UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

T-38C, T/N 68-8181

50TH FLYING TRAINING SQUADRON
14TH FLYING TRAINING WING
COLUMBUS AIR FORCE BASE, MISSISSIPPI

LOCATION: ONE HALF MILE NORTHWEST OF COLUMBUS AIR FORCE BASE, MISSISSIPPI

DATE OF ACCIDENT: 23 MAY 2018

BOARD PRESIDENT: COLONEL DAVID B. LOWE

Conducted IAW Air Force Instruction 51-503

United States Air Force Accident Investigation Board Report

Class A Mishap, Columbus AFB, MS

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION

T-38C, T/N 68-8181
ONE HALF MILE NORTHWEST OF COLUMBUS AIR FORCE BASE, MISSISSIPPI
23 MAY 2018

On 23 May 2018, at approximately 0820 hours local time, a T-38C, tail number 68-8181, assigned to the 50th Flying Training Squadron, 14th Flying Training Wing, Columbus Air Force Base (CAFB), Mississippi (MS), crashed during a student formation sortie approximately one half mile northwest of CAFB. During a touch-and-go landing at CAFB, the mishap aircraft (MA) struck a bird shortly after touchdown on runway 31 right. The resulting damage from the bird strike caused a loss of thrust due to a compressor stall in the right engine. This loss of thrust, combined with subsequent actions of the mishap instructor pilot (MIP), caused the MA to enter a low-altitude stall shortly after lifting off from the runway. The mishap crew (MC) performed a low-altitude ejection, sustaining only minor injuries. The MA impacted the ground just beyond the CAFB fence line at a low airspeed and low angle, destroying the MA at a loss of $10,100,058.

The mishap occurred during a student formation sortie as part of Specialized Undergraduate Pilot Training. The MA was number two in a two-ship formation when returning to base from the Military Operating Area to practice single-ship traffic patterns. Shortly after touchdown on the first touch-and-go, a bird struck the right side of the MA, and part of the bird went into the right engine. Following the bird strike, the mishap student pilot retarded the throttles to abort the takeoff. The MIP decided the aircraft was too fast to safely abort in the remaining runway and took control of the MA, immediately advancing both throttles to maximum afterburner (MAX). Soon after the bird strike, the MA experienced a loss of thrust in the right engine due to a compressor stall. Upon liftoff from the runway, the MIP attempted to regain thrust on the right engine by retarding the right throttle below the AB range and then selecting MAX, but inadvertently reduced the left throttle to minimum AB. Additionally, the MIP did not follow the emergency procedures, which direct flap retraction to 60%, airspeed to final approach speed, and landing gear retraction. The combination of low airspeed, limited thrust, and excess drag caused the MA to stall. The MIP initiated a low-altitude ejection approximately 3 seconds later and the MA crashed into the ground. The MC successfully ejected and sustained only minor injuries

The Accident Investigation Board (AIB) president found, by clear and convincing evidence, two causes led to the destruction of the MA. First, the bird strike – coupled with rapid throttle movements by the MC – caused a compressor stall, thus significantly reducing the thrust of the right engine during a critical phase of flight. Second, the MIP's actions aggravated this reduced-thrust condition. The combination of the damaged right engine and the actions of the MIP resulted in a low-altitude stall, destroying the MA upon impact with the ground. The AIB president did not find any areas of concern.

United States Air Force Accident Investigation Board Report

Class A Mishap, Columbus AFB, MS

SUMMARY OF FACTS AND STATEMENT OF OPINION
T-38C, T/N 68-8181
23 MAY 2018

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ACRONYMS AND ABBREVIATIONS

°	Degrees
$	Dollars
’	Feet
%	Percent
31C	Runway 31 Center
31R	Runway 31 Right
AB	Afterburner
AETC	Air Education and Training Command
AF	Air Force
AFB	Air Force Base
AFE	Air Flight Equipment
AFI	Air Force Instruction
AFLCMC	Air Force Life Cycle Management Center
AFPET	Air Force Petroleum Agency
AFTO	Air Force Technical Order
AGL	Above Ground Level
AIB	Accident Investigation Board
AIMWTS	Aeromedical Information Management Waiver Tracking System
ATIS	Automated Terminal Information System
BERASSE	BOLDFACE, Engine Shutdown, Restart Alternate Landing Gear Extension, Single-Engine Landing, Single-Engine Go-Around, Ejection
BIP	Buddy Instructor Pilot Program
BPO	Basic Post-flight Inspection
CAC	Common Access Card
CAFB	Columbus Air Force Base
CRM	Crew/Cockpit Resource Management
EADI	Electronic Attitude Display Indicator
EED	Electronic Engine Display
e.g.	*Exempli Gratia*
EGT	Exhaust Gas Temperature
FAA	Federal Aviation Administration
FAIP	First Assignment Instructor Pilot
“Fat on Gas”	Enough Fuel
FOD	Foreign Object Damage
FTS	Flying Training Squadron
FTW	Flying Training Wing
HUD	Heads-Up Display
IAW	In Accordance With
i.e.	*Id Est*
IFF	Introduction to Fighter Fundamentals
IFT	Introductory Flight Training
IGV	Inlet Guide Vane
IMDS	Integrated Maintenance Data System
Inc.	Incorporated
IP	Instructor Pilot
ISB	Interim Safety Board
KIAS	Knots Indicated Airspeed
L	Local Time
MA	Mishap Aircraft
MAX	Maximum Afterburner
MC	Mishap Crew
MF	Mishap Flight
MFL	Mishap Flight Lead
MIL	Military Thrust
MIN AB	Minimum Afterburner
MIP	Mishap Instructor Pilot
MLG	Main Landing Gear
MOA	Military Operating Area
Mod	Moderate
MS	Mississippi
MSL	Mean Sea Level
MSP	Mishap Student Pilot
NCOIC	Non-Commissioned Officer In Charge
NOTAMs	Notices to Airmen
OG	Operations Group
ORM	Operational Risk Management
PE	Periodic Inspection
PHA	Physical Health Assessment
PLF	Parachute Landing Fall
PPL	Private Pilot License

RPM	Revolutions Per Minute
RSU	Runway Supervisory Unit
SETOS	Single-Engine Takeoff Speed
SIB	Safety Investigation Board
Sim	Simulator
S/N	Serial Number
SOF	Supervisor of Flying
STUS	Student Squadron
SUPT	Specialized Undergraduate Pilot Training
Tac	Tactical Formation
TCTO	Time Compliance Technical Order
TIMS	Training Integration Management System
T/N	Tail Number
TO	Technical Order
UHF	Ultra High Frequency
UPT	Undergraduate Pilot Training
U.S.	United States
WG	Wage Grade
VEN	Variable Exhaust Nozzle
VFR	Visual Flight Rules
VHF	Very High Frequency

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 Mishap, Columbus AFB, MS

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 24 May 2018, Major General Mark E. Weatherington, Deputy Commander, Air Education and Training Command (AETC), appointed Colonel David B. Lowe to conduct an aircraft accident investigation of a mishap that occurred on 23 May 2018 involving a T-38C aircraft, tail number (T/N) 68-8181, in the vicinity of Columbus Air Force Base (CAFB), Mississippi (MS) (Tab Y-2 to Y-3). The aircraft accident investigation was conducted in accordance with (IAW) Air Force Instruction (AFI) 51-503, *Aerospace and Ground Accident Investigations*, at CAFB, MS, from 24 July 2018 through 21 December 2018. The following Accident Investigation Board (AIB) members were appointed: Pilot Member (Lieutenant Colonel); Legal Advisor (Captain); Medical Member (Captain); Maintenance Member (WG-10); and Recorder (Technical Sergeant) (Tab Y-4 to Y-6).

