance

Major maintenance is any maintenance action that requires the aircraft be removed from flying status to be checked for potential failures, to have major components (such as flight control surfaces, engines, etc.) removed, or to accomplish special inspections (Tabs BB-32 to BB-39).

In October 2017, the ME was sent to Standard Aero Ltd. for a scheduled 4500 hour major overhaul (Tabs U-2 to U-16). During that overhaul, the Fuel Manifold Set and the Fuel Flow Divider Unit were removed, overhauled separately and reinstalled (Tabs U-2 to U-16). It was returned to COMBS at JBSA-Randolph, TX on 7 August 2018. COMBS received the ME, configured it with the required QEC Kit and then issued it to the MSU (Tab U-17 to U-27). The QEC Kit change does not involve maintenance on the fuel manifold hardware (Tab U-17 to U-27). COMBS performed no other maintenance or inspections on the ME (Tab V-14.7).

On 20 July 2018, the MA was inducted in for a scheduled 150 HPO inspection (Tab U-30 to U-66). The engine portion of the Technical Order (T.O.) 1T-6A-6WC-1, 150 HPO inspection work cards A through 6-004 were accomplished and signed off and remained signed off in the AFTO 781A forms for engine SN: PWV-RA0161 (Tabs BB-44 and U-30). Work card 6-004, item 10 addresses the inspection of fuel nozzles and fuel flow divider for leaks and security (Tab BB-44). The locking plates are an integral part of the fuel manifold system because they secure the fuel transfer tubes and manifold adapter, which houses the fuel nozzles (Tab BB-44). During the HPO inspection, engine serial number PWV-RA0161 was removed because it was found to be unserviceable (Tab U-30). This resulted in an unscheduled engine change that occurred on 13 August 2018 (Tab U-30). The MSU completed only the remaining work cards on the MA and ME. These work cards do not address the fuel manifold or associated components. MSU did not accomplish any additional maintenance on the fuel manifold or associated components (Tab V-12.10).

(3) Recurring Maintenance

In accordance with (IAW) T.O 00-20-1_AETCSUP, Paragraph 2.2.1, recurring maintenance occurs when issues reappear after two to four flown sorties (Tab BB-35 to BB-39). AFTO 781 series forms showed no evidence of or requirement for recurring maintenance on the ME or the MA associated with the fuel system IAW the definition in AFI 21-101 (Tab BB-32 to BB-34).

(4) Unscheduled Maintenance

T.O 00-20-1_AETCSUP, Paragraph 2.2.3 describes unscheduled maintenance as any maintenance action that is not the result of a scheduled inspection (Tab BB-37). On 20 July 2018, the MA was inducted in for a scheduled 150 HPO inspection (Tabs BB-44 and U-30 to U-66). That inspection resulted in an unscheduled engine change due to discrepancies identified with engine serial number PWV-RA0161 (Tab U-30). MSU mechanics replaced it with the ME on 13 August 2018 (Tab U-30). The MA had no other unscheduled maintenance accomplished that contributed to the mishap (Tabs U-30 to U-66). The ME had no other unscheduled maintenance after installation (Tabs U-30 to U-66).

(5) AFTO Form 781A

The AFTO forms are used to document maintenance actions taken on an aircraft (Tabs U-30 to U-66 and U-67 to U-122). The MA active AFTO Form 781A had a start date of 17 August 2018, with no grounding discrepancies at the time of the mishap (Tab U-30). AFTO Forms 781A historical hard copy documents identify the accomplishment of the 150 HPO inspection and all associated maintenance tasks to include the unscheduled engine change (Tab U-30 to U-66). There is no record of maintenance on the ME fuel manifold section of the engine in the AFTO 781A forms (Tabs U-30 to U-66 and U-68 to U-122).

(6) Pre-Flight Operational Checks

AFTO Form 781H provides the current flight condition of the aircraft, current flight hours, and current fuel status (Tab D-4 to D-6). In accordance with T.O. 00-20-1, when a period of 72-hours has elapsed with no maintenance or flight activity, an aircraft requires an updated 72-hour combined pre-flight/basic post-flight (BPO/PR) inspection before it is released for flight (Tab BB-35 to BB-39). There is also a combined BPO/PR daily inspection requirement that should be accomplished after the last flight of a flying period (Tab BB-35 to BB-39). This inspection consists of checking the aircraft to determine if it is suitable for another flight by performing visual examination of certain components, areas, or systems to ensure no defects exist which would be detrimental to flight (Tabs BB-44). The MA AFTO Forms 781H dated 17 August 2018, indicate the appropriate maintenance personnel completed a combined basic BPO/PR inspection on 17 August 2018 (Tab U-68). The BPO/PR does not inspect the fuel manifold section of the engine (Tab BB-44).

