

**UNITED STATES AIR FORCE**  
**AIRCRAFT ACCIDENT INVESTIGATION**  
**BOARD REPORT**



**T-38A, T/N 64-13304**

**1ST RECONNAISSANCE SQUADRON  
9TH RECONNAISSANCE WING  
BEALE AIR FORCE BASE, CALIFORNIA**



**LOCATION: SACRAMENTO MATHER AIRPORT, CALIFORNIA**

**DATE OF ACCIDENT: 18 FEBRUARY 2021**

**BOARD PRESIDENT: COLONEL ROBERT T. RAYMOND**

**Conducted IAW Air Force Instruction 51-307**




DEPARTMENT OF THE AIR FORCE  
HEADQUARTERS AIR COMBAT COMMAND  
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23 JUN 2021

**ACTION OF THE CONVENING AUTHORITY**

The report of the accident investigation board conducted under the provisions of Air Force Instruction 51-307, *Aerospace and Ground Accident Investigations*, that investigated the 18 February 2021 mishap involving a T-38A, T/N 64-13304, operated by the 1st Reconnaissance Squadron, complies with applicable regulatory and statutory guidance, and on that basis it is approved.

  
CHRISTOPHER P. WEGGEMAN  
Lieutenant General, USAF  
Deputy Commander

*People First... Mission Always...*

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

**T-38A, T/N 64-13304  
Sacramento Mather Airport, California  
18 February 2021**

On 18 February 2021 the mishap pilot (MP) and mishap instructor pilot (MIP), flying T-38A tail number (T/N) 64-13304, assigned to the 1st Reconnaissance Squadron, Beale Air Force Base (AFB), California, flew a day training mission that included practice landings at nearby Sacramento Mather Airport. During a touch-and-go landing attempt at Mather Airport, at approximately 1648 Zulu, or 0848 Local Time (L), the mishap aircraft (MA) impacted the runway without its landing gear fully extended. The total cost of damage to the MA was \$3,001,563.

The flight was planned as a single-ship training mission from Beale AFB consisting of practice maneuvers in a local military operating area (MOA), practice approaches and landings at Mather Airport and a planned return to Beale AFB. After completing practice maneuvers in the MOA, the MIP flew the MA to Mather Airport and executed an uneventful approach to a touch-and-go landing on Runway 22 Left (22L). The MP then flew a second practice approach to Runway 22L and attempted a touch-and-go landing. After the MA touched down the MP initiated the takeoff portion of the maneuver, advancing the throttles and raising the landing gear lever. When the landing gear began to retract, the MA descended toward the runway. The MP then briefly put the landing gear lever back down before placing the lever back up. The MA descended and the main landing gear (MLG) contacted the runway in a partially extended position approximately 2,320 feet from the approach end of the runway. The MLG collapsed, and the MA settled onto the runway. The force of the MA on the partially extended MLG and subsequent ground impact caused a hydraulic system failure and fire in the right MLG bay. The MA slid on its fuselage before coming to rest approximately 6,170 feet from the approach end of the runway. The MP and MIP egressed the MA with no injuries as emergency response crews extinguished the fire.

The Accident Investigation Board (AIB) President found by a preponderance of evidence the cause of the mishap was the MP prematurely raising the landing gear lever during the touch-and-go landing maneuver. The MP failed to execute correct touch-and-go landing procedures, which state that the landing gear lever should be raised when “DEFINITELY AIRBORNE” and “WHEN POSITIVE RATE OF CLIMB IS ESTABLISHED.” The premature landing gear retraction resulted in the MA impacting the runway without its landing gear fully extended, and with no opportunity for the MIP to intervene to prevent the mishap. Additionally, the AIB President found by a preponderance of evidence the MP’s misperception of an established positive climb rate following the touch-and-go landing attempt substantially contributed to the mishap.

*“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 by the United States or by any person referred to in those conclusions or statements.”*

**SUMMARY OF FACTS AND STATEMENT OF OPINION**  
**T-38A, T/N 64-13304**  
**SACRAMENTO MATHER AIRPORT, CALIFORNIA**  
**18 FEBRUARY 2021**