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 23 May 2018, at approximately 0820 hours local time (L) the Mishap Aircraft (MA), a T-38C, T/N 68-8181, assigned to the 50th Flying Training Squadron, 14th Flying Training Wing, CAFB, MS, crashed during a formation student flight and impacted the ground approximately one half mile northwest of CAFB (preliminary data established the approximate time at 0830, later it was confirmed to be 0820) (Tabs N-3, Q-5, and R-4). The Mishap Instructor Pilot (MIP) and Mishap Student Pilot (MSP) ejected safely, sustaining minor injuries (Tab X-2). The MA was destroyed on impact with no significant damage to non-government property (Tab Q-6). Damage to government property is estimated at $10,100,058 (Tab Q-8).

3. BACKGROUND

a. Air Education and Training Command (AETC)

AETC's mission is to recruit, train and educate Airmen to deliver 21st Century airpower (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 inspire and develop Airmen (Tab CC-2). The command's organization includes the AF Recruiting Service, two numbered air forces, and the Air University (Tab CC-2). The command operates 12 major installations, numerous support tenant units on bases across the globe, and includes 16 active-duty and seven Reserve Wings (Tab CC-2). AETC, headquartered at Joint Base San Antonio (JBSA)-Randolph, Texas, has more than 29,000 active duty members, 6,000 Air National Guard and AF Reserve personnel, 15,000 civilian personnel, and more than 11,000 contractors assigned (Tab CC-2).

b. 19th Air Force (19 AF)

19 AF, also headquartered at JBSA-Randolph, executes operational-level command and control of all formal aircrew flying training missions within AETC (Tab CC-6). The mission is to train and educate the world's finest Airmen to deliver Airpower for America and is responsible for the training of more than 30,000 United States (U.S.) and allied students annually in numerous specialties (Tab CC-4). 19 AF consists of more than 32,000 personnel and operates over 1,250 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-6). 19 AF accounts for more than 490,000 flying hours annually, 44 percent of the AF's total flying hours (Tab CC-6 to CC-7).

c. 14th Flying Training Wing (14 FTW)

The 14 FTW, headquartered at CAFB, MS, mission is to "Produce Pilots, Advance Airmen, Feed the Fight" and is responsible for specialized undergraduate pilot training in the T-6 Texan II, T-38C Talon, and T-1A Jayhawk aircraft (Tab CC-8). The Wing trains an average of 475 officers per year, and is composed of 1,447 active duty members, 554 civilian personnel, and 522 contractor personnel (Tab CC-8 to CC-9).

d. 14th Operations Group (OG)

The 14 OG at CAFB, MS falls under the 14 FTW and follows the mission to "Produce Pilots, Advance Airmen, Feed the Fight" (Tab CC 10). The 14 OG has six squadrons and is responsible for the 52-week Specialized Undergraduate Pilot Training (SUPT) mission, as well as the quality assurance for contract aircraft maintenance (Tab CC-10).

e. 50th Flying Training Squadron (50 FTS)

The 50 FTS mission is to train combat pilots for America (Tab CC-11). The 50 FTS is responsible for the advanced phase of undergraduate pilot training and consists of 110 hours of flight instruction in the Northrop T-38C (Tab CC-11). Training includes advanced aircraft handling, tactical navigation, fluid maneuvering and an increased emphasis in two- and four-ship formation (Tab CC-11). At the completion of training, the graduate is awarded the aeronautical rating of pilot (Tab CC-11).

f. 14th Student Squadron (14 STUS)

The 14 STUS exercises administrative control for each student at CAFB, MS and provides daily administrative support (Tab CC-12). It is the largest squadron at CAFB and ensures student pilots have everything they need to become both officers and pilots while providing unrivaled academic and simulator training (Tab CC-12). The 14 STUS also conducts a majority of the student academic and simulator training (Tab CC-12).

g. T-38 Talon

The T-38 Talon is a twin-engine, high-altitude, supersonic jet trainer used in a variety of roles because of its design, economy of operations, ease of maintenance, high performance and exceptional safety record (Tab CC-13). AETC is the primary user of the T-38 for joint specialized undergraduate pilot training and uses it to prepare pilots for front-line fighter and bomber aircraft (Tab CC-13).

The Talon first flew in 1959 and more than 1,100 were delivered to the Air Force between 1961 and 1972 (Tab CC-13). As the T-38 fleet has aged, specific airframe, engine and system components have been modified or replaced (Tab CC-13). AETC began receiving T-38C models in 2001 as part of the Avionics Upgrade Program (Tab CC-13). T-38C models underwent a propulsion modernization program that replaced major engine components to enhance reliability and maintianability, and an engine inlet/injector modification to increase available takeoff thrust (Tab CC-13). These upgrades and modifiiations, with the Pacer Classic program, should extend the service life of T-38s to 2020 (Tab CC-13 to CC-14).

The T-38 features swept wings, streamlined fuselage, tricycle landing gear with a steerable nose wheel, and two independent hydraulic systems (Tab CC-13). It incorporates a glass cockpit with integrated avionics displays, head-up display, and an electronic "no bomb drop" scoring system as

well as a gun sight and practice bomb dispenser (Tab CC-13). The T-38 needs as little as 2,300 feet of runway to take off and can climb from sea level to nearly 30,000 feet in one minute and its modified propulsion modernization program provides approximately 19 percent more thrust, reducing takeoff distance by 9 percent (Tab CC-13). In the T-38, the instructor and student sit in tandem on rocket-powered ejection seats in a pressurized, air-conditioned cockpit (Tab CC-13).

4. SEQUENCE OF EVENTS

a. Mission

The mishap sortie was scheduled, briefed, and executed with the MC flying as number four of a four-ship formation training mission, callsign "Scar 1/2/3/4" (Tabs K-2 and R-4). Scar flight also briefed and executed a formation split into two separate two-ship formations in the Columbus 1 Military Operating Area (MOA) approximately 10 minutes into the sortie (Tabs R-4 and AA-4). Based on MC testimony, Scar flight planned to remain in two-ship formations until returning to the local traffic pattern, at which time formations would split to land as single aircraft (Tabs R-4 and R-24). The mission was flown IAW AETC Syllabus P-V4A-A, T-38C SUPT, dated December 2016 (Tabs AA-2 and BB-4). The squadron Top-3 (Operations Supervisor) authorized the mission (Tab K-2).

b. Planning

The mission was planned IAW the T-38C SUPT syllabus, applicable flying regulations, and local flying standards (Tabs AA-2 to AA-3). The Mishap Student Pilot (MSP) arrived at the squadron around 0530L, and the Mishap Instructor Pilot (MIP) arrived shortly before the 0610L mission brief start time (Tabs R-4 and R-23). The mishap flight lead (MFL) conducted the four-ship formation brief using the briefing guide contained in the 50 FTS In-Flight Guide; then the four-ship separated into two-ship elements where the Scar 3 instructor pilot (IP) briefed the MC; finally, the elements split into single-ships for crew briefing and final mission instruction (Tabs R-23 and BB-11 to BB-13). The briefings covered all required items IAW AFI 11-2T-38v3, including Notices to Airmen (NOTAMs), special interest items, forecast weather, emergency divert airfields, and planned flying events (Tabs AA-2, BB-11 to BB-13, and BB-55 to BB-58).