b. Inspections

(1) MISHAP AIRCRAFT

On 17 September 2018 at 18:03L, the aircraft maintainer/crew chief performed a combined BPO/PR inspection of the MA at the end of the flying day (Tab U-68). On 18 September 2018, the expeditor signed the Exceptional Release (ER) verifying the 72-hour inspection was completed and that the MA was airworthy (Tab U-68). The ER serves as a certification that the expeditor

reviewed all active forms, acknowledging that the aircraft inspections are complete, and that the aircraft was safe for flight IAW T.O 00-20-1_AETCSUP, paragraph 5.13.1.2.7.3 (Tab BB-44). Two sorties were flown with accompanying thruflight inspections accomplished prior to the MS with no discrepancies noted (Tabs D-4 to D-5 and D-6 to D-7). The thruflight turnaround inspection requirements will be accomplished in lieu of a combined BPO/PR daily inspection where multiple missions are flown during the same flying period IAW 1T-6ABD-6WC-1, card i-002 and i-003 (Inspection Definitions) (Tab BB-44). The inspection is a visual examination of the aircraft to discover defects or malfunctions, which, if not corrected, would impair safety of flight (Tab BB-44). Maintenance Records show all inspections required prior to the MS were performed IAW T.O. guidance and with the exception of non-contributing AFTO 781J inconsistencies, no anomalies/discrepancies were observed (Tab D-8). The thruflight does not inspect the fuel manifold section of the engine (Tab BB-44).

(2) MISHAP ENGINE

The ME was sent to Standard Aero Ltd for a scheduled 4500 hour major overhaul in October 2017 (Tabs U-2 to U-16). On 7 August 2018, Standard Aero Ltd, shipped the ME to COMBS at JBSA-Randolph TX (Tab U-17 to U-27). COMBS received the ME on 8 August 2018 and configured it with the required Quick Engine Change (QEC) Kit (Tab U-17 to U-27). The MSU installed it in the MA on 13 August 2018. 17 sorties totaling 27.8 hours were flown prior to MS (Tabs U-68 to U-75).

(a) Maintenance Procedures:

Maintenance Records show all maintenance procedures the night prior and the day of the MS were performed IAW T.O. guidance and only non-contributory anomalies were found (Tab D-8).

(b) Maintenance Personnel and Supervision:

Training records of the involved maintenance members showed they were qualified to complete their assigned tasks (Tabs T-2 to T-12 and T-13 to T-23).

(c) Fuel, Hydraulic and oil inspection Analyses:

Prior to the MS, the MA was serviced with fuel twice on 18 September 2018 and received the appropriate amount of fuel after the previous missions. The ME did not require oil servicing prior to the MS (Tabs D-4 to D-5 and D-6 to D-7).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

Structure and System

(1) Engine

The MA was equipped with one PT6A-68 Turbo Prop Engine (Tab BB-43). On 13 August 2018, ME S/N: PWV-RA0325 was installed on the MA (Tab U-44). Following the installation of the ME, the MA was flown 17 sorties, totaling 31.9 hours. In addition, on the day of the mishap, 18 September 2018, the MA was flown two times with no Pilot Discrepancy Reports (PDR) prior to the mishap (Tabs D-6 and U-30 to U-31).

The ME was recovered and analyzed by Pratt & Whitney Canada, which provided a complete report of the engine. The report stated that circumferential marks on the compressor turbine disc/blades (Fig 5) and the bending of all the propeller blades indicate that the engine was rotating slowly at impact (Tab J-24).

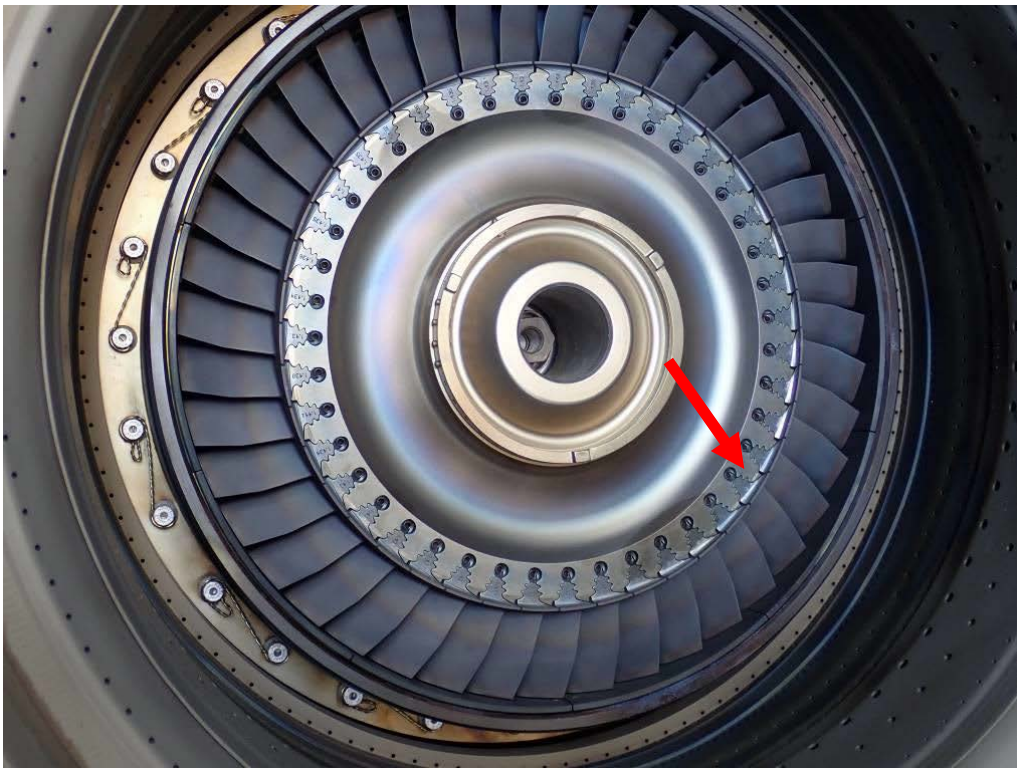

Figure 5: ME compressor turbine disc with rub marks (Tab J-29)