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## ACRONYMS AND ABBREVIATIONS

|       |                                      |        |                              |
|-------|--------------------------------------|--------|------------------------------|
| °     | Degrees                              | MIP    | Mishap Instructor Pilot      |
| ”     | Inches                               | MLG    | Main Landing Gear            |
| 22L   | 22 Left                              | MOA    | Military Operating Area      |
| 2FL   | 2-Ship Flight Lead                   | MP     | Mishap Pilot                 |
| 4FL   | 4-Ship Flight Lead                   | MS     | Mishap Sortie                |
| ACC   | Air Combat Command                   | MX     | Maintainer                   |
| AF    | Air Force                            | NLG    | Nose Landing Gear            |
| AFB   | Air Force Base                       | OG     | Operations Group             |
| AFE   | Aircrew Flight Equipment             | OG/CC  | Operations Group Commander   |
| AFI   | Air Force Instruction                | ORM    | Operational Risk Management  |
| AFGM  | Air Force Guidance Memorandum        | OS     | Operations Supervisor        |
| AFMAN | Air Force Manual                     | PEX    | Patriot Excalibur            |
| AFPET | Air Force Petroleum                  | PIC    | Pilot in Command             |
| AFTO  | Air Force Technical Order            | PR/BPO | Pre-Flight/Basic Post-Flight |
| AGL   | Above Ground Level                   | PSI    | Pounds Per Square Inch       |
| AIB   | Accident Investigation Board         | RCP    | Rear Cockpit                 |
| BASH  | Bird/Wildlife Aircraft Strike Hazard | RH     | Right Hand                   |
| BMC   | Basic Mission Capable                | rpm    | Revolutions Per Minute       |
| CA    | California                           | RS     | Reconnaissance Squadron      |
| CC    | Commander                            | RW     | Reconnaissance Wing          |
| CTP   | Companion Trainer Program            | SOF    | Supervisor of Flying         |
| CTR   | Contractor                           | SPO    | System Program Office        |
| DoD   | Department of Defense                | SQ/CC  | Squadron Commander           |
| DO    | Director of Operations               | T/N    | Tail Number                  |
| FCF   | Functional Check Flight              | TH     | Through Flight               |
| FCP   | Front Cockpit                        | T.O.   | Technical Order              |
| IAW   | In Accordance With                   | TP     | Traffic Pattern              |
| IFE   | In-Flight Emergency                  | USAF   | United States Air Force      |
| ILOC  | In-Flight Operations Check           | VFR    | Visual Flight Rules          |
| ILS   | Instrument Landing System            | Z      | Zulu Time                    |
| IMDS  | Integrated Maintenance Data System   |        |                              |
| IP    | Instructor pilot                     |        |                              |
| L     | Local Time                           |        |                              |
| L1    | Level 1                              |        |                              |
| LASDT | Low Altitude Step-Down training      |        |                              |
| LH    | Left Hand                            |        |                              |
| LG UP | Landing Gear Up                      |        |                              |
| LRS   | Logistics Readiness Squadron         |        |                              |
| MA    | Mishap Aircraft                      |        |                              |
| MAX   | Maximum Afterburner                  |        |                              |
| MC    | Mishap Crew                          |        |                              |
| MEF   | Mission Execution Forecast           |        |                              |
| MIL   | Military Power                       |        |                              |

## SUMMARY OF FACTS

### 1. AUTHORITY AND PURPOSE

#### a. Authority

On 13 April 2021, Colonel Gail E. Crawford, the Staff Judge Advocate, on behalf of the Deputy Commander of Air Combat Command, appointed Colonel Robert T. Raymond to conduct an aircraft accident investigation of the 18 February 2021 mishap of a T-38A aircraft at Beale AFB, California (CA) (Tab Y-4 to Y-5). The Accident Investigation Board (AIB) convened at Beale AFB (Tab Y-4). A Legal Advisor (Lieutenant Colonel), Medical Member (Major), Pilot Member (Captain), Maintenance Member (Master Sergeant), and a Recorder (Staff Sergeant) were also appointed to the board (Tab Y-4 to Y-5). The AIB was conducted in accordance with Air Force Instruction (AFI) 51-307\_AFGM2020-01, *Aerospace and Ground Accident Investigations*, dated 26 February 2020.

#### b. Purpose

In accordance with AFI 51-307\_AFGM2020-01, *Aerospace and Ground Accident Investigations*, this Accident Investigation Board conducted a legal investigation to inquire into all the facts and circumstances surrounding this Air Force aerospace accident, prepare a publicly-releasable report, and obtain and preserve all available evidence for use in litigation, claims, disciplinary action, and adverse administrative action.

### 2. ACCIDENT SUMMARY

On 18 February 2021, at approximately 1648 Zulu (Z), or 0848 Local Time (L), a T-38A Talon aircraft, tail number (T/N) 64-13304, (referred to as the mishap aircraft or MA) landed without its landing gear fully extended following a touch-and-go landing attempt on Runway 22 Left (22L) at Sacramento Mather Airport, CA (Tabs A-30 to A-31, and V-6.4).

