UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

T-38C, T/N 68-8152

87TH FLYING TRAINING SQUADRON
47TH FLYING TRAINING WING
LAUGHLIN AIR FORCE BASE, TEXAS

LOCATION: Laughlin AFB, Texas

DATE OF ACCIDENT: 13 November 2018

BOARD PRESIDENT: Brigadier General James R. Sears, Jr.

Conducted IAW Air Force Instruction 51-503

United States Air Force Accident Investigation Board Report

Class A Mishap, Laughlin AFB, TX

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION

T-38C, T/N 68-8152
Laughlin AFB TX
13 November 2018

On the night of 13 November 2018, mishap instructor pilot 1 (MIP1) and mishap instructor pilot 2 (MIP2), flying T-38C tail number (T/N) 68-8152, assigned to 87th Flying Training Squadron, 47th Flying Training Wing, Laughlin Air Force Base (AFB), Texas (TX), conducted a routine training sortie at Laughlin AFB with MIP1 as the pilot in command. During the sortie, at approximately 1924 local time, the mishap aircraft (MA) impacted the ground and MIP1 was fatally injured during an ejection attempt.

The mishap mission was planned and authorized as an instructor development sortie to regain rear cockpit night landing currency for MIP2. During the takeoff portion of MIP2's fifth practice touch-and-go landing at Laughlin AFB, as MIP2 advanced the throttles for takeoff, the mishap crew (MC) heard a loud buzz later determined to indicate a compressor stall in the right engine. MIP1, the aircraft commander, took control of the aircraft and continued the takeoff. MIP1 did not select maximum afterburner as the MA rolled, yawed, and drifted to the right of the runway, failing to accelerate appreciably. While continuing the takeoff, MIP1 failed to recognize aural and visual aerodynamic stall warnings and lost situational awareness regarding the MA's ground track and low height above the ground. MIP1 regained awareness when the MA was close enough to the terrain to illuminate the ground approximately one second before the MA touched down off the runway surface. MIP1 initiated a climb approximately three seconds later and commanded ejection. The MC initiated ejection at approximately 147 knots indicated airspeed, 45 degrees of right bank, with approximately 500 feet per minute descent rate. The MA impacted the ground approximately 350 feet right of the paved runway surface. MIP2 successfully completed the ejection with minor injuries. MIP1 was fatally injured when the MA impacted the ground before MIP1's ejection seat completed the ejection sequence.

The Accident Investigation Board (AIB) President found by a preponderance of evidence the cause of the mishap was the combination of: (a) an engine compressor stall during a critical phase of flight and (b) MIP1's failure to apply necessary throttle and flight control inputs following a loss of thrust on takeoff. Additionally, the AIB President found by a preponderance of evidence that each of the following factors substantially contributed to the mishap: (a) the low illumination the night of the mishap and (b) MIP1's misperception of the rapidly evolving emergency after taking control of the MA.

United States Air Force Accident Investigation Board Report

Class A Mishap, Laughlin AFB, TX

SUMMARY OF FACTS AND STATEMENT OF OPINION
T-38C, T/N 68-8152
13 November 2018

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ACRONYMS AND ABBREVIATIONS

AB	Afterburner
ABU	Automatic Backup Unit
ACDE	Aircrew Chemical Defense Ensemble
ACFT	Aircraft
ACMI	Air Combat Maneuvering Instrumentation
ADO	Assistant Director of Operations
ADU	Automatic Deployment Unit
AETC	Air Education and Training Command
AETCI	AETC Instruction
AETCMAN	AETC Manual
AF	Air Force
AFB	Air Force Base
AFE	Aircrew Flight Equipment
AFFTC	Air Force Test Center
AFGM	Air Force Guidance Memorandum
AFI	Air Force Instruction
AFLCMC	Air Force Life Cycle Management Center
AFMAN	Air Force Manual
AFPET	Air Force Petroleum Office
AFRL	Air Force Research Laboratory
AFSAS	Air Force Safety Automated System
AFSEC	Air Force Safety Center
AFTO	Air Force Technical Order
AGE	Aerospace Ground Equipment
AGL	Above Ground Level
AM	Ante Meridiem
AO	Action Officer
APP	Approach
AR	Laughlin Arrival
ARMS	Aviation Resource Management System
ATC	Air Traffic Control
BIP	Buddy Instructor Program
BIT	Built-In-Test
BTRU	Barostatic Time Release Unit
BY46	BULLY46
BY53	BULLY53
BY63	BULLY63
BY88	BULLY88
BY92	BULLY92
BY97	BULLY97
C	Celsius
CAD	Cartridge Actuated Device
CAF	Combat Air Force
CAP	Capture
CAP	Capability
CBT	Combat
CC	Commander
CD	Deputy Commander
CD	Laughlin Clearance Delivery
CD	Compact Disk
CDI	Commander-Directed Investigation
CEA	Communications and Electronics Association
CERT	Certification
CES	Civil Engineering Squadron
CGO	Company Grade Officer
Comm	Commercial
CONDCT	Conduct
CRM	Cockpit/Crew Resource Management
CST	Central Standard Time
CT	Continuation Training
C/F	Carry Forward
DALR	Digital Audio Legal Recorder
DC	Direct Current
DD	Department of Defense
DDU	Drogue Deployment Unit
DIM	Dead Injured Missing
DLF	Laughlin AFB, Del Rio, TX
DL01	DEVIL01
DoD	Department of Defense
DSN	Defense Switched Network
EED	Emergency Evacuation Drill
EGT	Exhaust Gas Temperature
ELT	Emergency Locator Transmitter
EMER	Emergency
ENG	Engine
EO	Emergency Oxygen
EOC	Emergency Operations Center
EOD	Explosive Ordinance Disposal
EOT	Engine Operating Time

EP	Emergency Procedure
EQUIP	Equipment
ER	Exceptional Release
ERRC	Engine Regional Repair Center
ESN	Electronic Serial Number
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
FAIP	First Assignment Instructor Pilot
FAST	Fatigue Avoidance Scheduling Tool
FCF	Functional Check Flight
FCP	Front Cockpit
FCIF	Flight Crew Information File
FDP	Flight Duty Period
FERMS	Flight Equipment Records Management System
FLT	Flight
FOD	Foreign Object Damage
FTW	Flying Training Wing
G	Gravity
GE	General Electric
GOV	Government
GPS	Global Positioning System
GS	General Schedule
HBDU	Headbox Deployment Unit
HEEDS	Helicopter Emergency Egress Device
HFACS	Human Factors Analysis and Classification System
HHT	Hanging Harness Training
HIPAA	Health Insurance Portability and Accountability Act
HPO	Hourly Post-Flight Inspection
HPRU	Harness Powered Retraction Unit
HQ	Headquarters
Hrs	Hours
HUD	Head-Up Display
IAW	In Accordance With
ICNS	Integrated Chin and Nape Strap
ID	Instructor Development
ID	Identify
IDMS	Integrated Data Maintenance System
IFF	Introduction to Fighter Fundamentals
IGV	Inlet Guide Vane
ILS	Instrument Landing System
INDOC	Indoctrination
INST	Instructor
IO	Investigating Officer
IP	Instructor Pilot
IRC	Instrument Refresher Course
ISB	Interim Safety Board
ISS	Inter-seat Sequencing System
JA	Judge Advocate
Jan	January
JBSA	Joint Base San Antonio
JDRS	Joint Deficiency Reporting System
JOAP	Joint Oil Analysis Program
KCAS	Knots Calibrated Air Speed
KIAS	Knots Indicated Air Speed
LA	Legal Advisor
LAO	Local Area Orientation
LC	Laughlin Tower
LH	Left Hand
LND	Landing
LSEL	Life Sciences Equipment Laboratory
LVL	Level
MA	Mishap Aircraft
MAJCOM	Major Command
MAX	Maximum
MDP	Mission Display Processor
MDS	Mission Design Series
MED	Medical
MED	Medical Member
MEF	Mission Execution Forecast
MEP	Mission Essential Personnel
MFC	Main Fuel Control
MFD	Multi-Function Display
MFP	Main Fuel Pump
MIL	Military
MIP1	Mishap Instructor Pilot 1
MIP2	Mishap Instructor Pilot 2
MLG	Main Landing Gear
MOC	Maintenance Operations Center
MOR	Manual Over-Ride
MPI	Multi-purpose Initiator
MS	Mishap Sortie
MSD	Multiple Surface Distortion
MSN	Mission
MX	Maintenance
MXM	Maintenance Member
N	North

