UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

T-38C, T/N 68-8206

25th FLYING TRAINING SQUADRON
71st FLYING TRAINING WING
VANCE AIR FORCE BASE, OKLAHOMA

LOCATION: 62 MILES WEST OF VANCE AIR FORCE BASE, OKLAHOMA

DATE OF ACCIDENT: 17 AUGUST 2018

BOARD PRESIDENT: COLONEL WILLIAM MICKLEY

United States Air Force Accident Investigation Board Report

Aircraft Accident, Vance AFB

Conducted IAW Air Force Instruction 51-503

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTGATION

T-38C, T/N 68-8206
VANCE AIR FORCE BASE, OKLAHOMA
17 AUGUST 2018

On 17 August 2018, at approximately 1341 hours local time a T-38C, tail number 68-8206, assigned to the 71st Flying Training Wing (FTW), Vance Air Force Base (AFB), Oklahoma crashed in a field approximately 62 miles West of Vance AFB. The mishap aircraft (MA) was flown by a single pilot and was the lead aircraft in a two aircraft formation performing low-level training as part of a series of cross-country flights from Vance AFB to Minneapolis-St Paul, Minnesota. The mishap pilot (MP) was assigned to the 25th Flying Training Squadron within the 71 FTW. While flying at approximately 1,000-1,500 feet above the ground and looking over his left wing at his wingman, the MP heard a loud noise on the right side of the aircraft. The MP noted hearing an audible fire warning, seeing the right engine fire light, and seeing indications of right-hand flight control hydraulic and right generator failures. While initiating a climb away from the low-level route, the MP experienced a degradation in aircraft controllability and his wingman reported seeing a visible fire coming from the MA. The MP successfully ejected from the aircraft, sustaining minor injuries. The crash resulted in an impact crater and post-impact ground fire. The aircraft was valued at $11,015,639 and damaged beyond repair.

The Accident Investigation Board President found by a preponderance of the evidence that the cause of the mishap was ingestion of a Swainson's Hawk into the right, or number two, engine during flight. This bird strike caused the catastrophic loss of the engine and a fire in the forward engine bay. The fire melted through the aircraft skin, exposing the Flight Control and Utility Hydraulic Systems' flexible hydraulic pressure and return lines to extreme heat, causing the degradation, and ultimate loss, of aircraft controllability. The MP applied all appropriate emergency procedures. However, the fire and loss of flight control authority necessitated ejection from the MA.

United States Air Force Accident Investigation Board Report

Aircraft Accident, Vance AFB

SUMMARY OF FACTS AND STATEMENT OF OPINION
T-38C, T/N 68-8206
17 August 2018

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

ACMI	Air Combat Maneuvering Instrumentation
ADO	Assistant Director of Operations
AETC	Air Education and Training Command
AETCMAN	AETC Manual
AF	Air Force
AFB	Air Force Base
AFE	Aircrew Flight Equipment
AFH	Air Force Handbook
AFI	Air Force Instruction
AFLCMC	Air Force Life Cycle Management Center
AFMES	Armed Forces Medical Examiner System
AFRL	Air Force Research Laboratory
AFTO	Air Force Technical Order
AGL	Above Ground Level
AHAS	Avian Hazard Advisory System
AIB	Accident Investigation Board
AIMWTS	Aeromedical Information Management Waiver Tracking System
AOA	Angle of Attack
AP1B	Area Planning 1 Bravo
ARTCC	Air Route Traffic Control Center
ATC	Air Traffic Control
BIP	Buddy Instructor Pilot
BPO	Basic Post Flight
C	Degrees Celsius
CAMS	Computer Assisted Maintenance System
Capt	Captain
DE	Delaware
DNIF	Duties Not Including Flying
DTC	Data Transfer Cartridge
DLI	Defense Language Institute
EFB	Electronic Flight Book
EGT	Exhaust Gas Temperature
EMT	Emergency Medical Technician
EOR	End of Runway
F	Degrees Fahrenheit
FCF	Functional Check Flight
FCP	Front Cockpit
FOD	Foreign Object Debris
FPM	Feet per Minute
FTS	Flying Training Squadron
FTW	Flying Training Wing
G	Gravity
GPS	Global Positioning System
HSC	Home Station Check
HUD	Head-Up Display
IAW	In accordance with
IFF	Introduction to Fighter Fundamentals
IFG	In-Flight Guide
IMDS	Integrated Maintenance Data System
IP	Instructor Pilot
IR	Instrument Route
ISB	Interim Safety Board
ISO	Isochronical
L	Local Time
LOX	Liquid Oxygen
MA	Mishap Aircraft
MAAF	Mishap Analysis Animation Facility
Maj	Major
MEDEVAC	Medical Evacuation
MFD	Multifunction Display
MOA	Military Operations Area
MOC	Maintenance Operations Center
MOR	Manual Override
MP	Mishap Pilot
MS	Mishap Sortie
MSL	Mean Sea Level
MW	Mishap Wingman
MWP	Mission Weather Product
NEXRAD	Next Generation Weather Radar
NM	Nautical Miles
NOTAM	Notice to Airmen
OG	Operations Group
OK	Oklahoma

ORM	Operational Risk Management
OSC	On-Scene Commander
OSS	Operations Support Squadron
OST	Operation Support Training
PE	Phase Inspections
PHA	Preventive Health Assessment
PTO	Power Take Off
RALT	Radar Altimeter
RAPCON	Radar Approach Control
RH	Right Hand
RPM	Revolutions per Minute
RTB	Return to Base
SARCAP	Search & Rescue/Combat Air Patrol
SDS	Safety Data Sheet
SIB	Safety Investigation Board
SM	Statute Miles
SOF	Supervisor of Flying
SPO	System Program Office
Sup	Supplement
SUPT	Specialized Undergraduate Pilot Training
SSK	Seat Survival Kit
TDY	Temporary Duty
TI	Theater Indoctrination
T.O.	Technical Order
TSgt	Technical Sergeant
TX	Texas
URT	Universal Receiver Transmitter
USAF	United States Air Force
VR	Visual Route
WSO	Weapon Systems Officer
Z	Zulu Time