c. Preflight

After the briefing, the members of the Mishap Formation (MF) received a final step briefing from the Top-3 before proceeding to the flightline (Tabs V-3.3 and AA-2). The step briefing from the Top 3 assigned aircraft to the individual aircrews and included an update on aircraft status, weather, NOTAMs, bird condition, and active runways (Tab AA-2). The Top 3 also reviewed the MF's operational risk management (ORM) status and provided final approval to fly (Tabs V-3.9, AA-2, and AA-5). The MC arrived at their assigned aircraft, there is no evidence to suggest that they deviated from their required routine and procedures which included reviewing the maintenance forms, accomplishing an external aircraft inspection, and starting the aircraft engines and required systems (Tabs R-4, R-23, and AA-3).

d. Summary of Accident

(1) Taxi, Takeoff, Departure, and MOA Training

The MF's taxi, takeoff at approximately (0732L), departure, and formation training were all uneventful and there is no evidence to suggest that they deviated from their local standards, procedures, and requirements (Tabs R-4, R-5, and R-23). After splitting the formation, the individual two-ships assumed separate sectors of airspace within the Columbus 1 MOA (Tab R-23). The MC, callsign Scar 4, was paired with Scar 3 after splitting from Scar 1/2 (Tab R-4).

(2) Return to Base

Following formation training in the MOA, Scar 3/4 returned to CAFB with enough fuel ("fat on gas") to execute touch-and-go landings prior to the full stop landing (Tab R-4). The two-ship executed an overhead pattern, and Scar 3 performed a touch-and-go without incident (Tab R-43).

(3) Touch-and-Go Landing and Bird Strike

After Scar 3's touch-and-go, Scar 4 executed a practice touch-and-go (Tab R-5). Eyewitness account indicated the flaps were hanging at 100% (Tab R-46). At 08:19:25L, the MSP, flying in the front cockpit, touched down approximately 1,500 feet down runway 31 right (31R) at approximately 140 knots indicated airspeed (KIAS) (Tabs R-5, R-24, BB-3, and DD-26). The MSP selected military thrust (MIL) and accelerated to continue the touch-and-go (Tab R-5). While the MA was accelerating on the runway, an Eastern Meadowlark struck the right side of the aircraft, and part of the bird went into the right engine (Tabs R-5 and DD-28 to DD-30). The MSP recognized the bird strike and rapidly retarded the throttles to idle to abort the takeoff (Tab R-5). The MIP deemed the aircraft was too fast to abort in the remaining runway and he assumed control of the aircraft, immediately placing both throttles in maximum afterburner (MAX) (Tab R-5). When the MSP rapidly moved the throttles from MIL all the way back to idle immediately followed by a rapid advancement to MAX by the MIP, the engine had to make large, fast changes in inlet guide vane geometry, air bleed valve positioning, and engine nozzle scheduling (Tab BB-17).

(4) Touch-and-Go Takeoff

Expert analysis determined that after the bird strike and rapid throttle movements, the right engine sustained a compressor stall, which eliminated the engine available thrust (Tabs J-66, R-26, and DD-32). The MA lifted off in a normal climb attitude (7 degrees nose high) with usable thrust from only the left engine and remained fully configured through impact (landing gear extended and flaps 100%) (Tabs J-46, R-24, and BB-60). As the MA became airborne, the MSP noticed the right compressor speed decreasing and exhaust gas temperature (EGT) increasing and told the MIP (Tabs R-5 and R-24). Simultaneously, the MC heard the aural warning stating "Engine, Engine" (Tab V-1.14). Based on the MIP's testimony, he misperceived that the right engine had shut down (Tab R-5). As a result of this misperception, the MIP executed the "Alternate Airstart/Loss of Thrust (Low Altitude)" critical procedure (commonly referred to as "BOLDFACE") by retarding the right throttle below the afterburner range and then selecting MAX, but the engine remained in

a stalled condition (Tabs R-5 and BB-19). While simultaneously working to regain right engine thrust, the MIP made three radio calls to the Runway Supervisory Unit (RSU) in the span of 12 seconds to coordinate for a landing on runway 31 center (31C) (Tab N-2 to N-3). Although the MIP stated he did not recall reducing left engine thrust below MAX, in the course of making large right throttle movements while keying the radio switch on the throttle, left engine thrust was reduced to minimum afterburner (MIN AB) where it remained through impact (Tabs J-59 and V-1.19). The aircraft avionics produced visual and aural warnings that the aircraft was approaching stall, and the MIP noted airspeed of 143 KIAS (Tabs R-8 and R-24). Based on flight simulations, it was determined the MA slowed below the stall speed of 139 KIAS due to insufficient thrust needed to sustain normal climbout pitch while overcoming the drag of a fully configured aircraft (Tabs BB-22 and DD-24 to DD-25). The MA then stalled, causing a rapid and uncontrolled roll to the right followed by a slower, uncontrolled roll to the left at approximately 200 feet above the ground (Tabs R-24, R-44, and DD-24 to DD-25). At approximately at 08:20:00L, the MIP initiated a sequenced ejection while the aircraft was in left bank and continuing to roll left (Tabs R-24, S-8, and DD-26).

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Graphic Depiction of Mishap Timeline

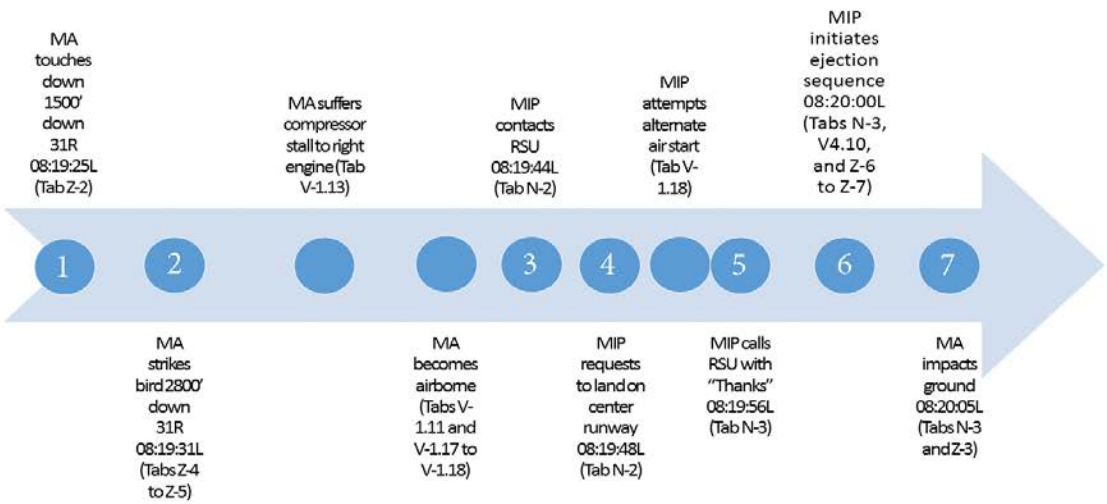

Figure 1 (Tabs DD-26 to DD-27 and DD-33)

(5) Simulation

The AIB attempted to replicate the conditions present during the mishap and flew 22 different scenarios of the touch-and-go leading to the mishap (Tab DD-24). During simulation, the AIB assumed the right engine produced zero thrust after the bird strike and controlled the following variables: left throttle position (MIN AB vs. MAX), liftoff speed, climb pitch, and configuration (Tab DD-24).