NAV	Navigation
NAVAIDS	Navigational Aid System
NDI	Non-Destructive Inspection
NCOIC	Non-Commissioned Officer in Charge
NM	Nautical Miles
NOTAM	Notice to Airmen
Nov	November
N/A	Not Applicable or Not Available
OFT	Operational Flight Trainer
OG	Operations Group
OGV	Operations Group Standardization and Evaluation Office
OPS	Operations
ORM	Operational Risk Management
ORM	Operational Risk Matrix
OSAR	Operations Suitability Assessment Report
OSAT	On-Sire Assessment and Training
OSS	Operations Support Squadron
OTC	Over-the-Counter
OVR	Over
NLG	Nose Landing Gear
PA	Public Affairs
PAD	Power Actuated Device
PARA	Parachute
PARCH	Parachute
PATT	Pattern
PCU	Power Control Unit
PCS	Permanent Change of Station
PE	Periodic Engine
PHA	Periodic Health Assessment
PIT	Pilot Instructor Training
PLB	Personnel Locator Beacon
PM	Pilot Member
PM	Post Meridiem
PMP	Professional Management Plan
PMP	Propulsion Modernization Program
POC	Point of Contact
PPE	Personal Protective Equipment
PQDR	Product Quality Deficiency Report
PRD	Pilot Reported Discrepancy
PRE	Precision
PREC	Precision
PROC	Procedure
PSI	Pounds per Square Inch
PTO	Power Take Off
PUB	Published
PWC	Pilot Weather Category
QUAL	Qualification
RAPCON	RADIO Approach Control
RC	Recorder
RCP	Rear Cockpit
REC	Recovery
RECOG	Recognition
RF	Radio Frequency
RFP	Rudder Force Producer
RH	Right Hand
RM	Risk Management
RPM	Revolutions per Minute
RSU	Runway Supervisory Unit
RTV	Room Temperature Vulcanization Silicone
RTD	Resistance Temperature Detector
SA	Situational Awareness
SAC	Survival Aids Container
SARM	Squadron Aviation Resource Management
SAS	Stability Augmenter System
SAYA	Stability Augmenter Yaw Actuator
SFS	Security Forces Squadron
SI	Seat Initiators
SIB	Safety Investigation Board
SIM	Subscriber Identity Module
SIM	Simulator
SE	Safety
SE	Single Engine
SERE	Survival, Evasion, Resistance, Escape
SFS	Security Forces Squadron
SN	Serial Number
SOAP	Joint Oil Analysis Program
SOF	Supervisor of Flying
SOS	Squadron Officer School
SOW	Statement of Work
SPO	System Program Office
SSK	Seat Survival Kit
STUD	Student
SUP	Supervisor
SURV	Survival
TCI	Time Change Item

TCTO	Time Compliance Technical Order
TDU	Time Delay Unit
TEU	Trailing Edge Up
TG77	TIGER77
TI	Theatre Indoctrination Training
TIMS	Training Integration Management System
T/N	Tail Number
TNG	Training
TO	Technical Order
TOLD	Take-off and Landing Data
TRNG	Training
TX	Texas
UCMJ	Uniform Code of Military Justice
UFCP	Up Front Control Panel
UND	Underwater
Unk	Unknown
UPT	Undergraduate Pilot Training
USAFA	United States Air Force Academy
USM	Unit Safety Monitor
USRM	Under-Seat Rocket Motor
UWARS	Universal Water Activated Release System
VCOA	Vertical Climb Over Airport
VDC	Volts Direct Current
VEN	Variable Exhaust Nozzle
VFR	Visual Flight Rules
VOR	Very High Frequency Omni-Directional Range
W	Witness
W	West
WG	Wage Grade
WL	Wage Leader
WS	Wage Supervisor
WST	Water Survival Training
W/	With
Y-SAS	Yaw Stability Actuating System
Z	Zulu

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, Laughlin AFB, TX

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 15 November 2018, Major General Mark E. Weatherington, the Air Education and Training Command (AETC) Deputy Commander, appointed Brigadier General James R. Sears, Jr. to conduct an aircraft accident investigation of a mishap that occurred on 13 November 2018 involving a T-38C aircraft, tail number (T/N) 68-8152 on Laughlin Air Force Base (AFB), Texas (TX) (Tabs Q-8 and Y-2). The investigation was conducted at Laughlin AFB from 7 January 2019 through 28 January 2019. The following board members were appointed: a Lieutenant Colonel Medical Member, a Lieutenant Colonel Pilot Member, a Major Legal Advisor, a Civilian Maintenance Member, and a Technical Sergeant Recorder (Tab Y-2 and Y-4).

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 the night of 13 November 2018, mishap instructor pilot one (MIP1) and mishap instructor pilot two (MIP2) flew a local training mission in a T-38C, tail number (T/N) 68-8152, assigned to the 87th Flying Training Squadron (FTS), 47th Flying Training Wing (FTW), Laughlin AFB, TX (Tabs K-3, Q-7 and Q-8). Shortly after touchdown on a touch-and-go, the aircrew heard a noise (Tab J-4). The mishap aircraft (MA) then experienced a four degree pitch up and a four degree right heading change followed by increasing angle of attack, right bank, and continuing right heading change (Tab J-4). The MA remained airborne for a short time, and then touched down in the grass approximately 55 feet from the edge of the runway, approximately 195 feet from runway centerline in an approximate heading of 13 degrees to the right of the centerline (Tab J-4). The right wheel touched down followed by the left wheel approximately 175 feet later (Tab J-4). The aircraft remained on the ground for an additional approximate 350 feet, approximately 525 feet total, before again becoming airborne over a shallow depression in the ground (Tab J-4). The MA impacted the ground approximately 605 feet later in an approximate 45 degree right bank angle (Tab J-4). The Mishap Crew (MC) initiated ejection (Tab J-25). MIP2 ejected successfully and received only minor injuries (Tab J-25). MIP1's sequenced ejection, however, was interrupted when the aircraft impacted the ground, and MIP1 was fatally injured (Tab J-25).

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). AETC, with headquarters at JBSA-Randolph, was established and activated in January 1942, making it the second oldest major command in the Air Force (Tab CC-2). 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 15,000 civilian personnel (Tab CC-2). The command also has more than 11,000 contractors assigned (Tab CC-2). AETC flies approximately 1,300 aircraft operating at 12 major installations and supports tenant units on numerous bases across the globe, encompassing 16 active-duty and seven Reserve wings (Tab CC-2).

b. 47th Flying Training Wing (47 FTW)

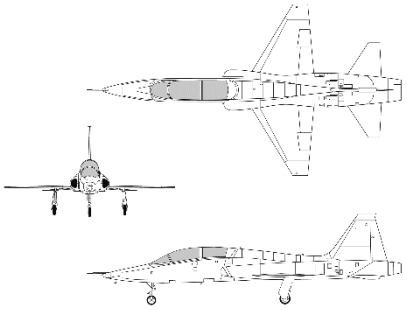
The 47 FTW's mission is to conduct specialized undergraduate pilot training for the United States Air Force, Air Force Reserve, Air National Guard and allied nation air forces utilizing the T-6A, T-38C, and T-1A aircraft while deploying mission-ready Airmen as well as developing professional, disciplined leaders (Tab CC-3). The 47 FTW commands a flying operation which exceeds 80,000 flying hours and 54,000 sorties per year (Tab CC-3). It is composed of more than 1,400 military personnel, 1,360 civilian employees, and a total base community exceeding 4,300 people (Tab CC-3).

c. 87th Flying Training Squadron (87 FTS)

The 87 FTS flies the T-38C Talon and provides students with advanced flight training in contact, formation, acrobatics, navigation, and instrument procedures for fighter fundamentals (Tab CC-4).

d. The T-38C Talon

The T-38C 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-5). The T-38C has swept wings, a streamlined fuselage, and tricycle landing gear with a steerable nose wheel (Tab CC-5). Two independent hydraulic systems power the ailerons, rudder, and other flight control surfaces (Tab CC-5). Critical aircraft components are waist-high and easily reached by maintenance crews (Tab CC-5).



AETC is the primary user of the T-38C for specialized undergraduate pilot training (Tab CC-5). The instructor and student sit in tandem on rocket-powered ejection seats in a pressurized, air-conditioned cockpit (Tab CC-5).

4. SEQUENCE OF EVENTS

a. Mission

On Tuesday, 13 November 2018, the MC was scheduled to fly a night, single-ship sortie (Tab K-3). MIP1 was the aircraft commander (Tab V-13.3). The flight was a T-38C instructor development sortie to obtain recurrency for MIP2 on rear cockpit nighttime landings (Tabs K-3, V-13.2, and V-16.3). The 87 FTS Operations Supervisor authorized the flight. (Tabs K-3 and DD-20).

b. Planning

MIP1 and MIP2 each flew one previous sortie on 13 November 2018 prior to the mishap sortie (MS) (Tabs K-3, R-4, and V-13.3). MIP1, the aircraft commander, briefed the sortie according to normal procedures (Tab V-13.3). The mission was planned and briefed as a night rear cockpit recurrency sortie with two instrument approaches followed by visual patterns until MIP2 felt comfortable with rear-cockpit landings (Tab V-13.3). The MC completed an operational risk management (ORM) matrix designed to identify risks for the MS and dictate varying approval authority (Tab AA-3 and AA-4). MIP2 assessed their risk being low with one point for less than seven hours of sleep and three points for nighttime (Tab AA-4).

c. Preflight

The Operations Supervisor briefed the pilots to use appropriate procedures for the weather conditions that night (Tabs V-13.3 and AA-2). The MC obtained takeoff data and MIP1 signed the flight authorization and filed a flight plan (Tabs K-2 to K-3 and V-10.3). Engine start was normal with the minor exception that the crew chief had to reset the diverter valve (Tabs N-2 and V-3.2). Such a diverter valve reset is a relatively routine start-up action. (Tab U-8).

d. Summary of Accident

MIP1 taxied at 18:39, checked the flight controls, then transferred aircraft control to MIP2 to check the flight controls (Tab N-2 and N-4). After being cleared for takeoff at 18:49, MIP2 positioned the aircraft on the runway, checked the engines, then selected afterburner as brakes were released for takeoff at 18:50 (Tabs N-4 and DD-15). MIP2 performed an Instrument Landing System (ILS) approach to a touch-and-go landing (Tab N-6). MIP1 demonstrated a visual pattern to a touch-and-go landing, followed by five more visual patterns with three touch-and-go landings by MIP2 and another visual pattern by MIP1 (Tab N-7 to N-11). MIP2 then assumed control of the aircraft at 19:21 and performed a visual pattern for MIP2's fifth touch-and-go and mishap crew's ninth approach (Tab N-6 to N-12).