United States Air Force Accident Investigation Board Report

Aircraft Accident, Vance AFB

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 11 October 2018, Major General Mark E. Weatherington, Deputy Commander, Air Education and Training Command (AETC), appointed an Accident Investigation Board (AIB) to investigate a T-38C aircraft mishap that occurred on 17 August 2018 near Vance Air Force Base (AFB), Oklahoma (Tab Y-3 to Y-6). Colonel William B. Mickley was appointed as the Board President (Tab Y-3). Board members included a Major Legal Advisor, a Major Medical Member, a Civilian Maintenance Member, a Major Pilot Member, and a Technical Sergeant Recorder (Tab Y-3 to Y-6). The aircraft accident investigation was conducted at Vance AFB (Tab Y-4 and Y-6). This report pertains to the immediate causes of the 17 August 2018 mishap (Tab Y-3 and Y-5).

b. Purpose

In accordance with Air Force Instruction (AFI) 51-503, *Aerospace and Ground Accident Investigations,* this accident investigation board conducted a legal investigation to inquire into all 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 17 August 2018, at approximately 1341 hours local time (L) a T-38C, tail number 68-8206, assigned to the 71st Flying Training Wing (FTW), Vance AFB, OK crashed in a field approximately 62 miles west of Vance AFB (Tabs D-2, J-5, N-3, S-3 and U-18). The mishap aircraft (MA) was flown by a single pilot and was the lead aircraft in a two aircraft formation performing low-level training as part of a series of cross-country flights from Vance AFB, to Minneapolis-St Paul, Minnesota (Tabs K-2, R-5 and R-25). The Mishap Pilot (MP) and Mishap Wingman (MW) were assigned to the 25th Flying Training Squadron (FTS), located at Vance AFB, OK (Tabs G-2 and R-25). While flying at approximately 1,000-1,500 feet above ground level (AGL), the MP heard a loud noise on the right side of the aircraft, followed by an audible fire warning, the right-hand (RH) engine fire light, and indications of the loss of RH flight control hydraulics and electrical generator (Tabs V-1.4, Z-4, and AA-3). While initiating a climb away from the low-level route, the MP experienced a degradation in aircraft controllability and the Mishap Wingman (MW) reported a visible fire coming from the MA (Tabs N-2 and V-1.3). The

MP successfully ejected from the aircraft, sustaining minor injuries (Tabs N-5 and V-1.7). The aircraft was valued at $11,015,639 and was damaged beyond repair (Tab CC-15).

3. BACKGROUND

The MA was assigned to the 71 FTW, 19th Air Force (AF), AETC, and located at Vance AFB, OK (Tabs K-2 and U-18). It was maintained by Vertex Aerospace LLC, the aircraft maintenance contractor for the 71 FTW (Tabs V-5.2 and CC-26). The MP was assigned to the 25 FTS, which reports to the 71st Operations Group (OG) also assigned to the 71st FTW (Tabs G-4 and CC-10).

a. Air Education and Training Command (AETC)

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

b. 19th Air Force

19 AF is responsible for the training of more than 30,000 U.S. and allied students annually in numerous specialties ranging from aircrews, remotely piloted aircraft crews, air battle managers, weapons directors, Air Force Academy Airmanship programs, and survival, escape, resistance, and evasion specialists (Tab CC-6). They execute operational-level command and control of all formal aircrew flying training missions within AETC and provide Airmen with a 5th generation, cross-domain warrior mindset to the Combat Air Forces, Mobility Air Forces, and Special Operations Air Forces to sustain the combat capability of the USAF (Tab CC-6).

c. 71st Flying Training Wing

The mission of the 71 FTW is to develop professional Airmen, deliver world-class U.S. and allied pilots and deploy combat-ready warriors (Tab CC-4). Vance is responsible for training Air Force and allied student pilots for worldwide deployment and Aerospace Expeditionary Force support (Tab CC-4). Specialized Undergraduate Pilot Training (SUPT) is divided into three phases that cover 52 weeks (Tab CC-4). The wing reports to AETC through 19 AF (Tab CC-6).

d. **Vertex Aerospace LLC** (71 FTW Maintenance Operation)

Vertex Aerospace is the prime contractor for Vance AFB aircraft maintenance operations (Tab CC-26). Vertex Aerospace, based in Madison, Mississippi, is a worldwide provider of aerospace sustainment and support as well as aviation and aerospace technical services for the U.S. Department of Defense, government agencies and foreign governments (Tab CC-19). Its workforce of 7,300 professionals at 136 locations offers integrated logistics support, contractor logistics support, component repair and overhaul, in-house component repair, supply chain management, repair station support, pilot services and contract field services (Tab CC-19).

e. 71st Operations Group

The 71 OG, located at Vance AFB, OK, is aligned under the 71 FTW, and conducts Joint SUPT for over 400 U.S. Air Force and allied student pilots each year (Tab CC-11). The group conducts training in the T-6, T-1, and T-38 aircraft (Tab CC-11). Additionally, the unit flies more than 55,000 sorties annually, and logs over 81,000 flying hours each year (Tab CC-11).

f. 25th Flying Training Squadron

The 25th Flying Training Squadron (FTS) is part of the 71 OG and trains pilots for U.S. and allied air forces through comprehensive advanced flying training using the T-38C aircraft (Tab CC-12).

g. T-38C – 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-7). AETC is the primary user of the T-38 for Joint SUPT using it to prepare pilots for front-line fighter and bomber aircraft such as the F-15E Strike Eagle, F-15C Eagle, F-16 Fighting Falcon, B-1B Lancer, A-10 Thunderbolt II, and F-22 Raptor (Tab CC-8).

The Talon first flew in 1959 (Tab CC-8). More than 1,100 were delivered to the Air Force between 1961 and 1972 when production ended (Tab CC-8). As the T-38 fleet has aged, specific airframe, engine and system components have been modified or replaced (Tab CC-8). AETC began receiving T-38C models in 2001 as part of the Avionics Upgrade Program (Tab CC-8). T-38C models have also undergone a propulsion modernization program (Tab CC-8).