The simulations showed that adherence to Technical Order (TO) 1T-38C-1 critical procedures (BOLDFACE) for single-engine go-around would have allowed the MIP to safely climb the aircraft above obstacles while accelerating to a safe, sustainable airspeed (Tabs BB-20 to BB-21 and DD-24 to DD-25). The simulations also demonstrated that adherence to the first step – ensuring maximum afterburner thrust on the left engine for the duration of the climb – would have been sufficient to safely climb the aircraft even if the rest of the checklist was not accomplished (i.e. no change to configuration and imprecise airspeed/pitch control) (Tab DD-24 to DD-25). Furthermore, the simulations showed that MIN AB on the left engine would have been sufficient to safely climb and accelerate if the remainder of the checklist had been correctly accomplished (i.e. proper configuration and airspeed/pitch control) (Tab DD-24 to DD-25). Finally, simulations indicate that the MA did not accelerate to final approach speed but lifted off around 150 KIAS (Tab DD-24 to DD-25).

e. Impact

At 08:20:05L, the MA crashed one half mile northwest of the departure end of runway 31R, approximately 400 feet outside the CAFB north fence (Tabs Q-5, S-8, DD-26 and DD-33). The MA was configured with landing gear down and flaps 100% (Tab J-46). Wreckage indicates the MA impacted a roadway in an inverted and nose low attitude (Tab J-29). The roadway is elevated approximately 15 feet above the surrounding terrain, so the aircraft briefly became airborne after initial impact then came to rest upside down and nose down leaning against a treeline (Tab J-29). A subsequent fire melted most of the remaining components of the forward fuselage as well as the center wing area, separating the wings from the aircraft (Tab J-29).

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Figure 2 (Tab J-30)

f. Egress and Aircrew Flight Equipment (AFE)

At 08:20:00L, the MIP initiated sequenced ejection for both seats (Tab R-6 and DD-26). Both pilots had very little time under parachute due to their low altitude at the time of ejection (Tabs R-6 and R-25). The ejection seats were recovered mostly intact, but the aft seat was significantly damaged by ground impact (Tab J-20 to J-21). Post-ejection analysis determined both ejection seat subsystems functioned as intended (Tab J-18 to J-24). The MIP and MSP suffered only minor injuries (Tab X-2).

A post-ejection analysis of both MIP and MSP AFE, including parachute fabric and suspension line cords, showed all equipment to be in serviceable condition (Tab DD-9).

The MC was current for AFE continuation training requirements (Tab DD-16 to DD-17). There were no overdue inspections or time changes due on the AFE equipment (Tab DD-18 to DD-23).

g. Search and Rescue

The MIP impacted the ground on a steep berm next to a roadway (Tab R-6). The MSP impacted dense trees, and then slowly and safely descended through them while under parachute (Tab R-25). Both pilots were able to quickly move away from the burning wreckage and call first responders on their personal phones after surveying themselves for injuries (Tabs R-6 and R-25).

First responders from the 14th Civil Engineer Squadron at CAFB received notification at 08:22:12 and responded at 08:26:46, within 4 minutes of the crash; but were delayed until 08:30:11 by a locked gate along the base perimeter (Tabs DD-2, DD-4, and DD-5). While coordinating to unlock the gate, they spoke to the pilots through the wire fence, confirmed the pilots were not in need of immediate medical attention and approximately 9 minutes after the crash, they used bolt-cutters to cut the lock and open the gate (Tabs R-26 and DD-5). An ambulance arrived shortly thereafter, and both pilots were treated at the local emergency room and released the same day (Tabs X-2 and DD-2).

Figure 3 (Tab S-8)

h. Recovery of Remains

Not applicable.

5. MAINTENANCE

a. Forms Documentation

L3 Communications Vertex Aerospace LLC, Inc., a private defense contractor, that provided services and personnel to maintain the T-38C aircraft at CAFB at the time of the mishap (Tab U-4). Air Force Technical Order (AFTO) Form 781 Series, AFTO Form 95, L3 Form 295, and Time Compliance Technical Orders (TCTOs) were used to document all maintenance performed on the MA (Tab U-2). The AIB reviewed and verified these forms using the Integrated Maintenance Data System (IMDS), which is the standard Air Force system for maintenance information (Tab U-2). A detailed review of the records did not reveal any recurring maintenance problems with the MA nor was there evidence to suggest maintenance was a factor in the mishap. (Tab U-2).

TCTOs direct and provide instructions for modifying military systems and end items or performing one-time inspections (Tab U-2). The MA right engine S/N GEOO232118, had three open TCTOs: 2J-J85-1030, *Inspection of Combustion Chamber Cowl and Dome Rivet Weld*; 2J-85-1014D-J85-5, *Series Engine VEN Housing and Bracket Replacement, Roller and Shaft Improvement*; and 2J-J85-1012, *Replacement of Compressor Stage 1 Blades and Stage 2 Blades from Compressor Rotor Assemblies* (Tab J-58). TCTOs 2J-J85-1030 and 2J-85-1014D-J85-5 were not a factor to the mishap (Tab J-59). However, engineer analysis indicated that new compressor blades with a mid-span damper feature, installed IAW TCTO 2J J85 1012 (which was in abeyance at the time of the mishap) increase stall margin thus reducing the engine's susceptibility to stalls (Tab J-59).

A recurring discrepancy is a system or subsystem malfunction that reappears during the third, fourth, or fifth sortie (or attempted sortie) following its first appearance (Tab U-2). A review of the records revealed no recurring discrepancies, and all required TCTOs were accomplished IAW applicable guidance (Tab U-2). There is no evidence to suggest that TCTOs restricted the MA from flight (Tab U-2).

b. Inspections

L3 Communications Vertex Aerospace LLC, Inc. maintenance personnel performed a basic post flight inspection (BPO) and a preflight inspection on 22 May 2018 prior to the MA's last flight (Tab U-2). These inspections were documented in the AFTO Form 781 (Tab U-2). A BPO is an inspection which 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 make sure no defects exist which would be detrimental to further flight (Tab U-3). The BPO was completed satisfactorily with no discrepancies (Tab U-3). A preflight inspection was scheduled before the first flight of the day (Tab U-3). The inspection consists of checking the aircraft preparedness by doing visual examination and operational checks of some components (Tab U-3). The preflight inspection is valid for a period not to exceed 72 hours (Tab U-3). The preflight inspection was completed satisfactorily with no discrepancies (Tab U-2). There is no evidence to suggest any items discovered during the inspection were factors in the mishap (Tab U-2).