At 19:23:48, the airplane touched down during a touch-and-go landing (Tab DD-15). The touch-and-go landing was routine with no indications of operational problems (Tab J-49). MIP2 advanced the throttles to military (MIL) power (Tab V-13.2). MIL is the power setting used for touch-and-go landings and corresponds to 100% rotational speed of the engine, referred to as revolutions per minute (RPM) (Tab DD-13). Maximum (MAX) power is the power setting that adds afterburner when the engine is already at 100% rotational speed, creating approximately 40% additional thrust (Tab DD-13). MAX is used for initial takeoff and any time additional thrust is needed (Tab DD-13).

As the engines were approaching MIL power at 19:23:52, the MC noted a loud noise and queried, "What's that?" with no verbal response identifying the sound (Tabs N-12, V-13.2, DD-15, and DD-16). This buzz lasted approximately one to one and a half seconds while the right engine rotational speed decreased from 97% to 66% and the Exhaust Gas Temperature (EGT) began to increase, indicative of a compressor stall and resulting in a loss of most of the thrust being provided by that engine (Tabs J-49, J-63, V-13.2, BB-13, and DD-13). As this was happening, at 19:23:53, the MA became airborne (Tab DD-16). MIP2's initial reaction was that the MA experienced a tire failure (Tab V-13.3). MIP2 momentarily reduced power at 19:23:54, then began to increase power towards MIL (Tabs V.13-5 and DD-16). The airplane yawed to the right four degrees and began to roll to the right, which led MIP2 to recognize this as a compressor stall (Tabs J-4 and V-13.4). MIP1, the pilot in command, took control of the aircraft at 19:23:54.5 and continued to advance power to MIL power (Tabs V-13.5 and DD-16). Figure 1 shows the parameters approximate to when MIP1 assumed control of the aircraft (Tab Z-5). The left engine operated normally until impact (Tab J-50). The right engine never stabilized and continued to oscillate between 65% and 93% RPM with three momentary over temperature indications (Tabs J-50 and DD-16).

Figure 1 - MIP1 Assumes Control of Aircraft (Approximate) (Tab Z-5)

At 19:23:55.1, MIP2 noted a right bank and moved the stick to the left, but MIP1 reiterated that he had control of the aircraft (Tabs V-13.3 and DD-17). At 19:23:56, aural, head-up display (HUD), and multi-function display (MFD) stall indications began and continued for the next four seconds as the aircraft continued to roll to the right (Tab DD-17). According to the Global Positioning System (GPS), at 19:23:57.9, the MA drifted over the edge of the runway with approximately 20 degrees angle of bank and 13 degrees off runway heading as shown in Figure 2 (Tabs Z-6 and DD-18). The landing light illuminated the grass at approximately 19:23:58.9, which coincides with MIP1 exclaiming "Dude" and making a small correction to bring the bank angle of the aircraft back to 8 degrees, but the MA returned to 12 degrees of bank to the right (Tabs V-13.4 and DD-18). Throughout this time, the MA failed to accelerate appreciably, the aerodynamic stall warning continued, and the maximum height reached was less than 10 feet above ground level (AGL) (Tab DD-18).

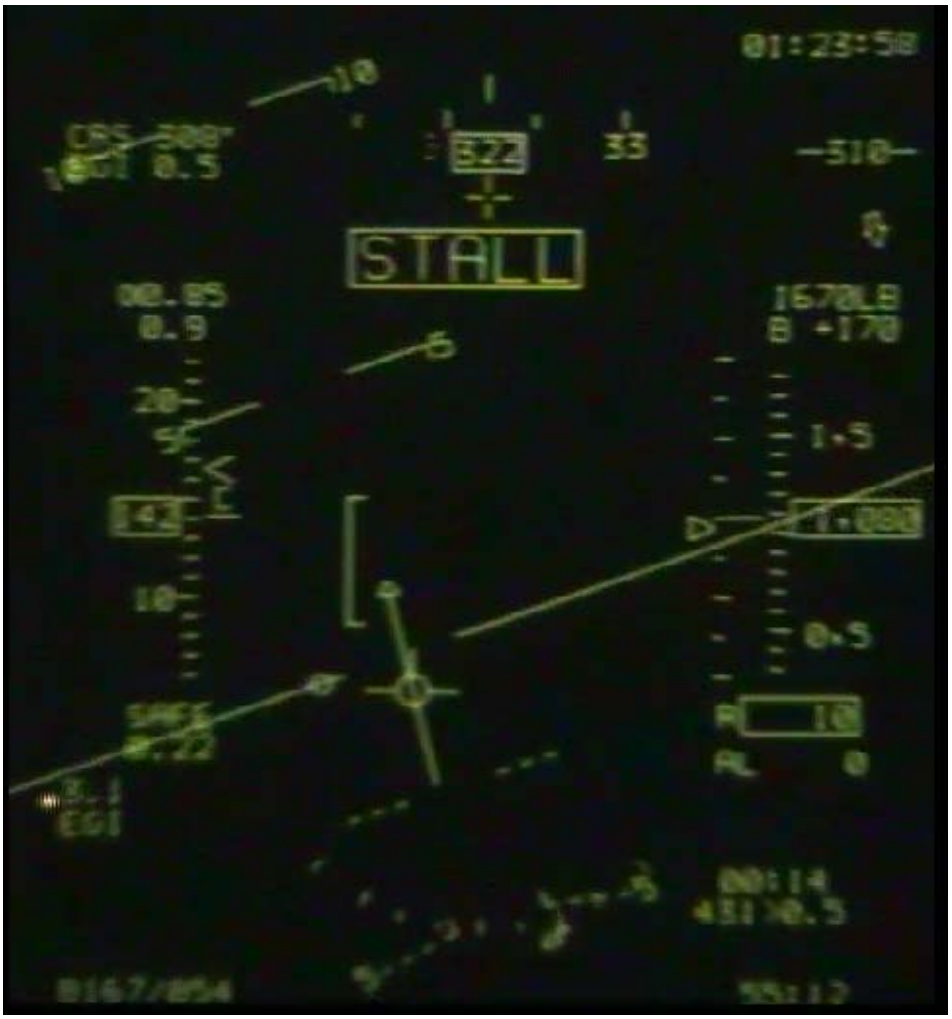


Figure 2 - Aircraft Overflying Edge of Runway (Tab Z-6)

At 19:24:00, the aircraft touched down on the grass approximately 55 feet from the runway surface as shown in Figure 3, with the right tire first, followed by the left tire approximately 175 feet later, which leveled the wings, travelling approximately 13 degrees off runway heading (Tabs J-4, Z-7, and DD-18). The MA's high pitch and the landing light's downward angle when airborne limited the illumination of the ground until sufficient bank and proximity allowed the MC to see the grass (Tab DD-18). The MA traveled approximately 350 feet more during which time the aerodynamic stall warning subsided as MIP1 relaxed aft stick pressure (Tab DD-19). At 19:24:01.5, MIP1 pitched up the nose, and the left engine went to MAX power at 19:24:02.0 (Tab DD-18 to DD-19). This was the first selection of MAX power on either engine since the compressor stall (Tab DD-19). The MA became airborne at 19:24:02.5 (Tab DD-19).

Figure 3 - Aircraft Touchdown in Grass (Tab Z-7)

At 19:24:03.2, as the aircraft reached its maximum pitch, MIP1 commanded ejection (Tab DD-19). Simultaneously, the MA reached full aerodynamic stall and rolled to the right as the nose dropped (Tab DD-19). The MA angle of attack indicates that MIP1 released the stick as he finished commanding ejection approximately one second later (Tab DD-19). Figure 4 shows the parameters of the aircraft at 19:24:04.9, immediately prior to ejection and impact, with a slightly nose low attitude, 45 degrees of right bank, a descent rate of 500 feet per minute, and an airspeed of 147 knots (Tabs Z-8 and DD-19). The MC initiated ejection (Tab J-25). MIP2 successfully ejected and sustained minor injuries (Tab J-25). However, impact interrupted MIP1's ejection sequence after the canopy departed but before the forward seat ejected (Tab J-25 and J-40).