4. SEQUENCE OF EVENTS

a. Mission

The Mishap Sortie (MS) was a two-ship cross-country training and upgrade mission for the MW (Tab R-25). The MS was the first of four planned for the three day cross-country mission (Tabs K-2 and R-25). Objectives included regaining the MW's low-level currency, accomplishment of instrument procedures, and completion of MW's T-38C instructor certification cross-country flying requirements (Tab R-27 to R-30). The MP was the designated instructor for accomplishment of the MW's training requirements (Tab R-5). The 25 FTS scheduled and authorized the MS and subsequent sorties for the cross-country mission (Tab K-5 and K-7).

b. Planning

Mission planning was accomplished in the days preceding the MS (Tab R-30). On 17 Aug, the MP and MW collected all required items to accomplish the mission to include a weather briefing, all relevant Notices to Airmen (NOTAMs), flight publications, and the Avian Hazard Advisory System (AHAS) status (Tab R-30). Their scheduled Military Training Route, Instrument Route (IR)-145, was predicted to be bird status "moderate" for all but the last leg of the route, which was estimated to be "severe" (Tab R-5). A later review of the AHAS system updated the bird status with Next Generation Weather Radar (NEXRAD) information and displayed bird activity as "moderate" (Tab O-13). An operational risk management (ORM) assessment was accomplished and determined to be low (Tabs R-5 and AA-5). The MP, as the designated lead pilot, conducted a mission brief covering all required topics (Tab R-30). The briefing emphasized low-level procedures to include bird mitigation (Tab R-30).

c. Preflight

The MP and MW reported to the 25 FTS operations desk at approximately 1235L for their step brief (Tabs R-5 and V-10.3). The Operations Supervisor briefed them on the current field conditions, advised them of applicable NOTAMs, reviewed their ORM assessment, and confirmed their formation and individual aircraft call-signs (Tabs V-10.3 and BB-8 to 9). The MP and MW were given call-signs SHOOT 11 and SHOOT 12 respectively (Tabs K-5 and R-26). The formation carried the MP's call-sign, SHOOT 11, as he was the designated lead for the sortie (K-5). They proceeded to the Aircrew Flight Equipment (AFE) shop and accomplished preflight checks of their AFE gear, and stepped to their respective aircraft (Tab V-14.6).

The MA was configured for the cross-country flight with a full fuel load and a travel pod (Tab R-25). The MP reviewed the aircraft maintenance forms and performed an exterior inspection of the aircraft (Tab R-5 and R-6). No aircraft issues were encountered during preflight, engine start, taxi, take-off, or enroute to the low-level (Tab R-5 and R-30).

d. Summary of Accident

At 1305L, SHOOT11 flight departed Vance AFB and entered IR-145 (Tabs R-6 and Z-4). The formation completed the first five legs of the low-level without incident (Tabs R-6, R-31, and N-2). The route was flown at 1,000 feet AGL, with the exception of one leg flown at 500 feet AGL to meet training objectives (Tab R-5 and R-31). The MP reported seeing one bird on the route that was not a factor to the formation (Tab R-6). Once training objectives were complete, the formation returned to approximately 1,000 feet AGL (Tabs R-25, V-1.2, V-1.5 and Z-4).

While flying the sixth segment of the low-level route, the MA ingested a Swainson's Hawk, having an average weight of approximately 32 ounces, into the RH (number 2) engine (Tabs R-6 and CC-16). While looking over his left wing at the MW, the MP felt a thump on the right side of the aircraft accompanied by a fire warning light, associated audible "Engine Fire" warning, RIGHT GENERATOR and FLIGHT HYDRAULIC Master Caution lights, and a spike in the right engine exhaust gas temperature (EGT) (Tab R-6 and R-7).

At 1338:22L, the MP directed, "Knock it off" to the MW and attempted to climb out of the low altitude environment to reach the Technical Order (T.O.) prescribed minimum ejection altitude and gain a margin of safety for the formation (Tabs R-6, N-2, and V-1.2). The MP experienced sluggish flight controls and needing nose up trim in addition to full aft stick deflection to get the aircraft to climb (Tabs N-2, R-6, and V-1.3). Once climbing, and above a broken cloud layer, the MP applied the first two steps of the FIRE WARNING DURING FLIGHT checklist, moving the right throttle to IDLE and then OFF (Tab V-1.3).

At 1338:52L the MW stated, "Two's going to chase," a position 30 to 60 degrees behind the lead aircraft at approximately 1,000 feet (Tabs N-2, V-14.3, and BB-16).

At 1339:01L the MP told the MW, "This is going to be bad…request chase" (Tab N-2).

At 1339:13L, while maneuvering to the chase position, the MW observed yellow to orange flames coming out of the back of the MA and reported to the MP, "SHOOT 1 from 2, you have a…looks like an engine fire" (Tabs N-2, R-26, and R-28).

At 1339:23L the MW made a MAYDAY call and declared an emergency with Kansas City Air Route Traffic Control Center (ARTCC) (Tab N-2 and N-3).

At 1339:38L, the MW again reported to the MP that "you…have an engine fire" (Tab N-3). The MP continued to experience degradation of flight controls, stating full deflection of the flight controls was providing no response from the aircraft (Tabs R-9 and V-1.7).

At 1339:50L, the MP told the MW, "One's punching out" (Tab N-3). The MP confirmed the ejection seat pins were removed, established a good body position in accordance with (IAW) emergency procedure guidance, and ejected at 1340:14 (Tabs N-3, R-6 to R-7, and BB-24). The aircraft was approximately 3,000 feet AGL, 195 knots, 10 degrees nose low, and with a descent rate of 3,500 feet per minute (fpm) (Tab Z-3). The MP stated the aircraft was in approximately 60 degrees of right bank at the time of ejection (Tab V-1.8). This combination of parameters is within the prescribed ejection limits (Tab BB-24).

e. Impact

The MP successfully ejected from the MA and sustained only minor injuries (Tabs J-57 and X-7). The MA impacted the ground approximately 62 miles west of Vance AFB at approximately 1341L (Tabs J-5, N-3, and S-3). At the time of impact, the aircraft was at least 40 degrees nose low in 30 to 40 degrees of right bank in excess of 300 knots (Tabs J-5 and Z-3).