The last scheduled periodic inspection (PE)/phase inspection was completed 272.8 flying hours prior to the date of the incident (Tab D-2). A PE primarily consists of checking certain components, areas, and systems of the aircraft to ensure proper function (Tab U-3). The last PE was conducted on 11 September 2017 and noted zero discrepancies (Tab U-2 to U-3). It was determined the PE was not a factor in the mishap (Tabs D-2 and U-2).

c. Maintenance Procedures

There is no evidence to suggest in the documented maintenance records that maintenance procedures were factors in the mishap (Tab U-2).

d. Maintenance Personnel and Supervision

The AIB reviewed all maintenance personnel training records on personnel involved in servicing or inspecting the MA (Tab U-3). Training records confirmed maintenance personnel were trained and certified on the tasks they performed on the MA (Tab U-3). There is no evidence to suggest maintenance personnel and maintenance supervision were factors in the mishap (Tab U-3).

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

Fuel, hydraulic, and oil samples were taken from the MA at CAFB after the mishap (Tab D-11 to D-19). The Air Force Petroleum Agency (AFPET) at Wright-Patterson AFB, Ohio, analyzed these samples and determined quantities of these samples were insufficient to complete all tests and requirements necessary to draw and analysis or conclusion of fuel, hydraulic, oil, and oxygen inspection analyses (Tab D-11 to D-19).

f. Unscheduled Maintenance

Unscheduled maintenance is any action taken that is not the result of a scheduled inspection and normally is generated by a pilot-reported discrepancy or condition discovered by ground crew personnel (Tab U-3). No unscheduled maintenance action was performed on the MA since the last scheduled inspection (Tab U-3). Unscheduled maintenance was not a factor in this mishap. (Tab U-3).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Conditions of the Systems

The MA was destroyed upon ground impact (Tab J-57). About two-thirds of the plane was missing and the remaining one-third was resting on the ground, with significant fire damage (Tab J-57). The fire destroyed the majority of the cockpits, control setting, instruments, and avionics systems, including the data transfer cartridge (U-2). The aft section of the fuselage and the engines were still intact with significant damage (Tab J-57). The fire melted through the center wing section, which separated the wings from the aircraft (Tab J-29). The left and right main landing gear (MLG) were still attached (Tab J-31). The rest of the debris was confined to a small area in a

scattered pattern and included the following: vertical fixed surfaces, wing/wingtip, aileron, flaps, stabilizer, vertical stabilizer including v-tip, rudder, speed brake, nose landing gear door, MLG strut doors, and the left MLG inboard gear door (Tab J-30). The speed brake and the right MLG inboard gear door were not recovered with the main wreckage but were discovered in the wreckage in the larger debris field (Tab J-30). The front and rear canopy were recovered with major structural damage (Tab J-18 to J-19). The rudder surfaces sustained heavy damage from ground impact (Tab J-32). The rudder actuators were located in the intact aft fuselage section (Tabs J-35 and J-36). The aft lug of both actuators had broken free of the rudder horn but were otherwise in good condition (Tabs J-35 and J-36).

b. Technical Information and Analysis

(1) Escape System

Both of the Martin Baker MKUS16T ejection seats were recovered (Tab J-18). Ejection seat analysis indicated the aft ejection seat was significantly damaged on both lower outer catapult main beam assemblies from trees and ground impact (Tab J-18 to J-21). Base on the engine analysis, the fwd ejection seat only had minor scrape damage by tree and ground impact. (Tab J-18 to J-21).

(2) Left Engine Analysis

The Air Force Life Cycle Management Center (AFLCMC) conducted an analysis and inspection on engine 23-0454, the left engine (Tab J-59). The variable exhaust nozzle (VEN) diameter was measured at 15.5 inches indicating that the VEN was open at 40-41 percent which corresponds to MIN AB (Tab J-59). AFLCMC determined, there were significant hard foreign object damage (FOD) indications on three front strut leading edges at the four to five o'clock position aft looking but no significant damage on the trailing edges of the inlet guide vane (IGV) (Tab J-60). The first stage compressor blades had only minor nicks and dents with no indications of tip curls, tears or major bends (Tab J-60). Thorough engine inspection by AFFLCMC revealed that the engine was functioning normally at the time of impact (Tab J-61). The following engine components were removed and individually inspected:

(a) Main Fuel Pump:

Visual inspection showed some minor handling damage from transport along with charring and severe fire damage (Tab J-74). Despite fire damage, the pump was able to function within limits (Tab J-74). The Main Fuel Pump was determined to be functioning normally at time of impact (Tab J-74).

(b) Main Fuel Control Part:

Visual inspection showed signs of minor handling damage along with charring and severe fire damage (Tab J-74). A functional test could not be done due to heat damage to the O-rings causing it to leak (Tab J-74). The Main Fuel Control Part operation at the time of the crash could not be verified but showed no indications of malfunction prior to the mishap (Tab J-74).

(c) AB Fuel Pump:

Visual inspection showed signs of minor handling damage along with severe heat distress and charring (Tab J-74). The pump passed all functional checks with the exception of minor leaks due to damage from the fire after the crash (Tab J-74). The AB Fuel Pump was functioning normally at time of impact (Tab J-74).

(d) AB Fuel Control:

Visual inspection showed signs of minor handling damage along with severe heat distress and charring (Tab J-74 to J-75). The tests could not be done due to several leaks throughout the controls (Tab J-74 to J-75). The AB Fuel Control operating condition at time of impact could not be confirmed but teardown and inspection did not find any sign of malfunction prior to mishap (Tab J-75).

(e) T5 Motor:

Visual inspection showed signs of severe heat damage along with impact damage from the crash (Tab J-75). The T5 motor could not be functionally checked due to the damaged condition of the leads, housing, and internal components (Tab J-75). The motor was disassembled and it was severely damaged (Tab J-75). The rotating components were rough due to the fire and impact damage but did not show any signs of malfunction prior to crash (Tab J-75). The operating condition prior to the crash could not be confirmed but teardown and inspection did not find any signs of malfunction prior to mishap. (Tab J-75)

(3) Right Engine Analysis:

AFLCMC conducted an analysis and inspection on engine 23-2118, the right engine (Tab J-61). The outer shroud was observed to be smashed into the gas path and contracting the front frame struts (Tab J-62). The VEN diameter was measured between 10.5 and 10.75 inches which is fully closed (Tab J-62). AFLCMC determined, there was a significant amount of hard FOD in the intake and significant impact damage along with torsional bending on the AB case (Tab J-62). The right engine appeared to take most of the impact (Tab J-62). AFLCMC determined the compressor blades in stages one through four had significant leading edge damage and first stage blades showed tip curl, indicating the engine had experienced a compressor stall (Tab J-62). All stages of the compressor rotor showed numerous FOD hits with blades bent in the opposite direction of rotation (Tab J-62). The following engine components were removed and individually inspected:

(a) Main Fuel Pump:

The visual inspection showed some minor handling damage from transport along with charring and heat damage (Tab J-75). The pump was able to be functionally tested and tested within limits (Tab J-75). The fuel filter was removed and inspected and showed no signs of debris, blockage or malfunction (Tab J-75). The Main Fuel Pump was determined to be functioning normally at time of impact (Tab J-75).