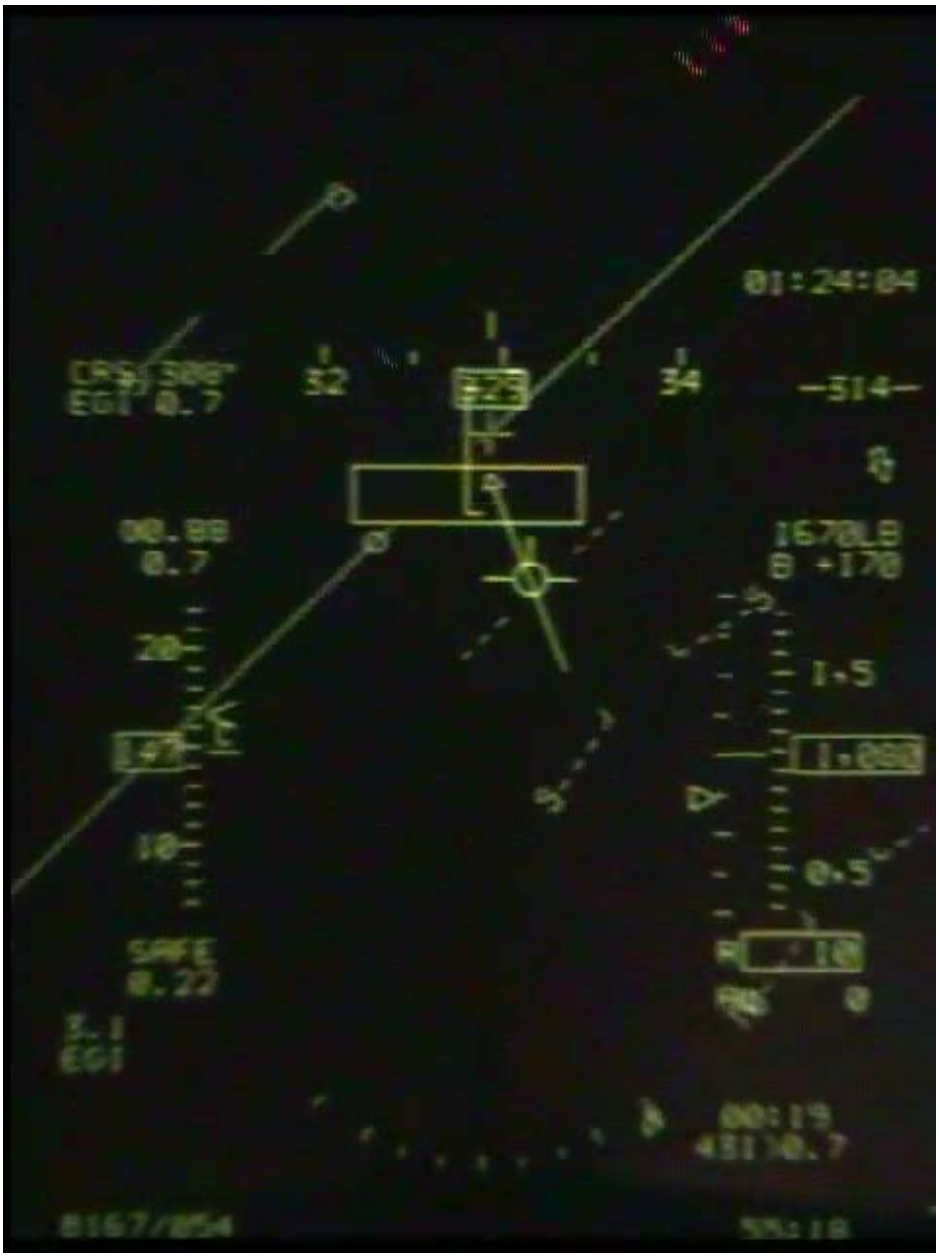


Figure 4 - Parameters prior to Ejection and Impact (Tab Z-8)

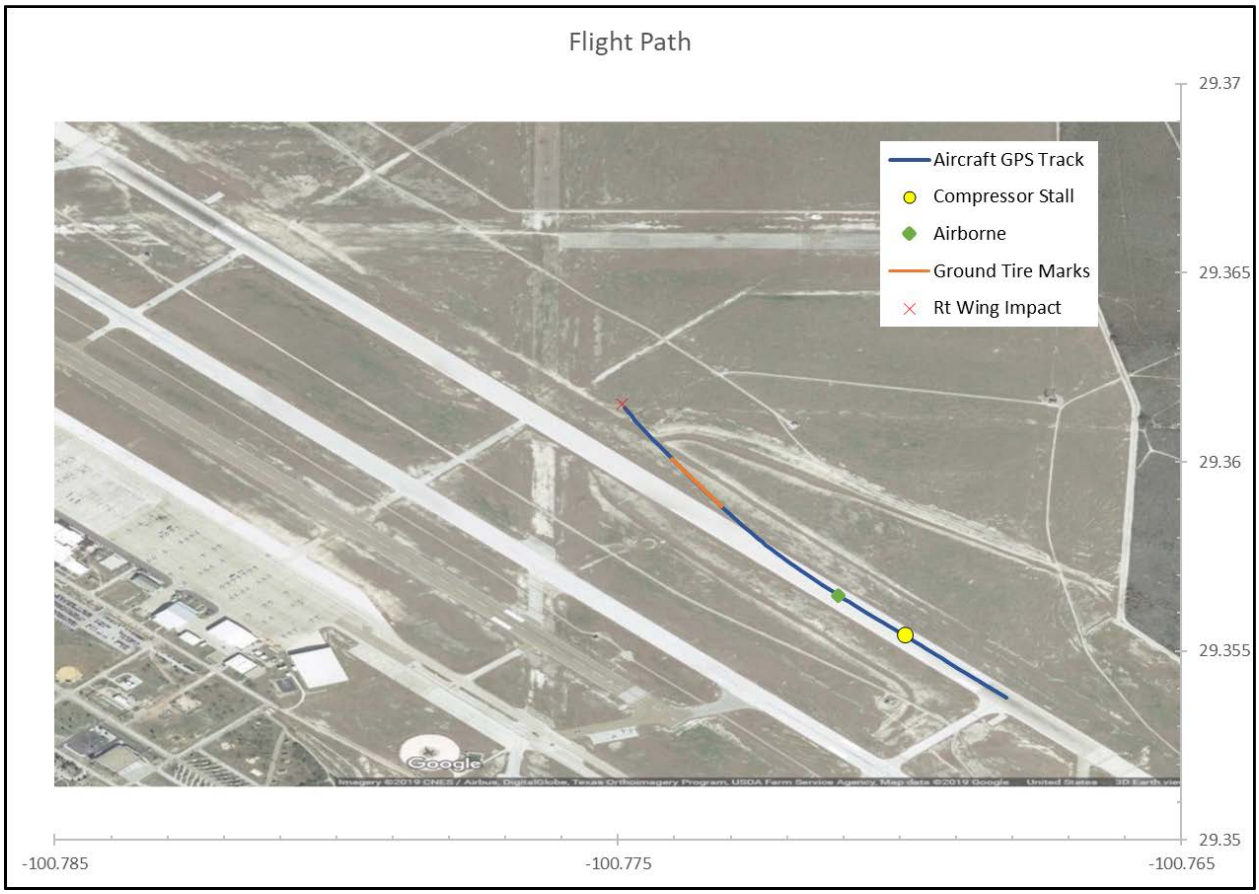


Figure 5 - Flight Path (Tab Z-4)

e. Impact

At approximately 19:24:05, with the approximate parameters of seven degree nose low at 145 knots with 45 degrees of right bank and approximately 350 feet right of the runway surface (approximately 500 feet from runway centerline), the aircraft's right wing impacted a relatively level grassy field, immediately followed by the right tire, separating the wing assembly, and rolling the fuselage (Tabs J-5 and DD-19).

f. Egress and Aircrew Flight Equipment (AFE)

The MC set the MA's Inter-seat Sequencing System (ISS) in the BOTH position (Tab J-33). When the ISS is in the BOTH position, the ejection sequence will follow these steps under normal circumstances: 1) either pilot pulls the ejection handle, 2) the rear cockpit canopy jettisons, 3) the rear seat catapult fires 0.4 seconds later, 4) the front canopy jettisons at 0.85 seconds after ejection is initiated, 5) the front seat catapult fires 0.4 seconds later, and 6) the front seat leaves the aircraft (Tab J-26 to J-28). The ejection sequence is the same regardless of which pilot initiates ejection (Tab J-26). The entire sequence lasts 1.3 seconds from initiation of the ejection to the front seat leaving the aircraft (Tab J-28).

MIP2 pulled the rear cockpit (RCP) ejection handle, but engineering analysis was unable to ascertain whether MIP1 also pulled the front cockpit (FCP) ejection handle or if impact dislodged the handle (Tab J-34 and J-36). Specialists analyzed the ejection and determined that the rear cockpit (MIP2) ejected normally (Tabs J-34 to J-36). Further analysis showed the front seat ejection sequence (MIP1) was also normal until after the front cockpit canopy departed, but before the front seat catapult fired 0.4 seconds later (Tab J-27 and J-34 to J-36). Analysis revealed the front seat catapult would have functioned properly; however, impact with the ground interrupted the remaining ejection sequence (Tab J-27, J-34, J-36 to J-38 and J-40).

The MA was not within the parameters required for successful completion of the ejection sequence due to the descent rate and bank angle at the time of ejection (Tab DD-13).

MIP1 and MIP2's AFE performed adequately and did not contribute to any injuries (Tab J-127). At the time of the mishap, all AFE inspections were current (Tab DD-2 to DD-11).