The impact crater was approximately 20 by 25 feet and 3 to 4 feet deep, and the overall debris field covered an area 150 yards long and 75 yards wide (Tab J-5). The front half of the aircraft was significantly damaged as a result of ground impact (Tabs J-5 and S-2). The majority of the forward part of the aircraft was broken into small pieces and thrown northeast from the impact crater (Tabs J-5 and S-6). The wings, aft fuselage, horizontal and vertical stabilizers and engines were found within feet of the impact crater (Tab J-6). All control surfaces, engines, and major aircraft components were found within the main crash site (Tabs J-6 to J-11, and S-5). Evidence of a post-impact ground fire extended in an approximately 65 degree arc from the crash site, extending up to 100 yards (Tab J-19 and J-32).

f. Egress and Aircrew Flight Equipment

All MP and MA AFE inspections were current and no discrepancies were discovered with the MP's ejection sequence (Tabs D-13, J-69, V-1.11). The front cockpit (FCP) ejection seat, FCP seat headbox, and the MP's parachute were recovered southeast of the main crash site (Tab S-5). All portions of the FCP egress system functioned as specified with the exception of the Manual Override Handle (MOR), the ejection seat left leg restraint, and the emergency locator beacon (Tab J-63 to J-69). The MOR Handle was found unseated from its housing, which was attributed to the seat impacting the ground (Tab J-63). The left-hand leg restraint did not separate at the shear ring as designed but instead was torn 18 inches from the tapered plug at the end of the restraint (Tab J-66 and J-67). The URT-33D emergency locater beacon did not activate automatically upon ejection (Tab J-70). The static line connecting the beacon activation plug to the seat survival kit (SSK) was broken (Tab J-70). None of these malfunctions affected the MP's ejection sequence or the recovery of the MP (Tabs V-1.11 and Z-18).

g. Search and Rescue

Following the ejection, the MW immediately established a search and rescue combat air patrol (SARCAP) in the vicinity of the ejection site, made a second MAYDAY call, and assumed on-scene commander (OSC) duties (Tabs N-3, N-4 and V-14.5).

At 1341:32L Kansas City ARTCC notified Vance Radar Approach Control (RAPCON) that SHOOT11 had declared an emergency and may have ejected (Tab DD-3, N-3).

At 1344:08L, the MW passed coordinates of the mishap to Vance RAPCON (Tab N-4). Vance ATC coordinated for local medical evacuation (MEDEVAC) support (Tab DD-8 to 10, and V-4.6).

At 1347:24L, the MP made radio contact with the MW on his emergency radio (Tab N-5).

At 1349:18L, the MW was forced to return to Vance AFB because of low fuel (Tab N-6).

At 1351:00L, a T-38C from Sheppard AFB, TX, call-sign TRICKY01, coordinated to fly north from the Washita Military Operating Area (MOA) to assist with the search and rescue operations and takeover OSC duties (Tabs Z-10, V-2.4 to V-2.5). While coordinating with ATC and flying north to the MP's location, TRICKY01 also coordinated efforts with IGLOO53, an MC-12, and ELVIS69, a C-17 (Tab Z-11 to Z-12).

At 1400:10L, TRICKY01 made contact with the MP and at 1404:15L established SARCAP over the crash site (Tab Z-13 to Z-14). TRICKY01 confirmed the MP was the only downed pilot, attempted to make visual contact through the broken cloud layer, relayed the MP's coordinates to the Vance Supervisor of Flying (SOF), and continued to coordinate tasks and altitude deconfliction with IGLOO53 (Tab Z-13 to Z-14 and Z-16).

At 1410:16L, the MP reported seeing a civilian vehicle on a nearby road (Tabs R-7 and Z-17).

At 1413:02L, the MP reported being picked up by a local farmer and later met up with Oklahoma Highway Patrol and a local emergency medical team (Tabs R-7 and Z-18). The MP did not require immediate medical attention or MEDEVAC (Tabs R-7 and V-12.3).

h. Recovery of Wreckage

The crash site was initially secured by Oklahoma Highway Patrol (Tab R-7). The crash scene was handed over to the Interim Safety Board (ISB) who coordinated recovery and transportation of the wreckage to Vance AFB (Tabs J-33 and Q-2).

5. MAINTENANCE

a. Forms Documentation

The MA hard copy Air Force Technical Order (AFTO) Form 781, *Aerospace Equipment Forms*, were destroyed in the MA and therefore unavailable for review (Tab V-16.6). The Integrated Maintenance Data System (IMDS) showed all required maintenance for 17 August 2018 was complied with before the MS (Tab U-3 to U-5). Aircraft AFTO 781A forms show maintenance and inspection reviews prior to 17 August 2018 were properly documented (Tab D-2 to D-11).

b. Inspections

Upon review of the AFTO Form 781H, the Basic Post Flight inspection was accomplished as required on the MA (Tab D-3). According to IMDS, there were no major discrepancies noted during this inspection (Tab U-5 to U-11). Though documentation of required inspections were destroyed in the accident, entries into IMDS indicate all inspections were performed on 17 August 2018 with no major discrepancies (Tab U-3 to U-5).

c. Maintenance Procedures

Maintenance procedures accomplished immediately prior to the MS were reviewed and deemed not to be a factor in the mishap (Tab D-5 to D-11).

d. Maintenance Personnel and Supervision

71 FTW aircraft maintenance at Vance AFB, OK is performed by a contractor, Vertex Aerospace LLC (Tab CC-26). A thorough review of maintenance personnel, supervision, and training was conducted during the investigation and maintenance and supervision personnel do not appear to have been a factor in this accident (Tabs U-3 to U-5 and U-19 to U-39).

e. Fuel, Hydraulic and Oil Inspection Analyses

Available fluid samples were taken and tested with no discrepancies noted (Tab D-20 to D-23). All fuel, hydraulic, and oil fluids used to service the MA met required specifications (Tab D-20 to D-23). The MA hydraulic reservoirs were serviced with MIL-PRF-5606H hydraulic fluid (Tab U-40). The Safety Data Sheet (SDS) provides the flash point of this hydraulic fluid is 82°C or 179.6° Fahrenheit (F) (Tab U-10).

f. Unscheduled Maintenance

The following unscheduled maintenance was accomplished after the last inspection of the MA:

Date Completed	Discrepancy	Corrective Action
17 Aug 18	Left tire worn for cross-country	Repaired/replaced tire & wheel assembly
17 Aug 18	Right tire worn for cross-country	Repaired/replaced tire & wheel assembly
17 Aug 18	Travel pod to be installed	Travel pod installed