(b) Main Fuel Control:

The visual inspection showed signs of minor handling damage along with charring and heat damage (Tab J-75). The functionality test failed for low flow at both the deceleration and acceleration schedules, the variable geometry schedule, and the acceptance test droop line check (Tab J-75). Engineer analysis stated the failure results are normal for this component after it has been in use (Tab J-75). Disassembly did not find any malfunctions and all damage was determined to be caused by the crash and fire (Tab J-75). During the inspection, a witness mark was found on the power sleeve and measurements taken indicate that engine 23-2118 was approximately 38% engine speed at time of impact (Tab J-75).

(c) AB Fuel Pump:

The visual inspection showed signs of minor handling damage along with severe heat distress and charring (Tab J-75 to J-76). The pump was tested and passed all functional checks with the exception of minor leaking during the fuel shutoff valve test point (Tab J-75 to J-76). The AB Fuel Pump was functioning normally at the time of impact (Tab J-75 to J-76).

(d) AB Fuel Control:

Visual inspection showed signs of minor handling damage along with heat distress and charring (Tab J-76). The AB fuel control failed testing but engineer analysis stated that test results could be due to ground impact and may not indicate pre-mishap performance (Tab J-76).

(e) T5 Motor:

Visual inspection showed signs of severe heat damage along with impact damage from the crash (Tab J-76). The T5 motor could not be functionally checked due to the damaged condition of the leads, housing and internal components (Tab J-76). The motor was disassembled and it was severely damaged (Tab J-76). The rotating components were rough due to the fire and impact damage but did not show any signs of malfunction prior to the crash (Tab J-76). The operating condition prior to the crash could not be confirmed but teardown and inspection did not find any signs of malfunction prior to the crash (Tab J-76).

7. WEATHER

a. Forecast Weather

The weather forecast at CAFB at the time of landing predicted winds 020° at 6 knots, 7 statute miles visibility, 19° Celsius, and scattered clouds at 25,000’ (Tab F-2).

b. Observed Weather

The CAFB observed weather at 0756L, 24 minutes before the mishap, matched the forecast weather with the exception of calm winds and 22° Celsius (Tabs F-2 and F-9).

c. Space Environment

Not Applicable.

d. Operations

Evidence indicated Operations were unrestricted due to weather conditions (Tab F-9).

8. CREW QUALIFICATIONS

a. Mishap Instructor Pilot

The MIP was a current and qualified T-38C IP with a current Form 8 flying evaluation (certificate of aircrew qualification), dated 4 October 2017 (Tab G-24). He was current and qualified in all aspects of the planned mission (Tabs G-3, G-24 to G-30, and G-38 to G-40). The MIP had 219.4 flight hours at the time of the mishap, all of which were in the T-38C, and he had 108.5 hours as an IP (Tab G-7). Within 30 months prior to the mishap, the MIP had completed SUPT, Pilot Instructor Training, Mission Qualification Training, and the Buddy Instructor Pilot Program with no deficiencies noted relative to the mishap (Tabs G-6, G-24 to G-38, and V-1.4).

Recent flight time is as follows (Tab G- 4):

	Hours	Sorties
30 days	20.5	20
60 days	41.0	39
90 days	61.3	57

b. Mishap Student Pilot

The MSP was a current T-38C Student Pilot in SUPT with three sorties remaining in the program (Tabs G-20 to G-21 and BB-6). His performance in the T-38C was below average, however he had met all standards of the T-38C SUPT syllabus (Tabs G-42, G-50, and G-54). The MSP had 165.9 cumulative flight hours as a student pilot at the time of the mishap (Tabs G-21 and T-3).

Recent flight time is as follows (Tab G-20 to G-21):

	Hours	Sorties
30 days	18.0	17
60 days	46.8	42
90 days	72.2	65

9. MEDICAL

a. Qualifications

The MIP was medically qualified for flying duties at the time of the mishap (Tab X-2). The MIP's most recent annual military Periodic Health Assessment (PHA) was performed on 27 February 2018 (Tab X-2). The MIP's annual dental examination was performed on 10 February 2017 (Tab X-2). The medical records contained a current AF Form 2992, Medical Recommendation for Flying or Special Operational Duty, dated 23 April 2018 (Tab X-2). Review of the Aeromedical Information Management Waiver Tracking System database (AIMWTS) showed the MIP had no aeromedical waivers (Tab X-2).

The MSP was medically qualified for flying duties at the time of the mishap (Tab X-2). The MSP's most recent annual military PHA was performed on 06 June 2017 (Tab X-2). The MSP's annual dental examination was performed on 11 May 2018 (Tab X-2). The medical records contained a current AF Form 2992, Medical Recommendation for Flying or Special Operational Duty, dated 13 October 2017 (Tab X-2). Review of AIMWTS showed the MSP had no aeromedical waivers (Tab X-2).

b. Health

The AIB Medical Member reviewed the medical and dental records in addition to the 72-hour/ 7-day histories of the MIP (Tab X-2). The MIP's records reflected good health and no recent performance-limiting illness prior to this mishap (Tab X-2). Based on witness testimonies, the MIP successfully ejected from the MA (Tab R-6). The injuries associated with this ejection were minor and were treated in the Baptist Memorial Hospital Emergency Department (Tab X-2). There is no evidence to suggest the MIP's health was a factor in this mishap.

The AIB Medical Member reviewed the medical and dental records in addition to the 72-hour/7-day histories of the MSP (Tab X-2). The MSP's records reflected good health and no recent performance-limiting illness prior to this mishap (Tab X-2). The MSP successfully ejected from the MA (Tab R-23). There were no significant injuries associated with this ejection (Tab X-2). The MSP was transported to the Baptist Memorial Hospital Emergency Department for evaluation and released (Tab X-2). There is no evidence to suggest the MSP's health was a factor in this mishap.

c. Pathology

Immediately following the mishap and in accordance with safety investigation protocols, blood and urine samples were collected on the MIP and MSP and submitted to the Armed Forces Medical Examiner System at Dover AFB for toxicological analysis (Tab X-2). All blood samples tested negative for ethanol and carbon monoxide levels (Tab X-2). Urine drug screen testing for all samples was negative for amphetamine, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates, phencyclidine, and sympathomimetic amines by immunoassay or chromatography/full scan-mass spectrometry, with the exception of the MIP who had a positive test for morphine, which

would be expected due to his treatment with morphine immediately following the mishap (Tab X-2).

d. Lifestyle

MIP and MSP testimonies, 72-hour/7-day histories and the medical charts revealed no lifestyle factors relevant to the mishap (Tabs R-14 to R-21, R-32 to R-39, and X-2).

e. Crew Rest and Crew Duty Time

AFI 11-202, Volume 3, AETC Supplement, General Flight Rules, dated 18 May 2015, prescribes mandatory crew rest and maximum Flight Duty Periods for all personnel who operate AF aircraft (Tab BB-26 to BB-29). Based upon witness testimony and supplemental history, crew rest was IAW paragraph 9.8 of AFI 11-202, Volume 3 (Tabs R-14 to R-15, R-32 to R-33, X-2, and BB-26).