The mishap crew (MC), consisting of the mishap pilot (MP) and mishap instructor pilot (MIP), were assigned to Beale Air Force Base (AFB), CA and executed a day training mission that included practice maneuvers in a local military operating area (MOA) followed by approaches and landings at nearby Mather Airport (Tabs A-30 to A-31, V-5.4, V-6.4, and AA-2). During a touch-and-go landing attempt, MA impacted the runway without its landing gear fully extended (Tab EE-19). The MA then slid on its fuselage and caught fire before coming to rest approximately 6,170 feet from the approach end of Runway 22L at Mather Airport (Tab EE-19). The MP and MIP egressed the aircraft with no injuries as emergency response crews extinguished the fire. (Tabs V-6.9 and EE-19). The total monetary value of government loss was \$3,001,563. (Tab EE-45)



### 3. BACKGROUND

#### a. Air Combat Command (ACC)

Headquartered at Joint Base Langley-Eustis, Virginia, ACC is one of ten major commands in the United States Air Force (USAF) (Tab CC-2). ACC organizes, trains, and equips Airmen who fight in and from multiple domains to control the air, space, and cyberspace (Tab CC-2). ACC is responsible for providing combat air, space, and cyber power and combat support that assures mission success to America's warfighting commands (Tab CC-2). In this role, ACC is the lead command for fighter, command and control, intelligence, surveillance and reconnaissance, personnel recovery, persistent attack and reconnaissance, electronic warfare, and cyber operations, ACC is responsible for providing combat air, space, and cyber power and the combat support that assures mission success to America's warfighting commands (Tab CC-2).



#### b. 16th Air Force (Air Forces Cyber) (16 AF)

Headquartered at Joint Base San Antonio-Lackland, Texas, 16 AF is the first-of-its-kind Numbered Air Force. Also known as the Air Force's Information Warfare Numbered Air Force, it integrates multisource intelligence, surveillance, and reconnaissance, cyber warfare, electronic warfare, and information operations capabilities across the conflict continuum (Tab CC-3). Additionally, it is the Service Cryptologic Component responsible to the National Security Agency/Central Security Service for Air Force matters involving the conduct of cryptologic activities, including the full spectrum of missions directly related to both tactical warfighting and national-level operations (Tab CC-4). It operates globally across nine wings and one center to provide capabilities to persistently engage with the adversary of today and protect the future of our nation (Tab CC-4).



#### c. 9th Reconnaissance Wing (9 RW)

Located at Beale AFB, CA, the 9 RW is responsible for providing national and theater command authorities with timely reliable, high-quality, high-altitude reconnaissance products (Tab CC-5). The 9 RW is composed of more than 4,500 personnel at Beale and multiple overseas operating locations (Tab CC-5). The 9 RW includes a command staff, seven directorates and 24 squadrons (Tab BB-44). In alignment with ACC guidance, 9 RW reorganized the Wing structure beginning in June 2019 (Tab BB-44). The reorganization executed by the 9 RW inactivated the 9th Operations Group, 9th Maintenance Group and 9th Mission Support Group, and realigned the existing resources into an A-Staff structure to facilitate enhanced communications between the Wing Commander, squadron, and directorate leadership (Tab BB-45). The 9 RW/A3 supports RW squadrons to provide mission-ready combat reconnaissance forces needed to respond to today's challenges and prepare for tomorrow's conflicts across the full range of military operations (Tab BB-46). The 9 RW/A3 supports squadrons in the planning, training, resourcing, and execution of 9 RW force employment worldwide, coordinates and synchronizes global/local 9 RW operations, and retains oversight of wing training, wing standardization and evaluations, wing





weapons and tactics, and operations supervision responsibilities formerly assigned to the 9th Operations Group Commander under the previous Wing structure (Tab BB-16 and BB-46).

**d. 1st Reconnaissance Squadron (1 RS)**



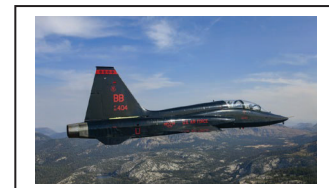
Located at Beale AFB, CA, the 1 RS is responsible for training all High-Altitude Intelligence, Surveillance, and Reconnaissance aircrew for the U-2S Dragon Lady and the RQ-4 Global Hawk (Tab CC-6). Training for all U-2S pilots includes additional qualification in the T-38A Talon, the companion trainer to the U-2S (Tab CC-6). Over 100 active duty airmen, civilians, and contractors are assigned to the 1 RS (Tab CC-7). The unit operates the world's only 5 TU-2S models in existence, and 11 T-38As (Tab CC-7).