Table 1 – Unscheduled Maintenance on MA (Tab U-3 to U-5)

After a review of all maintenance events that occurred on the day of the MS, no discrepancies were noted and unscheduled maintenance does not appear to have been a factor in the mishap (Tab U-3 to U-5).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

The aircraft impacted a generally level and wooded area in an east-northeast direction (Tab J-5). The wings, aft fuselage, engines, and horizontal and vertical stabilizers remained within feet of the initial crater (Tab J-6). Post-impact ground fire melted and destroyed portions of the wreckage near the impact site (Tab J-6). The leading edges of the right wing and right horizontal stabilizer were damaged at ground impact while the left wing leading edge was relatively undamaged (Tab J-6). The remaining portions of the fuselage sustained compression damage similar to a compressed accordion, consistent with a low Angle Of Attack, nose-low ground impact (Tab J-6). The aircraft and associated life support equipment is valued at $11,015,639 and was damaged beyond repair (Tab CC-15).

The MA wreckage was transferred to a hangar on Vance AFB for limited reconstruction and analysis (Tabs J-33 and Q-2). The T-38C Systems Program Office (SPO) analyzed aircraft systems, structures, and relative ground impact attitude (Tab J-5 to J-30). The Air Force Life Cycle Management Center (AFLCMC) analyzed aircraft engines, and related components, as well as maintenance records (Tab J-32 to J-53). The Air Force Research Laboratory (AFRL) analyzed the right power take-off input drive coupling shaft for cause of failure (Tab J-111 to J-129).

a. Aircraft Flight Data Records

The data transfer cartridge (DTC) was not recovered at the crash site (Tab J-32).

b. Right-Hand (number two) Engine Components

The section of the aircraft from the engine bays aft was found in large segments (Tab J-32). The RH engine was still in one assembly (Tab J-32). There was extensive impact damage to the bottom of the engine and evidence of a fire in and around the gearbox (Tab J-32). The engine was still contained in the boat tail, which was upside down (Tab J-32).

The throttle gauge on the main fuel control read at between shutdown and idle power at the crash site, consistent with the other evidence regarding the sequence of events (Tabs N-3, V-1.3, Tab J-40, and BB-24). The compressor case stator vanes were missing in every stage and the fracture surfaces were obscured by post-fracture impacts, consistent with a significant foreign object debris (FOD) or bird strike event (Tab J-44). No obvious foreign debris was present but parts of the compressor case and rotor fluoresced under a black light (Tab J-44). Significant debris was found in the combustor liner (Tab J-43). This debris fluoresced under a black light, and samples were taken for analysis (Tab J-43). This debris was analyzed at the Smithsonian Institute and determined to be the remains of a Swainson's Hawk which has an average weight of approximately 32 ounces (Tab CC-16). The turbine case also showed evidence of debris that fluoresced under a black light (Tab J-41 and J-42).

c. Right Power Take-Off (PTO) Input Drive Coupling Shaft

Examination of the fractured PTO input drive coupling shaft showed macroscopic features indicative of torsional overload (Tab J-127). No evidence of pre-existing defects, such as corrosion or fatigue cracking, were identified and the coupler sheared at the designed point (Tab J-127).

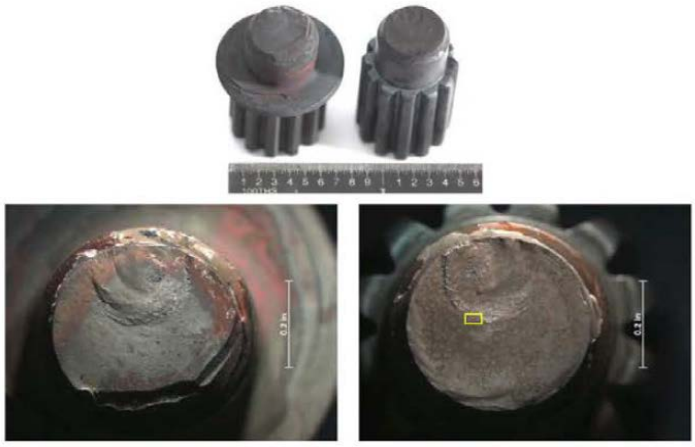

Figure 1: Right PTO Input Drive Coupling Shaft (Tab J-127)

d. Fire Damage

Fire damage was found on the right half of the bottom of the boat tail skin (Tab J-18). The melting point of this aluminum specification is between 935° to 1,180° Fahrenheit (F) (Tab CC-17). Melted aluminum streaks were found on the bottom right half of the engine exhaust ejector assembly (Tab J-18). These streaks were found from the ejector assembly forward to fuselage station 516 (Tab J-18).

Figure 2: Aluminum Splattering on the Ejector Assembly (Tab J-19)

The wreckage was inspected to determine where the fire exited the aircraft (Tab J-20). The right annulus door had fire damage which indicated the fire originated inside the door and exited through the door to the aft of the aircraft (Tab J-20).

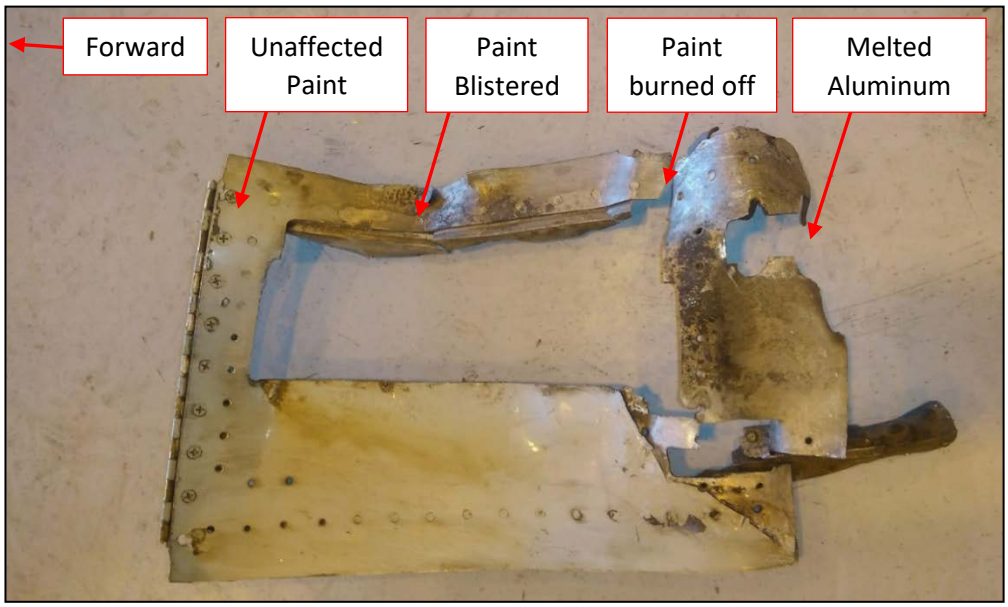

Figure 3: Fire Exit Point on the Right Annulus Door (Tab J-21)