10. OPERATIONS AND SUPERVISION

a. Operations

The 50th Flying Training Squadron's operations tempo was moderate with instructor pilots normally flying seven to ten sorties per week (Tab AA-4). Additionally, student pilots flew an average of seven to eight sorties per week not including simulator sorties (AA-4). This level of training is consistent with a moderate operations tempo (AA-4).

b. Supervision

The squadron Top-3 authorized the mission (Tab K-2). The MIP was qualified for the mission (Tabs G-2 to G-3 and G-24). The MC attended the formation briefing IAW AFI 11-2T-38, Volume 3 and T-38 Inflight Guide (Tabs R-4, AA-2, BB-11 to BB-13, and BB-55 to BB-58). The Top-3 also provided a step briefing including weather conditions, bird condition, Go/No-go status, and other applicable information (Tabs F-2 to F-8 and V-3.3). The Top-3 reviewed the formation's ORM worksheet, which included the MC ORM computation (Tab AA-5). Since MC ORM total was at the moderate risk level, Top-3 supervision was required to approve risk assessment (Tab AA-5).

11. HUMAN FACTORS ANALYSIS

a. Introduction

As defined by AFI 91-204, *Safety Investigations and Reports*, a human factor is any environmental factor or psychological factor a human being experiences that contributes to or influences performance during a task (Tab BB-31). The most current Department of Defense Human Factors Analysis and Classification System, Version 7.0, as implemented by AFI 91-204, establishes

several potential human factors for assessment during a mishap investigation (Tab BB-31 to BB-53).

b. Human Factor 1 AE202 (Failure to Prioritize Tasks Adequately)

AE202 is a factor when the individual does not organize, based on accepted prioritization techniques, the tasks needed to manage the immediate situation (Tab BB-37). The MIP stated that he became task saturated while attempting to recover function of the right engine while making radio calls and trying to maintain aircraft control (Tabs V-1.5 to V-1.6, and V1.14). The Emergency Procedures and Abnormal Operations section of TO 1-T-38C-1 (T-38C flight manual) contains a note which states that "a critical procedure is an emergency procedure that must be performed immediately without reference to a checklist and that must be committed to memory" (Tab BB-18). Simulations demonstrated that failure to immediately complete the single-engine go-around critical procedure would place the aircraft in a stall (Tab DD-24 to DD-25).

c. Human Factor 2 PC102 (Fixation)

PC102 is a factor when the individual is focusing all conscious attention on a limited number of environmental cues to the exclusion of others (Tab BB-44). The MIP stated upon taking control of the aircraft, he was fixated on a concern that the bird strike may have damaged the aircraft flight controls and failed to check his engine instruments for possible loss of thrust (Tab R-5). He accelerated slightly, began to climb, and then the MSP alerted him to a loss of thrust in the right engine (Tab R-5). After this discovery, the MIP fixated on the right engine and did not correctly position the flaps, landing gear, and left throttle to facilitate a safe climb in spite of the loss of thrust (Tabs J-46, J-59, R-5, and V-1.13 to V-1.15).

d. Human Factor 3 AE102 (Checklist Not Followed Correctly)

AE102 is a factor when the individual, either through an act of commission or omission, makes a checklist error or fails to run an appropriate checklist (Tab BB-36). The MIP stated that his actions during the mishap were guided by the critical procedure checklist for a single-engine go-around (Tab V-1.13). The applicable checklist for the T-38C flight manual provides instructions for a single-engine go-around which includes placing throttles in MAX, flaps to 60%, achieving final approach speed, and raising the landing gear (Tab BB-20 to BB-21). Evidence from the wreckage of the MA shows that at the time of impact the MA landing gear was down, the flaps were extended in the full position, and the left engine was in a MIN AB setting with normal engine function (Tabs J-46 and J-59).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

(1) AFI 51-503, Aerospace and Ground Accident Investigations, dated 28 January 2016
(2) AFI 44-170, Preventive Health Assessment, dated 30 January 2014
(3) AFI 48-123, Medical Examinations and Standards, dated 5 November 2013,

incorporating AFGM2018-02, dated 28 January 2018

(4) AFI 91-204, Safety Investigation and Hazard Reporting, dated 27 April 2018

(5) AFI 11-202, Volume 3, AETC Supplement, General Flight Rules, dated 30 January 2017

(6) AFI 11-202, Volume 2, Aircrew Standardization/Evaluation Program, dated 13 September 2010

(7) AFI 11-2T-38, Volume 3, T-38 Operations Procedures, dated 2 October 2015

(8) AFI 11-2T-38, Volume 2, T-38 Aircrew Evaluation Criteria, dated 5 August 2014

(9) AFI 11-301, Volume 1, Aircrew Flight Equipment, dated 10 October 2017

(10) AETC MANUAL 11-251, T-38C Flying Fundamentals, dated 4 April 2017

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) Department of Defense Human Factors Analysis and Classification System, Version 7.0

(2) USAF Medical Standards Directory, 29 May 2017

(3) TO 1T-38C-1, Flight Manual, dated 8 March 2016, incorporating Interim Safety Supplement Flight Manual, TO 1T-38C-1SS-20, dated 20 February 2018

(4) AETC Syllabus P-V4A-A T-38 Specialized Undergraduate Pilot Training, dated December 2016, with Change 1

(5) 50th Flying Training Squadron In-Flight Guide, dated 1 June 2015

(6) CAFB BASH Plan 91-02, Columbus AFB BASH Plan, dated 1 October 2017

c. Known or Suspected Deviations from Directives or Publications

The MIP deviated from AFI 11-2T-38, Volume 3, pages 3-63 and 3-64 when he failed to complete the procedure for Single-Engine Go-Around.

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21 December 2018

DAVID B. LOWE, Colonel, USAF
President, Accident Investigation Board

United States Air Force Accident Investigation Board Report

Class A Mishap, Columbus AFB, MS

STATEMENT OF OPINION

T-38C, T/N 68-8181
COLUMBUS AFB, MS
23 MAY 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

The aerospace accident occurred at approximately 0820 hours local time on 23 May 2018 involving a T-38C, tail number 68-8181. The mishap aircraft (MA) was assigned to the 50th Flying Training Squadron, 14th Flying Training Wing, Columbus Air Force Base (CAFB), Mississippi. The mishap crew (MC) consisted of the mishap instructor pilot (MIP) seated in the rear cockpit of the MA and the mishap student pilot (MSP) performing duties in the front cockpit. The training mission performed by the MC consisted of a student formation sortie followed by traffic pattern work with single-ship touch-and-go landings at CAFB. During their first touch-and-go landing, the MA struck a bird, an Eastern Meadowlark, shortly after touchdown on runway 31 right (31R). This bird strike – coupled with rapid throttle movements by the MC – caused a compressor stall in the right engine. The resulting loss of thrust combined with MIP actions caused the MA to enter a low-altitude stall shortly after lifting off from the runway. Believing the MA was unrecoverable, the MIP initiated a low-altitude ejection just beyond the departure end of the runway. The MC successfully ejected, sustaining only minor injuries. The MA was destroyed after impacting the ground at a low angle and airspeed just beyond the CAFB north gate. The destroyed aircraft was a loss of $10,100,058.

Upon returning from the Military Operating Area as number two of a two-ship formation, the MA entered the CAFB traffic pattern for its first touch-and-go landing. Shortly after touchdown, the bird went down the right side of the MA and struck near the right engine. The MA ingested parts of the bird into the right engine while in military power (MIL). Following the bird strike, the MSP reacted by retarding the throttles to idle in an attempt to abort the takeoff. The MIP decided the aircraft was too fast to safely abort in the remaining runway and took control of the MA, immediately advancing the throttles to maximum afterburner (MAX). Upon liftoff from the runway, the MC recognized a loss of thrust in the right engine due to a compressor stall. The MC noticed that the exhaust gas temperature (EGT) for the right engine exceeded the upper limit and the compressor speed – measured in revolutions per minute (RPM) – was decreasing. The MC also heard the aural warning of “Engine, Engine” triggered by the high EGT.