**e. 99th Reconnaissance Squadron (99 RS)**



The 99 RS mission is to employ High-Altitude Intelligence, Surveillance and Reconnaissance to execute effective and sustained U-2 operations globally (Tab CC-8). The 99 RS is responsible for providing critical intelligence for use by the highest levels of our government (Tab CC-8).

**f. T-38A Talon**



The T-38A 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-9). Most of the United States Air Force's T-38A's have been converted to T-38C's through an avionics upgrade program and a propulsion modification to improve low-altitude engine thrust (Tab CC-12 to CC-13). However, ACC uses the T-38A for its Companion Trainer Program (CTP) (Tab CC-6).

The T-38A is used in the ACC CTP to support the proficiency, instrument, evaluation, off-station training requirements, and other mission support duties as directed by wing and group leadership (Tab BB-48). The primary purpose of T-38A flying in the U-2 program is to maintain flying proficiency and continuity due to limited number of training sorties and hours available in the U-2 (Tab BB-48). The majority of instrument training for U-2 pilots is accomplished in the T-38A (Tab BB-48). Because of limited U-2 training resources, pilot instrument evaluations are administered in the T-38A (Tab BB-48).

**(1) Touch-and-Go Landing**

Air Force Manual (AFMAN) 11-250, Volume 1 (11-250v1), *T-38 Flying Fundamentals*, dated 23 June 2009 and the T.O. 1T-38A-1 flight manual describe proper procedures and techniques for

executing touch-and-go landings in the T-38A (Tab BB-13 to BB-14, BB-32, and BB-57). At touchdown, the pilot advances power to military power (MIL) or maximum afterburner (MAX), if required, and smoothly lowers the nose to takeoff attitude (Tab BB-32). The pilot checks the engine instruments, accelerates to takeoff airspeed, and allows the aircraft to fly off the runway (Tab BB-32). When definitely airborne and with a positive rate of climb established, the pilot retracts the landing gear, then retracts the wing flaps (Tab BB-13, BB-31, and BB-57).

An established positive climb rate can be verified by an increasing altimeter and a positive vertical velocity indicator, as well as visual confirmation that the aircraft is climbing away from the ground (Tab V-4.2 to V-4.3, and V-5.14).

Inexperienced pilots flying at formal undergraduate pilot training or pilot instructor training are required to make a “gear clear” call and pause before raising the landing gear lever (Tabs V-4.3, BB-29, and BB-31). This call gives the other crewmember a chance to intervene (Tab BB-31). However, there is no requirement for this communication outside of these formal training courses (Tabs V-4.3, BB-29, and BB-31).

## **(2) Single-Engine Patterns and Landings**

AFMAN 11-250v1 describes proper techniques for executing simulated single-engine patterns and landings. The pilot flies single-engine patterns from a straight-in approach (Tab BB-33). The pilot then sets the simulated failed engine not less than 60 percent revolutions per minute (rpm) during a simulated, single-engine approach (Tab BB-33). The single-engine landing is similar to the normal landing except that with 60-percent flaps selected, drag is not as great as with full flaps and power must be reduced slightly sooner than a full-flap landing under the same conditions to touch down in the same location (Tab BB-33). The pilot ensures both throttles are checked in idle for touchdown and uses both engines for the takeoff following a simulated single-engine touch-and-go landing (Tab BB-33).

## **(3) Traffic Pattern Stall**

AFMAN 11-250v1 describes the proper techniques for executing traffic pattern stall training, also known as a “turning approach-to-stall exercise” (Tab BB-34 to BB-35). Stall training develops a number of critical skills that can prevent catastrophe in the traffic pattern (Tab BB-34). Stall training keys on the important areas of recognition and recovery (Tab BB-34). To execute this training, the pilot establishes the landing configuration, sets the power, and flies a simulated final turn with an intentional error (Tab BB-35). For the level final turn, the pilot maintains a fairly constant bank angle and allows the airspeed to decrease (Tab BB-35). For errors in other than the level final turn, the pilot progressively increases the bank and increases aft (rear) pull on the control stick (Tab BB-35). For any of the above examples, as the pilot detects a stall, he or she executes a stall recovery (Tab BB-35).