Significant ME disassembly observations were made by the Pratt & Whitney Canada technicians. "The engine was removed from the shipping container and placed in a stand. The fuel management unit (FMU) was removed from the fuel pump. An adapter with a fitting to apply shop air to the fuel line was installed on the fuel line at the FMU fitting. One hundred PSI of shop air was applied into the fuel line. A leak was noted on one primary fuel transfer tube between the No. 9 & 10 fuel nozzles. The transfer tube bracket [fuel transfer tube locking plate] on the No. 9 fuel nozzle was out of position (Fig 7). The bracket was removed and the primary fuel transfer tube was found to be out of its respective position between the two fuel nozzles (Fig 6). The secondary transfer tube also appears to be partially displaced toward the No. 9 fuel nozzle. During the attempt to re-engage the transfer tube into the No. 10 nozzle the packing was damaged. The packing was changed and tube was re-installed. Air pressure was applied an audible noise was heard indicating the air

was being transferred through the fuel nozzles and no external leaks were detected. The No. 9 fuel nozzle transfer tube retention bracket was bent adjacent to the retention points" (Tab J-35). The lead Pratt & Whitney Canada investigator, WIT 9, testified that the fuel transfer tube locking plate displacement could not have occurred during ground impact (Tab V-13.2).

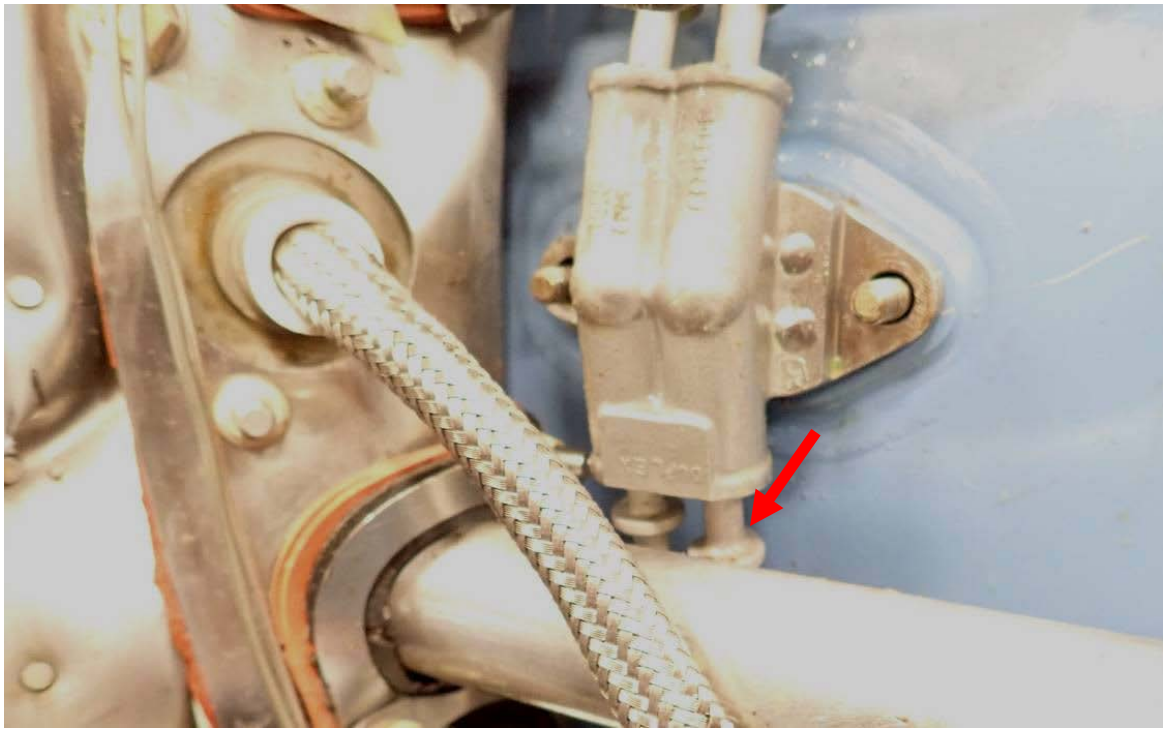

Figure 6: ME fuel transfer tube (locking plate removed) not properly seated and extended from nozzle (Tab J-37)