e. Hydraulic Components

The right horizontal stabilizer actuator flexible Flight Control and Utility System hydraulic hoses were located in the area of the in-flight fire (Tab J-22). These lines are rated for temperatures from -65°F to +400°F (Tab J-22). The in-flight fire melted through the aircraft skin and exposed the four hoses to extreme heat (Tab J-22). The lines were inspected and found to have all the internal rubber material and external rub strips melted away (Tab J-22).

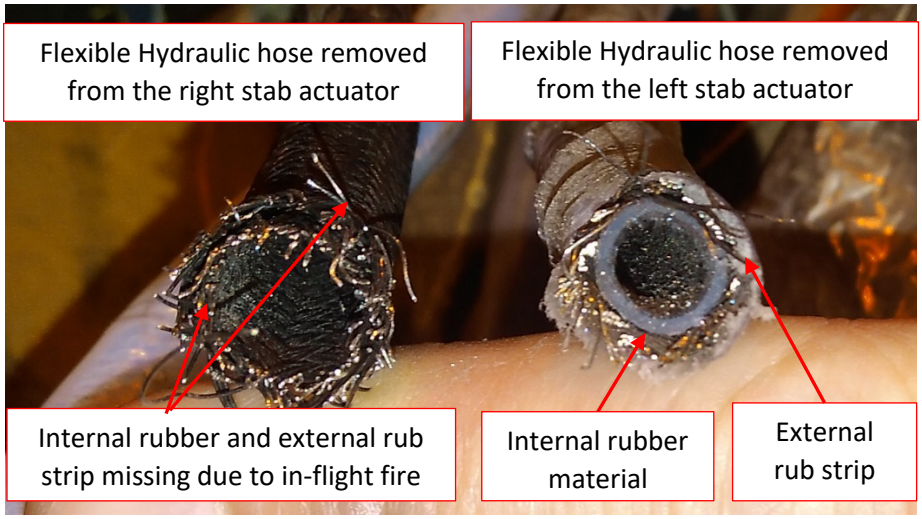

Figure 4: Right Stab Flexible Hydraulic Lines (Tab J-23)

Evidence indicates the fire damage to the boat tail skins, underlying structure, and hydraulic lines occurred in-flight prior to ground impact (Tab J-19).

f. Fire Source

The aircraft fuel and hydraulic systems were analyzed to determine the source of a fire that would produce a flame that could exit the annulus door and burn the bottom boat tail skin (Tab J-21). The fuel system is the only source capable of producing a sustained flame sufficient to melt aluminum skin (Tab J-21).

g. Fuel System

The flexible fuel lines located in the forward engine bay were recovered from the crash site and inspected for pre-impact damage (Tab J-21). The fuel lines were significantly damaged during the ground impact and no pre-impact failures could be determined (Tab J-21). The solid fuel lines in the forward engine bay were not recovered (Tab J-21).

7. WEATHER

a. Forecast Weather

On 17 Aug 18, the forecast for Vance AFB, IR-145, and the western MOAs was winds out of the northeast at 12 knots, 7 statute miles (SM) of visibility, few clouds at 3,000 feet AGL, and few to scattered clouds at 25,000 feet AGL (Tab F-3 and F-4).

b. Observed Weather

At 1256L, the observed weather at Vance AFB was broken clouds at 2,600 feet AGL, 10 SM visibility, winds from 010 degrees at 11 knots, with a temperature of 29°C (Tab F-5). At 1328L, the weather observation was updated to scattered clouds at 2,500 feet AGL and winds from 030 degrees (Tab F-5). The MP stated the weather enroute to and on IR-145 was similar to Vance AFB reports (Tab R-8).

At the time of the bird strike, the formation was flying below a broken cloud layer (Tab R-8 and R-25). During the mishap, the MP climbed to reach his minimum ejection altitude and, after climbing an estimated 500 feet, was above the clouds (Tabs R-6 and V-1.3).

Following the ejection, TRICKY01 reported a cloud layer over the crash site but was able to reference landmarks in the vicinity of the crash (Tab V-2.4 to V-2.5). However, he was not able to see the crash site or the MP (Tabs V-2.4).

c. Space Environment

Not applicable.

d. Operations

No evidence was found to suggest the mishap aircraft was operating outside its prescribed operational weather limits (Tab BB-23)**.**

8. PILOT QUALIFICATIONS

The MP completed the T-38C Pilot Instructor Training Course on 18 Aug 15, and all requisite Vance AFB T-38C Instructor Pilot training on 3 Mar 16 (Tabs G-13 and T-6). The MP was a Functional Check Flight (FCF) pilot and completed required training and certification on 24 Aug 17 (Tab T-8 to T-9). His last instrument qualification and mission evaluations were performed on 1 Feb 18 and 17 Apr 18 respectively (Tab G-13). The MP was current in all egress and flying training events (Tab T-3 to T-5). No deficiencies were noted in the MP's training records or flight evaluation record (Tab G-13 to G-15).

As of the MS, the MP had a total of 2,263.3 hours of flight time as a pilot and another 829.5 hours as a navigator (Tab G-10). Of these, 1,096.5 were in the T-38C over 989 sorties with 811.0 hours as an instructor and 15.0 hours as an evaluator (Tab G-9).