The MIP then performed simultaneous actions while climbing away from the runway. He made three radio calls to coordinate with the Runway Supervisory Unit (RSU) to land on runway 31

center (31C) and attempted an alternate airstart on the right engine by cycling the right throttle out of afterburner range and back to MAX. The MIP performed these actions in the span of approximately 12 seconds. Immediately after the final radio call, the MA rolled sharply to the right and then back to the left. As the aircraft was rolling, the MC noted the stall warning indications – which include an aural warning and visual "STALL" indications – as well as 143 knots indicated airspeed. While the MA was in a left bank, the MIP initiated a low-altitude ejection. The MC ejected safely and sustained only minor injuries. The MA impacted the ground at a low angle and airspeed only 5 seconds after MC initiated ejection.

I find by a preponderance of the evidence two causes led to the destruction of the MA. First, a bird strike in conjunction with rapid throttle movements caused a compressor stall, thus significantly reducing the thrust of the right engine during a critical phase of flight, a touch-and-go landing. Second, the MIP failed to execute immediately the critical procedure (BOLDFACE) for a single-engine go-around due to inadequate task prioritization. These actions aggravated the already reduced-thrust condition of the MA.

I also find by a preponderance of the evidence that each of the following factors substantially contributed to the mishap: 1) Fixation – The MIP first fixated on aircraft controllability concerns after the bird strike, and then on regaining thrust due to the compressor stall on the right engine. The MIP's fixation contributed to his inadequate prioritization of critical procedures; 2) Checklist Not Followed Correctly – The MIP failed to follow the appropriate checklist correctly. Once the MIP identified the loss of thrust condition in the right engine, he failed to follow through with the critical procedure (BOLDFACE) steps for a single-engine go-around. The MIP's fixation coupled with making untimely radio calls distracted him from properly analyzing his emergency and completing or following through with the correct procedures.

Although the MA's data transfer cartridge was destroyed in the crash and data could not be recovered, I developed my opinion by analyzing factual data, tangible evidence, engineering analyses, witnesses' testimonies, flight simulations, information provided by technical experts, technical orders, and applicable Air Force guidance and regulations.

2. CAUSE

a. Compressor Stall Malfunction Caused Limited Thrust

While performing a touch-and-go landing on runway 31R, the MA touched down approximately 1,500 feet down the runway at 08:19:25 hours local time. At approximately 2,800 feet down the runway and while still on the ground, the MA struck a bird on the right side and partially ingested it into the right engine. The bird remains were identified on the runway 1,300 feet from the MA's approximate touchdown point and in the right engine, as noted in the feather analysis report. After the bird strike and the MC's rapid throttle movements from MIL to idle to MAX, the right engine experienced a compressor stall, which significantly reduced the engine's thrust. Wreckage analysis of the right engine revealed that the engine sustained a compressor stall. Additionally, the MC testified seeing the engine compressor stall indications of decreasing engine compressor speed on the Engine Electronic Display (EED) and hearing the aural warning "Engine, Engine"

triggered by an EGT over-temperature condition. It is my opinion that the bird ingested into the right engine coupled with the MC's rapid throttle movement from MIL to idle to MAX, resulted in the subsequent compressor stall.

b. MIP Failed to Execute Critical Procedures Due to Inadequate Task Prioritization Causing Low Altitude Stall

The MIP had approximately 29 seconds from the bird strike until the ejection sequence was initiated in order to analyze the situation and take the proper action. He attempted an alternate airstart and made three radio calls without completing the single-engine go-around critical procedure (BOLDFACE). Due to his flawed prioritization of tasks, the MIP successfully completed only the first step of the single-engine go-around BOLDFACE: "THROTTLE(S) – MAX." He failed to complete the remaining steps: "FLAPS – 60%" and "AIRSPEED – ATTAIN FINAL APPROACH SPEED MINIMUM". If the MIP had correctly prioritized his actions, he could have completed these critical procedures. For example, if the MIP had waited to accomplish the radio calls on the downwind portion of the pattern, he would have eliminated an unnecessary task during the low-altitude emergency. The MIP failed to reduce the drag on the thrust-limited MA and failed to maintain the proper airspeed due to inadequate task prioritization, thus causing the aircraft to stall at a low altitude.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

a. Substantially Contributing Factor 1 [PC102 Fixation]

Upon touchdown, the MA experienced a bird strike. Soon afterward, the MIP took control of the aircraft, advanced the throttles to MAX, and initiated a climb. He stated his initial concern at this point was aircraft controllability. While the MIP fixated on options to determine aircraft controllability, and within seconds after liftoff, the MSP verbalized the right engine was winding down. The MC turned their focus to the EED and confirmed the right engine was in a compressor stall condition with engine RPM decreasing and EGT exceeding the upper limit. This sudden change to the MIP's perception (i.e. from a perceived flight control malfunction to a loss of thrust in the right engine) caused him to channelize his attention on trying to regain thrust. Although the right engine was stalled and not shut down, the MIP attempted an alternate airstart by retarding the right throttle out of the afterburner range and back to MAX. Based on engine analysis, the left engine and left afterburner section were working normally, however the left engine was in approximately minimum afterburner (MIN AB) on impact. The MIP does not recall retarding the left throttle below MAX, but it is my opinion that when he manipulated the right throttle for the alternate airstart while using the UHF/VHF push-to-talk microphone switch on the right throttle, he inadvertently pulled the left throttle out of MAX to MIN AB. This further limited the combined engine thrust in an already thrust-limited situation. This fixation on regaining right engine thrust distracted from properly assessing airspeed and configuration, which contributed to the MA entering a stall.

b. Substantially Contributing Factor 2 [AE102 Checklist Not Followed Correctly]

Although the MIP stated that the single-engine go-around BOLDFACE guided his actions during the mishap, he failed to complete it due to fixation and failure to prioritize critical tasks. Wreckage analysis revealed the landing gear was down, the flaps were 100%, and the left engine was in a minimum afterburner setting despite normal engine function. By completing the single-engine go-around BOLDFACE as outlined previously, the MIP would have reduced the drag on the MA and maximized available thrust, allowing the MA to clear all obstacles and accelerate to a safe airspeed.

4. CONCLUSION

I find by a preponderance of the evidence that the MA experienced a bird strike in the right engine which, combined with subsequent large and rapid throttle movements by the MC, caused a compressor stall, significantly reducing aircraft thrust during a touch-and-go. Additionally, the MIP failed to execute the critical tasks because of inadequate prioritization, which were required to safely climb and accelerate the aircraft. The combination of the compressor stall and MIP actions caused the aircraft to stall at low altitude and crash. The substantially contributing factors include the MIP's initial fixation on aircraft controllability concerns after the bird strike and subsequent fixation on regaining thrust when he was alerted to the compressor stall in the right engine. Additionally, when the MIP identified the loss of thrust in the right engine, he failed to follow the single-engine go-around checklist correctly.

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21 December 2018

DAVID B. LOWE, Colonel, USAF
President, Accident Investigation Board

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