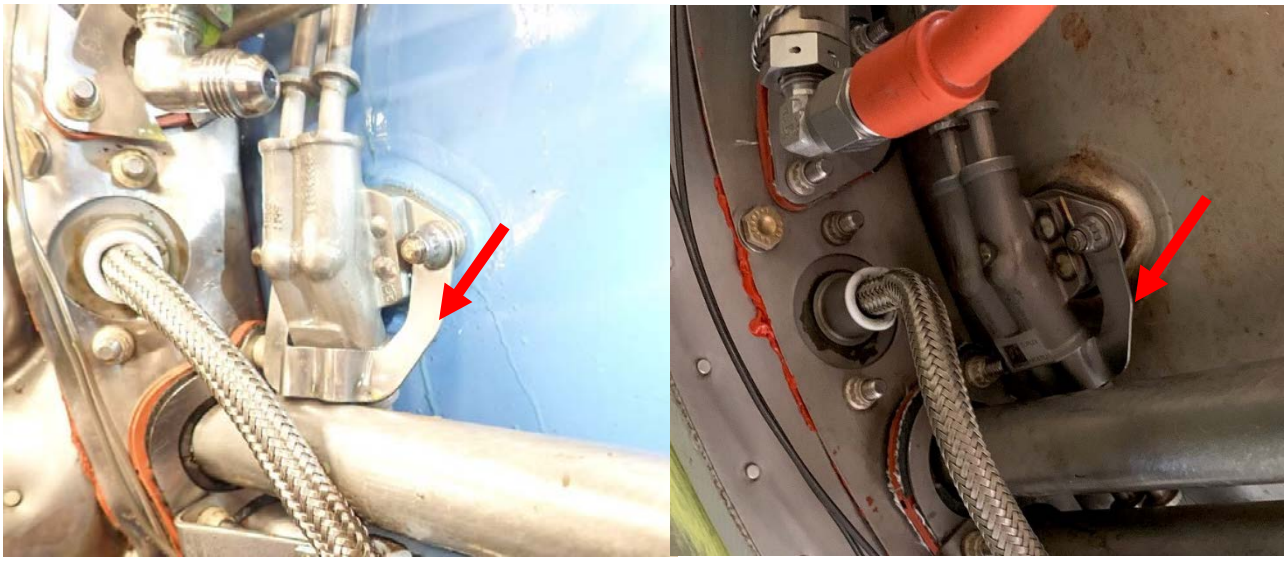

Figure 7: Left; ME fuel transfer tube locking plate (Tab J-36). Right; normal (non-ME) fuel transfer tube locking plate (Tab Z-6)

(2) Fuel, Oil, and Hydraulic

The MA received the appropriate amount of fuel after the previous mission (Tabs D-7). Additionally, the Air Force Petroleum Office (AFPET/PTPLA) conducted several tests on the Jet A aviation turbine fuel, hydraulic fluid, and oil samples taken post-accident from the aircraft and servicing equipment (Tab D-390 to D-395). AFPET/PTLA concluded that they were within limits and free of contamination (Tab D-390 and D-395).

(3) Egress System

The T-6A has two Martin Baker MKUS16LA Ejection Seats and two independently fractured canopies that provide emergency escape from the aircraft (Tab J-87). This aircraft incorporates a three-mode, inter-seat sequencing (ISS) selector valve, a Canopy Fracturing Initiation System (CFIS), and a Canopy Fracturing Explosive System (CFES) (Tab J-87). The CFIS and the CFES, combined, make up the Canopy Fracturing System (CFS) (Tab J-87). The ISS selector valve position, as set by the rear seat pilot, determines the initiation and sequencing of the pilots for ejection (Tab BB-43).

Review of AFTO Forms 781K maintenance documents and integrated maintenance data system (IMDS) for the MA revealed that egress system maintenance was up to date (Tab D-10). A Time Change Technical Order (TCTO) was pending on the canopy fracture initiation system with a required compliance date of 3 August 2022 (Tab D-11).

Air Force Life Cycle Management Center (AFLCMC/EBHJ) conducted a complete pose-mishap assessment of the egress system (Tab J-87). Both the forward and aft aircraft transparencies were fractured by the CFS and spread across the ejection location (Tab J-89). Both seats were recovered. The live/unfired aft seat manual override cartridge was removed in the field by egress personnel during the initial response to the mishap (Tab J-89).

The position of the ISS selector valve was found in the "BOTH" position, consistent with flight guidance for this type of sortie (dual rated personnel and aircraft having completed TCTO 13A5-69-518 (Tab J-92). Both seats were recovered with their manual ejection handles in the up "fired" position (Tab J-92). Video evidence of the ejection events recovered from a distant security camera indicates that the interval between aft and forward ejections was consistent with ISS timing (Tabs J-92, J-93 and S2.2). The emergency escape system and all of its subcomponents appeared to have operated as intended (Tab J-93).

Figure 8: ISS selector valve post mishap (Tab J-89)

7. WEATHER

a. Forecast Weather

Randolph AFB (KRND) weather brief (forecast) for the time of the MA takeoff was scattered clouds at 4,000 feet above ground level (AGL), broken clouds at 25,000 feet AGL with winds out of the South at 9 knots gusting to 15 knots (Tab F-3). No turbulence or icing conditions were

forecast. Isolated area thunderstorms were forecast with maximum tops estimated at 48,000 feet (Tab F-3).