The MP's flight time in the 90 days preceding the mishap was as follows:

	Total Time	Primary Time	Instructor Time	Evaluator Time	Total Sorties
30 Days	29.0	4.7	23.1	1.2	27
60 Days	37.6	6.5	28.8	2.3	35
90 Days	50.1	7.6	39.2	3.3	47

(time denoted in hours)

Table 2 – MP Recent Flight Time (Tab G-4)

At the time of the MS, the MP's total military flying experience was as follows:

	Total Time	Primary Time	Instructor Time	Evaluator Time	Other Time
T-38CIFF*	30.4	23.7	0.0	0.0	6.7
T-38C	1096.5	258.3	811.0	15.0	11.9
F-15E Pilot	1136.4	1063.1	73.3	0.0	0.0
F-15E WSO*	812.6	812.6	0.0	0.0	0.0
Total Time - Pilot	2263.3	1345.1	884.3	15.0	18.6

(time denoted in hours)

*IFF – Introduction to Fighter Fundamentals; *WSO – Weapon Systems Officer

Table 3 – MP Flying Totals (Tab G-9 and G-10)

9. MEDICAL

a. Qualifications

The MP was medically qualified for flying duties at the time of the mishap (Tab X-3). The MP's most recent annual military Periodic Health Assessment was finalized on 9 Jun 18 (Tab X-4). The MP was cleared for flight duty by a current AF Form 2992, *Medical Recommendation for Flying or Special Operational Duty*, dated 8 Jun 18 (Tab X-3). The MP's annual dental examination was performed on 30 Apr 18 (Tab X-4). Review of the Aeromedical Information Management Waiver Tracking System (AIMWTS) database showed the MP had an approved waiver, dated 5 Jan 16 with an expiration date of 30 Jun 19 (Tab X-4).

b. Health

The MP's records reflected good health and no recent performance-limiting illness prior to the mishap (Tab X-7). The MP successfully egressed from the MA (Tab N-3 to N-6). The injuries associated with egress included abrasions, contusion of the lower extremities, and a left shoulder injury (Tab X-7).

c. Pathology

Immediately following the mishap, and IAW safety investigation protocols, blood and urine samples were collected from the MP and submitted to the Armed Forces Medical Examiner System (AFMES), Dover AFB, DE, for toxicological analysis (Tab X-5). All the MP's blood samples tested negative for ethanol and were within acceptable limits for carbon monoxide and all urine drug tests were negative (Tab X-5). Select contract maintenance members were tested and the results were reported as negative (Tab X-8).

d. Lifestyle

The MP's testimony, 72-hour/7-day histories, and the medical chart revealed no lifestyle factors relevant to the mishap (Tabs X-6 and R-11 to R-20). 72-hour/7-day histories were not immediately taken on any contract maintenance members, however, 72-hour/7-day histories administered by the AIB revealed no lifestyle factors relevant to the mishap (Tab X-9).

e. Crew Rest and Crew Duty Time

Based upon witness testimony and supplemental history, crew rest and duty time were within required parameters and deemed not to be a factor in this mishap (Tabs R-11 to R-20 and BB-11 to BB-14).

10.OPERATIONS AND SUPERVISION

a. Operations

A review of 25 FTS operations was conducted and no discrepancies, anomalies, or deviations from normal operations tempo were noted (Tabs G-4, V-15.2 to V15.4, V-10.2 to V-10.3). Published guidance on flying military training routes with elevated bird-watch conditions were reviewed (Tab BB-57). Operations guidance specifies, when flying along segments reported in AHAS as SEVERE, crews will fly no lower than 1000 ft AGL until such time that a lower threat of bird activity can be determined and reported (Tab BB-57).

b. Supervision

The supervision for daily flight operations are the Director of Operations (DO) and Operations Supervisor (OpSup) (Tab BB-8). The DO monitors processes to document training and qualification of aircrew, scheduling of aircrew flying, verification of aircrew status, and approval of the daily flying schedule (Tab BB-4 to BB-5). The OpSup ensures prerequisites have been completed and briefs all pilots before flight on the current status of the airfield and training airspace as well as any updates to the weather (Tab BB-9). Additionally, the OpSup is available to assist aircrew in the event of a malfunction (Tab BB-8). A review of 25 FTS mission oversight of the MS was conducted, no discrepancies or anomalies were noted, and it was deemed not to be a factor in the mishap (Tabs R-47, V-15.2 to V15-4, V-10.3 to V-10.4).

11.HUMAN FACTOR ANALYSIS

The AIB evaluated human factors relevant to the mishap using the analysis and classification system model established by the Department of Defense Human Factors Analysis and Classification System guide and no defined human factors were found to be contributory in this mishap (Tabs BB-25 to BB-53, R-5 to R-22).

12.GOVERNING DIRECTIVES AND PULICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

i. AETCMAN 11-251, *T-38C Flying Fundamentals*, 4 April 2017
ii. AFH 11-203v1, *Weather for Aircrews*, 12 January 2012
iii. AFI 11-202v3, *71 OG Supplement, General Flight Rules*, 1 September 2017
iv. AFI 11-202v3 *AETC Supplement, General Flight Rules*, 30 January 2017
v. AFI 11-202v3, *General Flight Rules*, 10 Aug 2016
vi. AFI 11-2T-38v1 *AETC Supplement, T-38 Aircrew Training,* 30 January 2018
vii. AFI 11-2T-38v1, *T-38 Aircrew Training*, 1 September 2017

viii. AFI 11-2T-38v3 *AETC Supplement, T-38 Operations Procedures,* 6 October 2016
ix. AFI 11-2T-38v3, *T-38 Operations Procedures,* 2 October 2015
x. AFI 11-301v1, *AETC Supplement, Aircrew Flight Equipment (AFE) Program,* 18 August 2009, Certified Current on 9 May 2014
xi. AFI 11-301v1, *Aircrew Flight Equipment (AFE) Program,* 10 October 2017
xii. AFI 11-401 *AETC Supplement, Aviation Management,* 29 February 2016
xiii. AFI 11-401, *Aviation Management,* 10 December 2010, Certified Current 9 January 2013
xiv. AFI 11-418 *AETC Supplement, Operations Supervision,* 16 February 2016
xv. AFI 11-418, *Operations Supervision,* 14 October 2015
xvi. AFI 21-101, *Aircraft and Equipment Maintenance Management,* 21 May 2015
xvii. AFI 48-123, *Medical Examinations and Standards,* 5 November 2013
xviii. AFI 51-503, *Aerospace and Ground Accident Investigations,* 14 April 2015
xix. AFI 91-204, *Safety Investigations and Reports,* 27 April 2018
xx. AFI 38-101, *Air Force Organization,* 31 January 2017