MIP1 and MIP2 each had a Personnel Locator Beacon (PLB), which transmits an Emergency Locator Transmitter (ELT) signal when it functions properly (Tab J-112 to J-113 and J-123). Two aviators, who were airborne at the time of the mishap, reported an ELT signal (Tab J-123). The air traffic control (ATC) tower did not hear an ELT signal (Tab J-123). MIP1's PLB activation lanyard was broken, which prevented MIP1's PLB from transmitting an ELT signal (Tab J-112 to J-113). Post-mishap engineering analysis did not include determination of whether the lanyard was broken before or during the mishap sequence (Tab J-112 to J-113). MIP2's PLB passed all tests post-mishap (Tab J-123).

g. Search and Rescue (SAR)

A pilot in the ATC tower witnessed the mishap and immediately informed the ATC tower supervisor (Tab V-15.2). One of the air traffic controllers immediately initiated a conference call to inform other base agencies (Tab V-5.2). Airfield Management answered, followed by the Laughlin Fire Department (Tab V-5.2). The controller informed all parties available at 19:26 that a T-38C had slid off Runway 31R with two persons on board (Tab N-27 and V-5.2). The Fire Department dispatched units at 19:28 with units proceeding at 19:29 (Tab N-27). Due to the dark conditions, Fire Department personnel had difficulty finding the MA (Tab V-17.2). The Fire Department found the MA approximately seven minutes after dispatch and found MIP2 (Tab V-17.2). MIP2 was transported and treated at the local hospital for minor injuries (Tab X-2). At 19:46, the Incident Safety Officer found MIP1, recognized fatal injuries, and reported MIP1 was deceased (Tab N-30).

h. Recovery of Remains

At 19:46, MIP1 was found near the crash site at Laughlin AFB (Tab N-30). Laughlin AFB Security Forces personnel secured the area (Tab N-27). At approximately 20:39, the responding flight surgeon identified MIP1 as deceased (Tab DD-12). Later that evening, the Val Verde County Precinct Three Justice of the Peace responded to the scene because Laughlin AFB is not a federal jurisdiction (Tab DD-12). The Justice of the Peace inspected MIP1 and pronounced MIP1's death (Tab DD-12).

5. MAINTENANCE

a. Forms Documentation

There are two discrepancies between the active AFTO Form 781H and the historical AFTO Form 781H (Tab D-10 and D-55). The first discrepancy is the active AFTO Form 781H, Block 1 "FROM" should match the date in the historical AFTO Form 781H, Block 2 "TO," but the dates do not match (Tab D-10 and D-55). The second discrepancy is an incorrectly formatted "CARRY FORWARD" in Block 5 "ACCOMPLISHED BY" of the historical AFTO Form 781H (Tabs D-55 and U-8). There is no evidence to suggest that these minor transcription errors were factors in this mishap (Tab U-8).

The historical records do not reveal any recurring maintenance problems in the 90 days prior to the mishap (Tab U-8).

b. Inspections

The maintenance crew chief completed scheduled thruflight inspections on 13 November 2018, prior to the MS, in accordance with (IAW) AF TO 1T-38C-6WC-1, *Thruflight Workcards,* with no discrepancies noted (Tabs D-10 to D-11 and U-8).

A qualified crew chief collected 20-hour Joint Oil Analysis Program (JOAP) samples on 13 November 2018, prior to the MS (Tabs U-8 and V-3.2). A non-destructive inspection (NDI) noted no discrepancies in the samples (Tabs U-4, U-6, and V-3.2). At the time of the JOAP inspections, the MA had 16,743.4 total flight hours (Tab D-10). All scheduled inspections were completed according to standards and documented IAW applicable technical data (Tab U-8).

c. Maintenance Procedures

There is no evidence to suggest that maintenance procedures were a factor in this mishap (Tab U-8). The historical records do not reveal any recurring maintenance problems in the 90 says prior to the mishap (Tab U-8).

d. Maintenance Personnel and Supervision

There is no evidence to suggest that maintenance personnel or supervision were factors in this mishap (Tab U-8). All personnel who performed maintenance on the MA in the 90 days prior to the mishap were qualified to perform their duties (Tab U-8).

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

Fuel, hydraulic, oil, and oxygen inspection analyses from the MA revealed no abnormalities relevant to this mishap (Tab U-8).

f. Unscheduled Maintenance

The T-38C requires external pneumatic pressure to start the engines on the ground (Tab U-8). Although considered a relatively routine start-up action and not maintenance, during engine start for the MS, a maintenance professional manually reset the diverter valve (Tabs N-2, U-8, and V-3.2). The diverter valve is attached to the left engine and only functions to direct the pneumatic pressure during initial engine start on the ground (Tab U-8). The diverter valve directs external pneumatic pressure to start the right engine (Tab U-8). The maintainer then manually rotates the diverter valve to direct pneumatic pressure to start the left engine (Tab U-8). Once the engines have started and the external air hose is removed from the aircraft, the diverter valve has no further function during engine operation (Tab U-8). There is no evidence to suggest this was a factor in the mishap (Tab U-8).

6. AIRFRAME SYSTEMS

a. Structures and Systems

A post-accident engineering analysis indicated the right engine encountered an anomaly that caused the engine speed to drop and exhaust gas temperature (EGT) to rise (Tab J-63). The buzz, drop in speed, and rise in EGT are all indicative of a compressor stall (Tab DD-13).

An engine compressor stall is a disruption of air flow through the compressor section of the engine (Tabs DD-22 and DD-24). In the course of this mishap, the right engine experienced a decrease in RPM from 97% to 66%, which corresponds to a loss of thrust (Tabs J-49, V-13.2, and DD-13). Compressor stalls are more common in high performance aircraft like the T-38C with axial flow engines which balances maximum performance with an acceptable compressor stall margin (Tab DD-24). The following factors decrease the compressor stall margin and may lead to a compressor stall (Tab DD-24):

i. Engine structural failure
ii. Foreign object damage (FOD)
iii. Incorrect fuel flow trim
iv. Engine nozzle mis-scheduling
v. High aircraft angles of attack at low airspeeds
vi. Low compressor inlet temperatures
vii. Maneuvering flight
viii. Unusual flight attitudes
ix. Atmospheric variations
x. Jet wash
xi. Temperature and pressure distortion

Some of these potential causes can be ruled out as the cause of the compressor stall in this mishap (Tab DD-24 to DD-26. There were no skid marks or damage to the runway and no obvious signs of large FOD hazards (Tab J-49). A post-mishap engineering engine analysis stated there was no indication of structural disk failure, no indication of FOD, and all damage appeared to be caused

by the impact (Tab J-57). Although engine tear down and analysis could not determine the exact cause of the compressor stall, there is no evidence that a mechanical issue caused the compressor stall in this mishap (Tabs J-63 and U-8).

Although evidence does not point to a single factor, there were a number of factors which would have decreased the stall margin and when combined could have resulted in a compressor stall (Tab DD-25). The aircraft was at a moderate angle of attack with a low airspeed (Tab DD-25). The temperature that evening was mildly cold and decreased the temperature at the compressor inlet (Tab DD-25). Additionally, there may have been any combination of atmospheric variations, jet wash, and temperature or pressure distortions (Tab DD-25). Although not definitive, each of these possible factors may have combined to lower the stall sensitivity past the critical point for compressor stall (Tab DD-25).

Table 1 shows those factors that have no evidence to suggest they contributed and those factors, which were present and could have contributed to a compressor, stall (Tab DD-26):

Factors which can reduce the stall margin and contribute to compressor stalls	No evidence to suggest contributed	Possibly contributed
Engine structural failure	X	
Foreign object damage (FOD)	X	
Incorrect fuel flow trim	X	
Engine nozzle mis-scheduling	X	
High aircraft angles of attack at low airspeeds		X
Low compressor inlet temperatures		X
Maneuvering flight	X	
Unusual flight attitudes	X	
Atmospheric variations		X
Jet wash		X
Temperature and pressure distortion		X

Table 1 (Tab DD-26)

With the exception of the compressor stall, there is no evidence to suggest that other structures and systems were factors in this mishap (Tab U-8).

b. Evaluation and Analysis

There is no evidence to suggest that any data retrieved from evaluation and analysis were factors in the mishap (Tab U-8).

c. Simulator Replication

The AIB conducted multiple events simulating the touch-and-go landing, subsequent compressor stall, and different courses of action in the T-38 Operational Flight Trainer (OFT) (Tab DD-21). The aircraft was fully recoverable every time the AIB applied MAX power and raised the flaps to 60% in accordance with the first two steps of the single-engine go-around checklist (Tab DD-22). At no time was the takeoff recoverable in the simulator without using MAX thrust (Tab DD-22). However, leveling the wings with aileron only while using MIL thrust did provide more time for the MC to analyze the situation before the aircraft impacted rising terrain to the right of the runway (Tab DD-22). The aircraft was recovered on multiple attempts when the board selected MAX (afterburner) and rolled wings level at the same time stall indications were experienced by MIP1 after taking the MA (Tab DD-22). Each of these attempts was performed with only the left engine in afterburner and full flaps remaining down throughout the stall recovery (Tab DD-22).