At 12:00L, the forecast was updated to scattered clouds at 2,000 feet AGL and broken clouds at 15,000 feet AGL with winds out of the South at 6 knots (Tab F-6).

MOA weather forecast was reported as scattered cloud layers from 4,000 to feet, 7,000 feet AGL and between 13,000 feet and 16,000 feet AGL (Tab F-3).

b. Observed Weather

On 18 September, 2018 at 14:56L (approximately 45 minutes prior to mishap events), the observed weather was as follows:

Weather at takeoff at Randolph AFB, TX (KRND) according to a meteorological aviation report (METAR) was 10 miles of visibility and few clouds at 3,900 feet and 18,000 feet AGL (Tab F2). The observed winds from the automated weather report were from 170 degrees (South) at 6 knots (Tab F-13).

Another METAR issued at 15:48L, as a response to the mishap, observed the weather as 10 miles of visibility and clear skies (Tab F-13).

Figure 9 shows the weather immediately after ejection of the aircrew from the MA (visible in upper left corner of figure). At the time of the mishap, the environmental conditions were full daylight with a fully discernible horizon and no impediment to visibility.

Figure 9: Screen capture of video during MC ejection (MA and both parachutes top left) showing weather conditions (Tab S-2.2)

c. Space Environment

Not applicable.

d. Operations

Review of the applicable weather data did not disclose any weather phenomena that met or exceeded any operational limitation for the MA.

8. CREW QUALIFICATIONS

a. Mishap Instructor Pilot

The MIP had approximately 4482.4 total flight hours at the time of the mishap (Tab G-24 to G-25). The MIP had 2137.0 hours in the T-6A (Tab G-24). Prior to his assignment as a T-6A PIT Instructor, the MIP had approximately 680.5 hours in the KC-135 and 1657.7 hours in the T-37B as an Instructor Pilot (Tab G-24 to G-25). The MIP had logged approximately 129 hours combined in T-6A and T-37B simulators throughout his aviation career (Tab G-24). Additionally, the MIP logged 7.2 hours of "other" time in T-38C and T-1 aircraft.

The MIP's recent flight time was as follows:

	Total Time	Primary Time	Instructor Time	Total Sorties
30 Days	10.9	2.5	8.4	7
60 Days	40.1	5.4	34.7	24
90 Days	61.5	6.2	55.3	36

Table 1: MIP 30/60/90 Day Totals (Tab G-19)

	Total Time	Primary Time	Secondary Time	Instructor Time	Evaluator Time	Other
T-38C / T-1	7.2	0	0	0	0	7.2
KC-135	680.5	438.9	155.2	0.0	0	86.4
T-37B	1657.7	261.9	0	1394.5	0	1.3
T-6A	2137.0	414.7	0	1677.1	42.3	2.9
Total	4482.4	1115.5	155.2	3071.6	42.3	97.8

Table 2: MIP Total Flight Time Breakdown (Tab G-24 to G-25)

The MIP had a current AF Form 8, *Certificate of Aircrew Qualification*, instrument/mission re-qualification flying evaluation dated 31 August 2017 (Tab G-44). The MIP completed an instructor mission requalification flying evaluation on 31 Aug 2017. This was a result of a loss of qualification due to a long timeframe of medical duty not including flying (DNIF) (Tab X-1). The

MIPs instructor knowledge, briefing and debriefing were noted as commendable by the evaluator (Tab G-45).

The MIP's AF Form 4348, *USAF Aircrew Certifications*, shows the MIP was certified as a PIT instructor pilot on 7 September 2017 (Tab G-16). The MIP's squadron "Letter of Xs" (list of qualifications) shows the MIP was considered experienced (Tab G-17).

b. Mishap Pilot

The MP had approximately 188.9 total flight hours at the time of the mishap (Tab G-14). The MP had recently graduated from Specialized Undergraduate Pilot Training (SUPT) and was undergoing T-6A instructor pilot upgrade training in June of 2018 (Tab G-9). The MP was on his fourth sortie in the upgrade syllabus (Tab G-91).

The MP's recent flight time was as follows (Tab G-6 and G-10 to G-11):

	Total Time	Primary Time	Instructor Time	Other Time	Total Sorties
30 Days	7.8	6.5	0.0	1.3	7
60 Days	7.8	6.5	0.0	1.3	7
90 Days	7.8	6.5	0.0	1.3	7

Table 3: MP 30/60/90 Day Totals (Tab G-6)

	Total Time	Primary Time	Instructor Time	Other Time
T-6A	12.0	8.0	0.0	4.0
UPT	176.9	176.9	0.0	0
Total	188.9	184.9	0.0	4.0

Table 4: MP Total Flight Time Breakdown (Tab G-10 to G-11)

The MP was enrolled in course F-V5A-C v. Jun 18 – 2.0.0 T-6A Pilot Instructor Training (Tab G-90). The MP had not completed a form-8 checkride (Certificate of Aircrew Qualification) at the time of the mishap and thus possessed no qualifications in the T-6A (Tab G-90 to G-140).