NOTICE: All directives and publications listed above are available digitally on the Air Force Department Publishing Office website: http://www.e-publishing.af.mil or the Official Department of Defense website: http://www.dtic.mil/directives/index.html.

b. Other Directives and Publications Relevant to the Mishap

i. T.O. 1T-38C-1, *Flight Manual USAF Series T-38C Aircraft,* 8 March 16, Change 3, 5 October 2017, 1T-38C-1SS-20, 20 February 2018
ii. T.O. 1T-38C-1CL-1, *Flight Crew Checklist Pilot's Abbreviated,* 8 March 16, Change 3, 5 October 17, 1T-38C-1SS-20, 20 February 2018
iii. T.O. 1T-38C-2-4, *Pneudraulic Systems USAF Series T-38C Aircraft*
iv. *25 Flying Training Squadron Standards,* 16 February 2018
v. *25 Flying Training Squadron Briefing Guide,* 1 July 2017
vi. AP/1B, *Area Planning-Military Training Routes, North and South America,* 19 July 2018
vii. 71 FTW T-38C *In-Flight Guide,* 12 June 2017
viii. *Vance AFB Airfield Operations Flight Operating Instruction 91-1,* 27 June 2011
ix. *Supervisor of Flying (SOF) – Quick Reaction Checklist* (QRC), August 2018
x. *Department of Defense Human Factors Analysis and Classification System*

c. Known Deviations from Directives or Publications

None.

MICKLEY.WILLIAM.B.1048328705

21 February 2019

WILLIAM B. MICKLEY, Colonel, USAF
President, Accident Investigation Board

United States Air Force Accident Investigation Board Report

Aircraft Accident, Vance AFB

STATEMENT OF OPINION

T-38C, T/N 68-8206
VANCE AIR FORCE BASE, OKLAHOMA
17 AUGUST 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 17 August 2018, at approximately 1341 hours local time a T-38C, tail number 68-8206, assigned to the 71st Flying Training Wing (FTW), Vance Air Force Base (AFB), Oklahoma crashed in a field approximately 62 miles west of Vance AFB. The mishap aircraft (MA) was flown by a single pilot and was the lead aircraft in a two aircraft formation performing low-level training as part of a series of cross-country flights from Vance AFB to Minneapolis-St Paul, Minnesota. The mishap pilot (MP) was assigned to the 25th Flying Training Squadron within the 71 FTW. While flying at approximately 1,000-1,500 feet above the ground and looking over his left wing at his wingman, the MP heard a loud noise on the right side of the aircraft. The MP noted hearing an audible fire warning, seeing the right engine fire light, and seeing indications of flight control hydraulic and right generator failures. While initiating a climb away from the low-level route, the MP experienced a degradation in aircraft controllability and his wingman reported seeing a visible fire coming from the MA. The MP successfully ejected from the aircraft, sustaining minor injuries. The aircraft was valued at $11,015,639 and damaged beyond repair.

I find, by a preponderance of the evidence, that the cause of the mishap was ingestion of a Swainson's Hawk into the right, or number two, engine during flight. This bird strike caused the catastrophic loss of the engine and a fire in the forward engine bay. The fire melted through the aircraft skin, exposing the Flight Control and Utility Hydraulic Systems flexible hydraulic pressure and return lines to extreme heat, causing a degradation, and ultimate loss, of aircraft controllability. The MP applied all appropriate emergency procedures. However, the fire and loss of flight control authority necessitated ejection from the MA.

2. CAUSE

Upon investigation and analysis of aircraft systems, organic remains were found in the number two engine. The remains were confirmed by DNA experts at the Smithsonian Institute to have been from a Swainson's Hawk weighing approximately 32 ounces, on average. The loud noise

reported by the MP was the hawk striking the MA and being ingested into the engine. At the time of the bird strike, the engine was set to approximately 90% power and spinning at 15,500 revolutions per minute (RPM). When the bird entered the engine, it caused catastrophic damage to the compressor stage and an immediate deceleration of the engine. The rapid deceleration caused excessive torque to the engine-driven accessory gear box input drive coupling shaft. The drive coupling shaft sheared as designed, resulting in the loss of the aircraft's right electrical system generator and hydraulic system pump. Additionally, when the engine decelerated rapidly, fuel continued to be supplied to the ignition chamber at the commanded 90% power setting. The slowing of the engine RPM combined with constant fuel supply resulted in a rapid rise in exhaust gas temperature (EGT).

More significantly, the catastrophic damage to the engine compressor stage resulted in a fuel leak and fire in the forward engine bay. The fire, burning in excess of 935° F, exited the aircraft at the annulus door and melted the aircraft skin below the right horizontal stabilizer hydraulic actuator. This actuator is connected to the aircraft Flight Control and Utility hydraulic systems by four flexible, steel mesh covered, rubber hydraulic hoses rated to 400° F. The heat from the fire melted the internal rubber of these lines, resulting in the loss of hydraulic fluid and pressure in both systems. Further, the hydraulic fluid used in the mishap aircraft has an ignition flash point of 179.6° F. Once the rubber lining of the flexible hoses melted, hydraulic fluid seeped from the lines, ignited, and further fueled the aircraft fire.

3. SUBSTABTIALLY CONTRIBUTING FACTORS

I found no substantially contributing factors in the investigation of this mishap.

4. CONCLUSION

By preponderance of the evidence, I find the cause of the mishap to be ingestion of a Swainson's Hawk into the number two engine during flight. This bird strike resulted in catastrophic damage to the engine, an uncontrollable fire, and the loss of aircraft flight controls. The MP took all appropriate procedural actions in a timely manner but they were ineffective in rendering the aircraft safe to fly. The MP was forced to eject, which resulted in the destruction of a T-38C valued at $11,015,639.

MICKLEY.WILLIAM.B.1048328705

21 February 2019

WILLIAM B. MICKLEY, Colonel, USAF
President, Accident Investigation Board

United States Air Force Accident Investigation Board Report

Aircraft Accident, Vance AFB

INDEX OF TABS