7. WEATHER

a. Forecast Weather

On 13 November 2018, forecast weather for the time of the MS was clear skies, unrestricted visibility, winds out of the north at eight knots, temperature 6 degrees Celsius, density altitude of negative 387 feet, with no precipitation (Tab F-5). A waxing crescent moon was projected to provide 33% lunar illumination (Tab W-2).

b. Observed Weather

Observed weather near the time of the accident was clear skies, unrestricted visibility, winds out of the north-west at seven knots, 5 degrees Celsius (41 degrees Fahrenheit), with an altimeter setting of 30.53 inches of mercury (Tab F-8). Witnesses noted that it was very dark that evening (Tab V-1.5, V-9.3, and V-15.4). MIP2 testified that there was no visible horizon when the runway lights were not in view and described approaching the runway as a “black hole” (Tab V-13.9).

c. Space Environment

Not Applicable

d. Operations

The MA was operating within prescribed weather requirements (Tab DD-13). However, low compressor inlet temperatures and/or high angles of attack at low airspeeds can increase stall sensitivity and decrease the compressor stall margin (Tab DD-13).

8. CREW QUALIFICATIONS

a. Mishap Instructor Pilot 1

MIP1 was a qualified T-38C instructor pilot (Tab G-43). A review of MIP1’s training record

revealed normal progression, including emergency procedures (Tab DD-23). MIP1 had six inflight evaluations in the T-38C, all of which demonstrated desired performance and knowledge of procedures, equipment and directives within tolerances specified (Tab G-43). The only discrepancy noted on any of the six evaluations was the initial instructor evaluation in January 2016 for Flight Leadership where MIP1's performance delayed mission accomplishment (Tab G-54). MIP1 received a commendable grade on MIP1's most recent instrument/qualification evaluation for navigation (Tab G-47).

MIP1 was current in all flight events with the exception of night rear cockpit landings and low-level currency (Tab T-2 to T-4). MIP1 was current and qualified to instruct night rear cockpit landings from the front cockpit (Tab DD-23). MIP1's total flight time in the T-38C was 1156.2 hours with 906.8 hours of instructor time and 41.0 hours of night time (Tab G-7).

On the day of the mishap, MIP1's recent flight time in the T-38C was as follows (Tab G-7):

	Hours	Sorties
30 days	26.8	26
60 days	62.4	58
90 days	98.8	91

MIP1's most recent flight prior to the mishap was earlier that day on 13 November 2018 (Tab G-24). Prior to the date of the mishap, MIP1's most recent night landing was on 14 August 2018 and most recent night rear cockpit landing was on 18 July 2018 (Tab T-3 to T-4). MIP1's last emergency procedure simulator was on 21 June 2018 (Tab T-4).

b. Mishap Instructor Pilot 2

MIP2 was a qualified T-38C instructor (Tab G-57). MIP2 obtained initial instructor and mission qualification in the T-38C in March 2018 (Tab G-58). A review of MIP2's training records showed no deficiencies and every sortie was noted as "Average" or "Above Average" (Tab DD-23). MIP2 had two flight evaluations in the T-38C, both of which demonstrated desired performance and knowledge of procedures, equipment and directives within tolerances specified with no discrepancies noted (Tabs G-57).

MIP2's training transcript reflected currency in all flight events with the exception of night rear cockpit landings (Tab T-5 to T-7). However, at the time of this mishap, MIP2's most recent crew/cockpit resource management (CRM) class was on 13 September 2017 (Tab T-6). Air Force Instruction 11-2T-38V1, *T-38 Aircrew Training*, published on 1 September 2017, requires this training every 12 months (Tab BB-16). This training was not relevant to the MS as this ground training is tailored to the instructor role and interactions with students rather than the MS with two instructors (Tab DD-23).

MIP2's total flight time in the T-38C was 376.7 hours with 236.7 hours of instructor time and 4.6 hours of night time (Tab G-28).

On the day of the mishap, MIP2's recent flight time in the T-38C was as follows (Tab G-28):

	Hours	Sorties
30 days	36.4	38
60 days	69.6	68
90 days	120.7	114

MIP2's most recent flight prior to the mishap was earlier that day on 13 November 2018 (Tab G-42). His most recent night rear cockpit landing was on 17 July 2018 and his last emergency procedure simulator was 24 October 2018 (T-6).

9. MEDICAL

a. Qualifications

At the time of the mishap, MIP1 and MIP2 were medically qualified for flying duty (Tab X-2).

b. Health

MIP1 and MIP2 had no pre-existing medical conditions that impacted the outcome of the mishap (Tab X-2). MIP1 was fatally injured as a result of the mishap (Tab X-2). An autopsy revealed cause of death was multiple blunt force injuries (Tab X-2). MIP2 sustained minor injuries on ejection from the MA (Tab X-2). MIP2 received treatment at a local hospital (Tab X-2).

c. Pathology

MIP1's post-mortem toxicological testing was negative (Tab X-2). MIP2's post-mishap toxicological testing was negative (Tab X-2).

d. Lifestyle

There is no evidence to suggest lifestyle factors were relevant to the mishap (Tab X-2).

e. Crew Rest and Crew Duty Time

Crew rest and crew duty time requirements are detailed in AFI 11-202v3, *General Flight Rules* (Tab BB-2 to BB-6). Crew rest is compulsory for aircrew members prior to performing any duties involving aircraft operations and is a minimum of 12 non-duty hours before the flight duty period (FDP) begins (Tab BB-5). Crew rest is free time and includes time for meals, transportation, and rest (Tab BB-5). The MC had more than 72 hours of crew rest prior to the mishap FDP (Tabs R-4 to R-9 and T-9 to T-13).

Crew rest time must include an opportunity for at least eight hours of uninterrupted sleep (Tab BB-5). Aircrew members are individually responsible to ensure they obtain sufficient rest during a

crew rest period (Tab BB-5). While MIP1 had an opportunity for at least eight hours of uninterrupted sleep, MIP1 indicated he had obtained less than seven hours of sleep the night prior to the mishap (Tabs V-13.4 and AA-4). MIP2 had obtained approximately nine hours of sleep the night prior to the mishap (Tab T-9). Fatigue modeling using the Fatigue Avoidance Scheduling Tool (FAST) suggested that MIP1 and MIP2 were adequately rested at the time of the mishap and fatigue did not likely affect their reaction time or decision-making abilities (Tabs X-2 and Z-2 to Z-3).

Squadron commanders must ensure planned FDP timelines do not exceed 10 hours for dual continuation training sorties in T-38C aircraft when any portion of the training will occur at night (Tab BB-3 and BB-8). MIP1 reported for duty at approximately 10:50 on the day of the mishap, so his FDP at the time of the mishap was less than nine hours (Tab R-5). FAST modeling suggested that MIP1 was likely nearing a peak in alertness at the time of the mishap with an estimated effectiveness of 96.52 percent (Tabs X-2 and Z-2). MIP2 reported for duty at approximately 14:00 on the day of the mishap, so MIP2's FDP at the time of the mishap was less than six hours (Tab T-8 to T-9). FAST modeling suggested that MIP2 was likely near a peak in alertness at the time of the mishap with an estimated effectiveness of 84.20 percent (Tabs X-2 and Z-3).

10. OPERATIONS AND SUPERVISION

a. Operations

Operations tempo was normal with a moderately aggressive schedule, but instructors would not perform three flights or flight related duties within a single FDP on a regular basis (Tab V-4.2). The AIB found no evidence to suggest that operations tempo or other operational conditions were factors in this mishap (Tab DD-20).

b. Supervision

The AIB found no evidence to suggest that supervision was a factor in this mishap (Tab DD-20).

11. HUMAN FACTORS ANALYSIS

a. Introduction

Human factors describe how our interaction with tools, tasks, working environments, and other people influence human performance (Tab BB-25). Human factors are the leading cause of Department of Defense (DoD) mishaps (Tab BB-25). The DoD Human Factors Analysis and Classification System (DoD HFACS) Version 7.0 identifies human factors using HFACS codes and provides a template that organizes the human factors identified in a mishap investigation (Tab BB-25).

b. AE102 Checklist Not Followed Correctly

HFACS Code AE102, Checklist Not Followed Correctly, 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-26).

Maintaining aircraft control is the most important part of any emergency (Tab DD-13). TO 1T-38C-1 states (Tab DD-13 to DD-14):

> When an emergency occurs, three basic rules are established that apply to most emergencies while airborne. They should be remembered by each aircrew member.
> 1. Maintain aircraft control.
> 2. Analyze the situation and take proper action.
> 3. Land as soon as practical.

If an engine operates abnormally or fails during flight, TO 1T-38C-1 advises pilots to reduce drag to a minimum and maintain airspeed and directional control while investigating to determine the cause (Tab DD-14). Single-engine directional control can normally be maintained at all speeds above stall (Tab DD-14). After the MA's right engine experienced a compressor stall, the MA rolled and yawed to the right (Tab J-49 and J-63). MIP1 did not apply throttle or stick and rudder inputs sufficient to maintain control of the MA, and at 19:23:57, the MA over-flew the side of the prepared surface (Tab DD-18).

The flight manual directs the single-engine go-around checklist any time thrust is questionable on takeoff and a decision is made to continue takeoff (Tab DD-14). The first two actions of the SINGLE-ENGINE GO-AROUND checklist are: **1. THROTTLE(S)-MAX, 2. FLAPS-60%** (Tab DD-14). Pilots are warned that continuing a takeoff on a single engine should be attempted only at maximum thrust (Tab DD-14). Pilots are warned that, with other than 60% flaps, single-engine capability is impaired to such an extent that the combination of temperature, pressure altitude, and gross weight may make takeoff impossible (Tab DD-14). MIP1 did not move throttles to MAX until 19:24:02, 10 seconds after hearing a noise and one second before commanding ejection (Tab DD-18 to DD-19). The MC did not raise flaps to 60% at any point during the emergency (Tab J-19).