At the time of the mishap, the MP had completed 100.4 hours of academics, 6.5 of planned 64.5 hours of flying and 14.3 of planned 29.9 hours of simulator training (Tab G-91 to G-92). The MP's course gradebook (Aviation Training Jacket) shows the MP was progressing with above average assessments of skills and knowledge (Tab G-94 to G-119).

9. MEDICAL

a. Qualifications

The MC were medically qualified to perform flying duties without restriction (Tab X-2 to X-3). The MC's Preventative Health Assessment's (PHA) and associated AF Form 2992's were current (Tab X-2). The MC had current and valid medical waivers (Tab X-2). The MC displayed no physical or medical limitations prior to the mishap (Tab X-2 to X-3).

b. Health

The AIB Medical Advisor reviewed all available MC medical records (Tab X-2 to X-3). The evidence shows that the MC were in good health with no evidence that medication or a medical condition contributed to the mishap (Tab X-2 to X-3). The MC's post mishap medical evaluation revealed minor injuries following ejection from the MA (Tab X-2). The MC returned to flying status after a brief DNIF period (Tab X-2 to X-3).

c. Pathology

Immediately following the mishap, toxicology testing was performed on the MC (Tab X-2 to X-3). Blood and urine samples were submitted to the Armed Forces Medical Examiner System, Dover AFB, Delaware, for toxicological analysis (Tab X-2 to X-3). Testing included carbon monoxide and ethanol levels in the blood and drug testing of the urine (Tab X-2 to X-3). All samples were negative or within normal limits (Tab X-2 to X-3). The MC's urine was screened for amphetamine, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates and phencyclidine (Tab X-2 to X-3). None of these substances were detected (Tab X-2 to X-3).

d. Lifestyle

Lifestyle factors were not relevant to the mishap based upon a review of the MC's medical records and 72 hour/7 day histories (Tabs R-14 to R-21, R-36 to R-43, and X-2 to X-3).

e. Crew rest and flight duty period (FDP)

AFI 11-202, Volume 3, *General Flight Rules*, 2 Oct 2018, states crew rest is compulsory for aircrew prior to performing any duties involving aircraft operations and is a minimum of 12 non-duty hours before the flight duty period (FDP) begins. Crew rest is free time and includes time for meals, transportation, and rest. This time must include an opportunity for at least 8 hours of uninterrupted sleep. Crew rest period cannot begin until after the completion of official duties. FDP begins when an aircrew member reports for a mission, briefing, or other official duty and ends at final engine shutdown after the final flight of the completed mission AFI 11-202 Volume 3, paragraph 2.2.1 (Tab BB-3).

Crew rest and FDP information for the MP were obtained from medical record review and the 72-hour and 7 day history that was provided to the AIB (Tabs R-14 to R-16 and X-2). On the day of the MS, the MP had more than 12 hours of crew rest prior to the start of the FDP at 1230L (Tabs R-14 to R-16). The MP reported seven hours of good, quality sleep on the night prior to the MS (Tabs R-14 to R-16).

The MIP's crew rest and FDP information were obtained from his medical records and 72-hour/7 day histories that was provided to the AIB (Tabs R-36 to R-38, and X-2). On the day of the MS, the MIP had more than 12 hours of crew rest prior to the start of the FDP at 0830L. (Tabs R-36 to R-38). The MIP reported seven hours of good quality sleep on the night prior to the MS (Tabs R-36 to R-38).

10. OPERATIONS AND SUPERVISION

a. Operations

Per the squadron "Go/No-Go" data, the MC were authorized to fly and had all pre-requisites to fly (Tab AA-7 to AA-13). Flight authorization paperwork showed only ten pilot changes to a schedule of 109 pilots (Tab AA-3 to AA-6). The previous day's flight authorization paper work showed a similar trend of less than 10% change (Tab AA-3 to AA-6).

The MC conducted an ORM assessment which indicated a score of 6 (zero being lowest risk, 16 and above being severe risk (Tab AA-14). This assessment rested at the very minimum risk required for Operations Supervisor approval for a sortie (Tab AA-14). 0-5 allows for an aircraft commander to assume risks and 6-12 requires Operations Supervisor approval. A score of 3 was automatically directed by squadron supervision due to on-going T-6A On-Board Oxygen Generation System (OBOGS) issues (Tab AA-2). The MIP self-assessed two-points as a result of the MIP's nine day absence from flying due to temporary duty assignment (TDY) and one point for the thermal heat index (Tab AA-14, R-25). The Operations Supervisor approved the sortie (Tab AA-14).

b. Supervision

The MIP was acting in the instructor role and supervising the MP's syllabus backseat sortie (Tab R-24). The MIP was current and qualified to conduct the assigned mission on the day of the mishap sortie (Tab G-17 to G-18) even though he had not flown for the previous nine days due to a TDY to Colorado Springs for a Commander's Summit (Tab R-25). See AFI 11-2T-6Av2, *T-6A Aircrew Training*, table 4.2 T-6A, Currency Requirements in Days (T2) (Tab BB-31). The MC conducted ORM to assess personal currency and capability for this mission (Tab AA-14) which revealed that the MIP had an adequate number of sorties in the previous three months.