After the MA took off following the compressor stall, a blinking boxed STALL indication on the HUD and MFD plus a modulated aural tone indicated that the MA was approaching an aerodynamic stall (Tab DD-17). In this situation, pilots are trained to execute a traffic pattern stall recovery (Tab BB-10). Stalls can be terminated by simultaneously moving throttles to MAX, relaxing backstick pressure, and rolling wings level (Tab DD-14). MIP1 did not move throttles to MAX or roll wings level as the stall indications continued (Tab DD-18).

c. PC504 Misperception of Changing Environment

HFACS Code PC504, Misperception of Changing Environment, is a factor when an individual misperceives or misjudges altitude, separation, speed, closure rate, road/sea conditions,

aircraft/vehicle location within the performance envelope or other operational conditions (Tab BB-28).

While both MIP1 and MIP2 had practiced emergency procedures for compressor stall scenarios, neither had previously experienced an actual compressor stall (Tabs N-3, V-13.5 and DD-23). The flight manual describes compressor stall indications at low altitude and high airspeed as follows: Pop, bang, or buzz with rapid engine rotational speed drop or high EGT (Tab DD-13). During a post-mishap interview, MIP2 noted that the sound he heard in the aircraft was not similar to the sound associated with compressor stalls during emergency procedure simulator training (Tab V-13.5). MIP2 stated that he initially identified the emergency as a blown tire rather than a compressor stall or engine problem (Tab V-13.2).

Touch-and-go landings are the only time the T-38C flight manual refers to a critical phase of flight (Tab DD-14). The slow airspeed, close proximity to the ground, and multiple tasks that must be accomplished during a touch-and-go landing increase the complexity of emergencies and limit the time available for applying critical procedures (Tab DD-14).

TO 1T-38C-1 advises that ejection is preferable to landing on an unprepared surface (Tab DD-14). The MA overflew the right side of the prepared surface at 19:23:57 and touched down in the grass at 19:24:00 (Tab DD-18). The MA landing light illuminated the grass in the field to the right of the runway approximately one second before the MA touched down (Tab DD-18). This is the first time there is any indication that MIP1 or MIP2 knew they were no longer over the runway surface and were so close to the ground (Tab DD-18). The MA remained on the ground until 19:24:02 (Tab DD-19). Neither crewmember commanded ejection until 19:24:03, six seconds after departing the runway and three seconds after touching down off the prepared surface (Tab DD-19).

d. PE101 Environmental Conditions Affecting Vision

HFACS Code PE101, Environmental Conditions Affecting Vision, is a factor that includes obscured windows; weather, fog, haze, darkness; smoke, etc.; brownout/whiteout (dust, snow, water, ash or other particulates); or when exposure to windblast affects the individual's ability to perform required duties (Tab BB-27).

Darkness limits pilots' ability to accurately perceive the external environment, contributing to visual illusions that can interfere with safe flight (Tab BB-17). Altitude and rate of descent are more difficult to judge close to the ground (Tab BB-11). Sloping or featureless terrain, sloping runways, varying runway widths, runway lighting intensity, and (or) weather phenomena can cause visual illusions at night (Tab BB-11). One well-known hazard occurs during take-off on dark, moonless or overcast nights where the terrain off the runway is devoid of ground lights and no horizon is discernable (Tab BB-18). As an aircraft lifts off into such a "black hole", pilots relying on external visual cues may fail to accurately assess their climb angle and proximity to terrain (Tab BB-18). During flight operations that rely upon external cues for guidance, misperception of the environment is more likely at night than during the day (Tab BB-17). Visual references and depth perception change with night operations (Tab BB-11).

Multiple times during the MS, the MC commented on the darkness of the airfield environment, both while taxiing with the landing light on and while airborne (Tab N-3, N-4, N-6, and N-7).

18:44:26	MIP1: "Me as well… I'm just here… It is […] dark out here dude."
18:44:36	MIP2: "I was gonna say dude, I'm not getting a ton of lume right now out of this, this thin quarter moon or whatever."
18:44:42	MIP1: "I-I've got this landing light out in front of me and I got [...] nothing dude. I can't see […]."
18:46:49	MIP2: "Yea, It's dark."
18:46:52	MIP1: "It's really dark dude."
19:00:48	MIP2: "Ooh buddy, man, that is, that is it is darker than usual."
19:00:50	MIP1: "I'm fine, I'm fine. It's freaking dark dude, it is really dark. It is mad dark, dude."
19:05:12	MIP1: "That's pretty late, dude…The uh, I don't see the light on top of that shack to be honest with you. That's what I was looking for."
19:05:22	MIP2: "Uh, I can't. Yea I can't really see anything out here."
19:05:23	MIP1: "That's true, dude."
19:05:25	MIP2: "But uh, oh well. I can't. I can't really see anything out here."

During a post mishap interview, MIP2 described the appearance of the runway environment on approach stating, "It's a black hole. It is – it is either way you slice it but off the perch you perch into a black hole" (Tab V-13.9). He also described the environment where the emergency occurred explaining that "once the nose points away from the runway there's no horizon out off [runway] 31" (Tab V-13.8). The MA's high pitch angle and its landing light's downward angle when airborne further limited the illumination of the ground until sufficient bank and proximity allowed the MC to see the grass (Tab DD-18).

13. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publicly Available Directives and Publications Relevant to the Mishap

(1) AFI 51-503, *Aerospace and Ground Accident Investigations,* dated 14 April 2015, Incorporating Change, dated 12 March 2018
(2) AFI 11-202V3, *General Flight Rules,* dated 10 August 2016
(3) AFI 11-2T-38V1, *T-38 Aircrew Training,* dated 1 September 2017
(4) AETCI 11-251V1. *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) TO 1T-38C-1, Flight Manual, USAF Series T-38C Aircraft, dated 8 March 2016, Incorporating Change, dated 5 October 2017
(2) AETC Student Guide, P-V4A-A-SO-EP, *T-38C Systems Analysis/Emergency Action Guide*, June 2018
(3) DoD Human Factors Analysis and Classification System 7.0
(4) Wilson, Dale R., "Darkness Increases Risks of Flight," Flight Safety Foundation, *Human Factors & Aviation Medicine,* November – December 1999; Vol. 46 No. 6: 1-8.

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12 March 2019

JAMES R. SEARS, JR.
Brigadier General, USAF
President, Accident Investigation Board

United States Air Force Accident Investigation Board Report

Class A Mishap, Laughlin AFB, TX

STATEMENT OF OPINION

T-38C, T/N 68-8152
Laughlin AFB, TX
13 November 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 the night of 13 November 2018, mishap instructor pilot 1 (MIP1) and mishap instructor pilot 2 (MIP2), flying T-38C tail number (T/N) 68-8152, assigned to Laughlin Air Force Base (AFB), Texas (TX), engaged in a routine training sortie at Laughlin AFB with MIP1 as the pilot in command. During the sortie, at approximately 19:24 local time, the mishap aircraft (MA) impacted the ground and MIP1 was fatally injured during an ejection attempt.

The mishap mission was planned and authorized as an instructor development sortie to regain rear cockpit night landing currency for MIP2. During the takeoff portion of MIP2's fifth touch-and-go landing (mishap crew's (MC) ninth approach) at Laughlin AFB, the MA experienced a compressor stall in the right engine. The MA initially experienced a four degree pitch up and a four degree right heading change, followed by continuing heading change. The MA remained airborne for a short time and then touched down approximately 55 feet from the runway surface (approximately 195 feet from runway centerline) in an approximate heading of 13 degrees to the right of the original runway heading. The MA remained on the ground for approximately 525 feet before again becoming airborne over a shallow depression in the ground. The MA impacted the ground approximately 605 feet later (350 feet right of the runway surface and 500 feet from runway centerline), seven degrees nose low, and at a 45 degree right bank angle.

During the takeoff portion of the touch-and-go, the mishap crew heard a loud buzz corresponding to the compressor stall. MIP2 momentarily reduced the power after the sound but then elected to continue to takeoff and increased the throttles toward military (MIL), non-afterburner power, corresponding to the power setting used for the takeoff portion of touch-and-go landings. MIP1 then took command of the aircraft and continued the takeoff without selecting maximum (MAX) afterburner, corresponding to maximum engine thrust, as the MA rolled and yawed to the right, drifted right of the runway, and failed to accelerate appreciably. As MIP1 continued the takeoff, MIP1 failed to recognize aural and visual aerodynamic stall warnings and lost situational awareness regarding MA ground track and low height above the ground. This loss of situational awareness lasted for approximately four seconds and was exacerbated by the low illumination that night. MIP1 regained awareness when the MA landing light illuminated the ground approximately one second before the MA touched down to the right of the runway surface. Approximately three

seconds later, MIP1 commanded ejection and the MC initiated ejection at approximately 147 knots indicated airspeed as the MA rolled into approximately 45 degrees of right bank with approximately 500 feet per minute descent rate. MIP2 successfully completed the ejection with minor injuries. MIP1 was fatally injured when the MA impacted the ground before MIP1's ejection seat completed the ejection sequence.

I find by a preponderance of evidence the cause of the mishap was the combination of: (a) an engine compressor stall during a critical phase of flight and (b) MIP1's failure to apply necessary throttle and flight control inputs following a loss of thrust on takeoff. Additionally, I find by a preponderance of evidence that each of the following factors substantially contributed to the mishap: (a) the low illumination the night of the mishap and (b) MIP1's misperception of the rapidly evolving emergency after taking control of the MA.