The MP was not qualified to perform IP duties and was in a training program to attain the required qualifications (Tab G-94 to G-119). The MS was part of the training program (Tab G-94 to G-119). The MP had several assessments categorized as above average (Tab G-94 to G-119).

The Supervisor of Flying (SOF), SWIT 43, was a T-6 pilot and Flight Commander (Tab G-17). The SOF supervised ground operations, Air Traffic Control (ATC) operations, and supported emergencies as required (Tabs V-3.2 to V-3.3 and V-6.2). In this flight emergency, the SOF, SWIT 43, supported the MA by coordinating with control agencies and squadron operations (Tabs V-5.2, V-6.2 and V-1.3). On the day of the mishap, the SOF, SWIT 43, executed the Quick Response Checklists (QRC) and coordinated the SAR operations (Tab V-6.2). Additionally, an

alternate SOF, SWIT 32, reported to the tower to help with the workload of both the mishap and other airborne aircraft. The alternate SOF was experienced (Tab G-17) and verified QRC execution and SAR coordination (Tab V-2.2).

c. Guidance

Shortly before the ME failure, the MP perceived a slight and momentary change in torque without associated movement of the PCL, drawing his attention to the fuel flow indication on the display (Tabs L-19 to L-21, R-6 and V-11.3, V-11.4). The MIP did not perceive, nor did the MP communicate this uncommanded change in torque (Tab V-10.10). The MIP did not have any other engine indications aside from abnormal fuel flow stating in testimony "nothing was fluctuating to begin with" (Tab R-26). The MP communicated to the MIP that fuel flow numerical indications were abnormally high for the power settings established (Tabs R-6, R2-26). These indications transitioned to a fuel flow display of "three dashes" (Tab R-26) in place of the fuel flow pounds per hour. The MIP acknowledged and observed the unusual fuel flow indications and elected to make the approach a full stop, truncating further training (Tab R-26).

Per T.O 1T-6A-1, *T-6A Flight Manual*, pilots are required to accomplish the following three things in the event of an emergency: maintain aircraft control, analyze the situation, take the proper action, and land as conditions permit (Tab BB-43).

The indications and procedures outlined in the T-6A flight manual regarding *Uncommanded Power Changes/Loss of Power/Uncommanded Propeller Feather* includes momentary uncommanded changes in torque (Tab BB-43). The MP noticed the torque change but did not mention it to the MIP (Tabs R-26, V-10.10). Procedures for this checklist require the pilot to place the engine in a mode where fuel flow is solely based on throttle position, not on demand required for power requested (Tab BB-43). This action would have further reduced fuel flow to the engine (Tab BB-43).

The Engine Failure During Flight discussion in the T-6A flight manual directs that when above 150 knots, initial reaction to any malfunction at low altitude should be to trade excess airspeed for altitude (Tab BB-43). Initial indications of engine failure/flameout include only loss of power, airspeed and torque (Tab BB-43). During the MS, the first indication of engine failure, and when the MC applied the applicable steps in the *Engine Failure* procedures, was when the engine did not respond to the PCL movement for increased thrust following aircraft configuration (Tabs BB-43, V-10.4, V-10.8 and V-10.9).

The aircraft was at 1,950 feet above ground level, 120 knots, and 6.8 nautical miles from the runway surface when the MC assessed engine failure/loss of effective thrust (Tab S4). Per the T-6A flight manual, the aircraft would have the capability to glide approximately four nautical miles (Tab BB-43). The final applicable guidance in the T-6A flight manual is to eject if unable to reach a suitable landing field and prior to descending through 2,000 feet above ground level (Tab BB-43).

11. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

(1) AETCMAN 11-248, *T-6 Primary Flying,* Dated 17 August 2016

(2) AFI 11-2T-6 Volume 1, *T-6A Aircrew Training,* Dated 26 June 2017

(3) AFI 21-101 (AETC Supplement), *Aircraft and Equipment Maintenance Management,* Dated 18 September 2015

(4) AFI 11-2T-6 Volume 3, *T-6 Operations Procedures,* Dated 18 July 2018

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) T-6ABD-2-71, *Operational Supplement/Interim Rapid Action Change,* Dated 4 June 2018

(2) TO 1T-6ABD-6WC-1, *Operational Supplement/Interim Rapid Action Change,* Dated 4 June 2018

(3) TO 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures,* Dated 31 July 2018

(4) Pratt & Whitney Canada Overhaul Manual Part No. 3040873 (Tab U-67).

c. Known or Suspected Deviations from Directives or Publications

The fuel transfer tube locking plate was not installed in accordance with the overhaul manual during the contracted 4500 hour engine overhaul (Tab U-2 and U-67).

BOGER.MICHAEL.C.1049294120 Digitally signed by BOGER.MICHAEL.C.1049294120 Date: 2019.02.25 17:29:17 -07'00'

25 February 2019

MICHAEL C. BOGER, Colonel, USAF
President, Accident Investigation Board

United States Air Force Accident Investigation Board Report

Class A, JBSA-Randolph, Texas

STATEMENT OF OPINION

T-6A, T/N 05-6209
JOINT BASE SAN ANTONIO-RANDOLPH
18 September 2018

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 18 September 2018, at 15:40:41 local (L), a T-6A Texan II, tail number 05-6209, crashed approximately 4.8 miles northwest of Joint Base San Antonio (JBSA)-Randolph, TX, completely destroying the aircraft. The mishap aircrew (MC) consisted of a mishap instructor pilot (MIP), occupying the front seat, who was supervising the mishap pilot (MP). The MP was conducting an instructor upgrade sortie in the Pilot Instructor Training (PIT) course from the rear seat. The MC successfully ejected and sustained minor injuries. The MC and mishap aircraft (MA) were assigned to the 559th Flying Training Squadron, 12th Flying Training Wing, JBSA-Randolph, TX. During the mishap sortie (MS), the MA crashed while returning to base for local take-off and landing practice. The destroyed aircraft is valued at approximately $5.7 million with minor damage to civilian property and no casualties. Environmental remediation was accomplished at the crash site.

I find, by a preponderance of evidence, the cause of the mishap to be a fuel transfer tube locking plate that was improperly installed during a contracted 4500 hour engine overhaul. This resulted in engine failure while the aircraft was not in a position to land safely.

2. CAUSE

The MS was planned to include maneuvers in the nearby Tweet military operating area (MOA), followed by an approach into Kelly Field, and finally, a visual flight rules (VFR) recovery to Randolph for pattern practice. Due to air traffic congestion at Kelly Field, the MC elected to return directly to Randolph for an approach and patterns after departing the MOA. While being vectored for the approach to runway 15R at Randolph, at approximately 15:35:00L, the MC first noticed a high fuel flow reading, and thus decided to continue the approach to a full stop. Slightly over four minutes later, at 15:39:16L, while slowing and configuring to land, the ME failed. At the time of the engine failure, the MA was below the energy profile required to glide to a suitable landing surface.

Post-mishap analysis by the Pratt & Whitney Engineering Department showed that the fuel nozzle transfer tubes between nozzles 9 and 10 were out of position. The transfer tubes transfer fuel between each of the 14 fuel injection nozzles. The transfer tube locking plate, which holds the

transfer tubes in the proper position, was improperly installed, thereby allowing the transfer tubes to move. The transfer tubes being out of position resulted in fuel leaking out of the system prior to injection into the engine. Ultimately, despite increased fuel flow, the volume actually reaching the engine was not enough to sustain normal operation, resulting in unrecoverable engine failure.

The Aircraft Accident Investigation Board (AIB) found that neither the Contractor Operated and Maintained Base Supply (COMBS) nor the Maintenance Support Unit (MSU) at JBSA-Randolph, TX inspected or performed any maintenance on the fuel manifold system of the mishap engine (ME). Additionally, the lead Pratt & Whitney Canada investigator testified that the bracket displacement did not occur during ground impact. The preponderance of evidence indicates that the ME arrived from Standard Aero Ltd. with the fuel transfer tube locking plate installed incorrectly during a 4500 hour scheduled engine overhaul.

The incorrectly installed locking plate allowed the fuel transfer tubes to migrate out of position during operation, resulting in a substantial fuel leak. The engine subsequently failed due to loss of adequate fuel supply to sustain operation. Upon recognition of engine failure, the MA was at an airspeed and altitude that made ejection the only viable option.

High fuel flow and "dashed" fuel flow gauge readings alone did not indicate impending engine failure to the MIP and thus, did not require a climb to an altitude from which the MA could glide to land. For that reason, the MIP elected to continue the approach to a full-stop landing, truncating further training. At the point where the MC assessed engine failure/loss of effective thrust, the aircraft was at 1,950 feet above ground level (AGL), 120 knots, and 6.8 nautical miles from the runway surface. T-6A Flight Manual data and simulator re-creations show that an altitude of roughly 3,100' AGL, 800' above the final approach altitude, would have been required to successfully glide to the runway. As the MA was below the required altitude to safely land, the MC was forced to eject.

I find, by a preponderance of evidence, the cause of the mishap to be a fuel transfer tube locking plate that was improperly installed during a contracted 4500 hour engine overhaul. The improperly installed transfer tube locking plate allowed the fuel transfer tubes to migrate out of position during operation. This resulted in a loss of adequate fuel supply to the engine and engine failure at a point when the MA was not in, nor able to reach, a position to land safely.

3. CONCLUSION

I find, by a preponderance of evidence, the cause of the mishap to be a fuel transfer tube locking plate that was improperly installed during a contracted 4500 hour engine overhaul. This resulted in engine failure while the aircraft was not in a position to land safely.

BOGER.MICHAEL.C.1049294120
Digitally signed by BOGER.MICHAEL.C.1049294120
Date: 2019.02.25 17:29:40 -07'00'

25 February 2019

MICHAEL C. BOGER, Colonel, USAF
President, Accident Investigation Board

United States Air Force Accident Investigation Board Report

Class A, JBSA-Randolph, Texas

INDEX OF TABS

United States Air Force Accident Investigation Board Report

Class A, JBSA-Randolph, Texas