2. CAUSE

I find by a preponderance of evidence the cause of the mishap was the combination of: (a) an engine compressor stall during a critical phase of flight and (b) MIP1's failure to apply necessary throttle and flight control inputs following a loss of thrust on takeoff. The subsequent chain of events led to MIP1 and MIP2 initiating ejection too late for MIP1's ejection seat to complete the ejection sequence before the MA impacted the ground.

a. Engine Compressor Stall

The flight manual describes compressor stall indications at low altitude and high airspeed as follows: Pop, bang, or buzz with rapid engine rotational speed drop or high exhaust gas temperature (EGT). During multiple touch-and-go landings simulated in the T-38 Operational Flight Trainer (OFT), compressor stall indications showed a definite decrease in engine speed, clear and consistent over temperature in EGT, and made sounds that were not similar to the buzz sound in the mishap.

The aircraft began takeoff when at approximately 19:23:52, a loud buzz lasting approximately one to one and a half seconds was heard by the MC. The aircraft yawed to the right and began to roll to the right. At the time of the buzz the right engine rotational speed started dropping from 97% to 66% and then oscillated between 65% and 93%. The left engine continued to operate normally. Post-accident engineering analysis indicated the right engine encountered an anomaly that caused the engine speed to drop and exhaust gas temperature (EGT) to rise. I determined that these engine indications, the buzz, and eyewitness testimony indicate the MA right engine experienced a compressor stall.

I could not determine the cause of the compressor stall. Subsequent engine teardown and analysis was not able to determine the cause of this compressor stall. I was able to rule out the following as causes of the compressor stall: engine structural failure, Foreign Object Damage, incorrect fuel flow trim, engine nozzle mis-scheduling, maneuvering flight, and unusual flight attitudes.

Touch-and-go landings are the only time the T-38C flight manual refers to a critical phase of flight. The slow airspeed, close proximity to the ground, and multiple tasks required that must be accomplished during a touch-and-go landing increase the complexity of emergencies, limit the time available for considering and applying critical procedures, and lower the reaction time to recover the airplane in the event of a malfunction.

The compressor stall caused the MA to experience a loss of thrust and directional control challenges during a critical phase of flight, which caused the mishap.

b. MIP1's Failure to Apply the Necessary Throttle and Flight Control Inputs Following a Loss of Thrust on Takeoff

The touch-and-go landing was routine with no indications of operational problems. The decrease in thrust on the right side of the aircraft corresponded with the right yaw and roll and subsequent aircraft travel to the right of the runway. MIP1 took control of the MA at 19:23:54.5 and continued the takeoff in MIL. Aural, head-up display (HUD), and multi-function display (MFD) stall indications began at 19:23:56.9. During the approximately five seconds after MIP1 took control of the aircraft, with the exception of one brief input by MIP2 to level the wings at 19:23:55.6, the MA continued to track to the right of the runway, never climbed higher than 10 feet above the ground, did not appreciably accelerate, and continued to roll to the right until reaching approximately 20 degrees of right bank. The aerodynamic stall warning continued during this entire time. When I studied the HUD video and post-mishap engineering analysis, I observed no apparent attempt made by MIP1 to roll wings level or increase the throttles toward MAX power until commanding ejection.

There are three flight manual checklists that, had MIP1 followed one of them correctly, may have prevented the mishap: (1) Maintain aircraft control is the first step in any emergency situation and would have required MIP1 to level the MA wings, maintain runway alignment, and select MAX power due to proximity to the ground and lack of acceleration. (2) The flight manual directs the single-engine go-around checklist any time thrust is questionable on takeoff and a decision is made to continue takeoff; the first two steps in this critical action procedure are to select MAX on one or both throttles and raise the flaps to 60%. (3) The steps required to recover from a traffic pattern stall, recognized by aircraft buffet, HUD, MFD, or aural tone, is to simultaneously apply MAX power, roll wings level, and relax back stick pressure to stop the stall.

The AIB conducted multiple events simulating the touch-and-go landing, subsequent compressor stall, and different courses of action in the T-38 Operational Flight Trainer (OFT). At no time was the takeoff recoverable in the simulator without using MAX thrust. However, leveling the wings while using MIL thrust did provide more time for the MC to analyze the situation, regardless of rudder inputs, before the aircraft impacted rising terrain to the right of the runway. The aircraft was recovered on multiple attempts when the board selected afterburner and rolled wings level at the same time stall indications were experienced by MIP1 after taking the MA. Each of these attempts was performed with only the left engine in afterburner and full flaps remaining down throughout the stall recovery. The aircraft was fully recoverable every time the AIB applied MAX power and raised the flaps to 60% in accordance with the first two steps of the single-engine go-around checklist.

Based on the other evidence and the above OFT events, MIP1's failure to apply necessary throttle and flight control inputs following a loss of thrust on takeoff caused the mishap.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

I find by a preponderance of evidence that each of the following factors substantially contributed to the mishap: (a) the low illumination the night of the mishap and (b) MIP1's misperception of the rapidly evolving emergency after taking control of the MA.

a. Night Conditions Affecting Vision

Flight operations relying upon external visual cues for guidance are known to be riskier at night than during the day. Darkness limits pilots' ability to accurately perceive the external environment, contributing to visual illusions that can interfere with safe flight. One well-known hazard occurs during take-off on dark, moonless, or overcast nights where the terrain off the runway is devoid of ground lights and no horizon is discernable. As an aircraft lifts off into this "black hole," pilots relying on external visual cues may fail to accurately assess their climb angle and proximity to terrain.

As I reviewed the HUD video, I observed MIP1 and MIP2 commenting during the MS that it was very dark that night. Testimony from multiple witnesses confirmed the same. The MA was airborne for approximately six seconds between the compressor stall and touching down 55 feet right of the runway. The MA's high pitch during this time, combined with the landing light's angle when airborne, created the effect that the ground was not illuminated until sufficient bank and closer proximity allowed pilots to see the grass. Inferring from MIP1's control of the MA and a statement of surprise on the HUD video, the first indication that MIP1 was aware he was right of the runway surface and descending to the ground was when the MA landing light illuminated the grass approximately one second before touching down. Had this mishap occurred during daylight hours, daytime conditions with adequate view of the horizon would have provided peripheral vision cues to alert MIP1 that the MA was drifting away from the runway, continuing to roll to the right, and subsequently descending to the grass. The lack of these cues exacerbated MIP1's inability to perceive the changing environment or recognize the need for increased power. The darkness also prevented the MC from recognizing the need to initiate ejection until it was too late for MIP1's ejection seat to complete the ejection sequence before the MA impacted the ground.

b. Misperception of the Rapidly Evolving Emergency

The MC had accomplished eight routine instrument and visual patterns at Laughlin AFB prior to the final touch-and-go. Upon hearing the compressor stall, a member of the MC stated, "What's that?" and there was no verbal response, indicating the MC failed to immediately recognize the sound as a compressor stall. MIP2 initially considered discontinuing the takeoff and reduced the throttles before reconsidering this action because of a possible tire failure on takeoff. At no point in the remainder of the flight did MIP1 indicate recognition of a compressor stall or other engine malfunction. Neither MIP had experienced an actual compressor stall in the T-38C.

During the approximately four seconds after MIP1 took control of the MA and before it touched down 55 feet right of the runway, the MA continued to roll and drift to the right and failed to accelerate appreciably. I was unable to determine what specific actions MIP1 was taking during this time, but engineering analysis of engine indications throughout the mishap sequence showed no attempt to select MAX power on either engine until 19:24:02.0, approximately one second before MIP1 commanded ejection. HUD video revealed there was no apparent attempt made by MIP1 to roll wings level prior to the landing light illuminating the grass. MIP2 testified that after MIP1 took control of the aircraft, MIP2 intervened to attempt to level the wings by pushing the stick to the left, which indicated to me that MIP1 was unaware that the MA was rolling to the right.

There was a loud and unfamiliar sound, unexpected change in aircraft control, engine indications that did not clearly indicate a compressor stall or significant engine anomaly, and an engine malfunction neither MIP had experienced in an actual T-38C. These combined to create the effect that MIP1 did not perceive that the MA was drifting right of the runway surface at a very low altitude, nor did he react appropriately to the aural, HUD, or MFD stall indications. MIP1's failure to recognize the rapidly developing situation until the landing light illuminated the grass and subsequent decision to attempt to climb the MA after touching down led to the MC's ejection attempt being too late for MIP1's ejection seat to complete the ejection sequence before the MA impacted the ground.

4. CONCLUSION

I find by a preponderance of evidence the cause of the mishap was the combination of: (a) an engine compressor stall during a critical phase of flight and (b) MIP1's failure to apply necessary throttle and flight control inputs following a loss of thrust on takeoff. Additionally, I find by a preponderance of evidence that each of the following factors substantially contributed to the mishap: (a) the low illumination the night of the mishap and (b) MIP1's misperception of the rapidly evolving emergency after taking control of the MA.

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12 March 2019

JAMES R. SEARS, JR.
Brigadier General
President, Accident Investigation Board

United States Air Force Accident Investigation Board Report

Class A Mishap, Laughlin AFB, TX

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