Recovery is complete when the descent is stopped, positive controlled climb is established, and aircraft has sufficient airspeed for continued flight (Tab BB-35).

## **(4) Data Limitations**

The T-38A systems do not record control inputs, cockpit voice recordings, or any parametric data from gauges or sensors (Tab EE-46 to EE-47). However, the MP flew the MS with an approved global positioning system (GPS) device that recorded the MA's position and altitude data over time (Tabs AA-3 to AA-6, and BB-19). This data was extrapolated to recreate the MS profile (Tab AA-3 to AA-6, and Z-2 to Z-4)

#### **g. Flying Operations Supervision Structure**

The basic supervision structure for flying operations consists of the Operations Group Commander (OG/CC), the Supervisor of Flying (SOF) and the squadron supervisors, e.g., Operations Supervisor (OS or Top 3). (Tab BB-7). Of note, the 9 RW recently reorganized from a typical structure where the OG/CC is responsible for overseeing flying operations, to an Air Staff structure where the OG/CC responsibility and authority for operations supervision now falls to the A3 (Tab BB-45 to BB-46). The OG/CC (A3) will be available to the SOF or Top 3 for consultation during flying operations (Tab BB-7 and BB-16). The OG/CC (A3) will ensure locally developed checklists outline procedures for normal and emergency situations (Tab BB-8 and BB-16). The SOF is typically a group-level position and a direct representative of the OG/CC (Tab BB-9). The 9 RW reorganization changed the SOF to a wing-level position and a direct representative of the 9 RW/CC (Tab BB-16). The SOF is the focal point for command and control of flight operations, and ensures that In-Flight Emergency (IFE) recovery plans and weather related mission changes reflect sound airmanship, follow established guidance, and adhere to sound operational risk management (ORM) principles (Tab BB-9). The SOF directs appropriate actions to correct/prevent unsafe situations by using all resources to include radios, telephone hot lines, and all wing-flying operations on the ground or in the air (Tab BB-9). The OS/Top 3 will be available to assist the SOF and aircrew, be the liaison between Operations and Maintenance during the execution of the flying schedule, and debrief the Squadron Commander (SQ/CC) and/or Director of Operations (DO) of any aircraft involved in an unusual situation, IFE, weather divert, or other events (Tab BB-10).

### **4. SEQUENCE OF EVENTS**

#### **a. Mission**

The Mishap Sortie (MS) was scheduled as a single-ship local training mission from Beale AFB (Tabs V-5.4, V-6.4, and AA-2). The MP was in the front cockpit (FCP) and the MIP was in the rear cockpit (RCP) (Tabs V-6.2 and AA-2). The planned mission profile included practice maneuvers in the China MOA, followed by practice approaches and landings at Sacramento Mather Airfield (KMHR) and a return to Beale AFB (Tab V-5.4 and V-6.2).

#### **b. Planning**

The MC completed flight planning prior to the MS in accordance with applicable regulations and standard operational practices (Tab BB-18 to BB-19, and BB-54 to BB-56). The MC completed the ORM worksheet, a standardized checklist identifying common risk factors (Tab AA-10). As cumulative risk increases, the level of the authority required to approve the mission profile also

increases (Tab AA-10). The digital version of the ORM worksheet on the squadron computer network initially calculated a “Low Risk” level (between 0 and 10 total risk points), though the worksheet inaccurately totaled the MC’s risk points as 9 (Tab AA-10). The actual sum of the risk factors initially identified by the MC was 11, or “Medium Risk” (Tab AA-10). Due to computer network issues the MC was unable to update the digital ORM worksheet with additional factors prior to the MS (Tab V-5.6). However, the MC discussed their additional risk factors prior to the MS and verbally added “some points” to account for the risk caused by the MP leaving work the day prior just prior to crew rest requirements (Tab V-5.6). The MC verbally briefed the updated level of risk to the OS (Tab V-5.6). Risk factors initially identified on the ORM worksheet included: medium risk for sleep/circadian rhythm, medium risk for RCP personal concerns, high risk for duty day, medium risk for Bird/Wildlife Aircraft Strike Hazard (BASH), and medium risk for thunderstorms/icing/moderate or greater turbulence enroute (Tab AA-10).

The MP conducted the pre-mission briefing using the local In-Flight Guide, since computer issues prevented access to digital briefing slides that are typically used (Tabs V-5.4 and BB-22). The MP was to execute all ground operations, a static takeoff, departure to the China MOA, and a traffic pattern (TP) stall practice maneuver (Tab V-5.4 and V-6.4). The MIP was to execute a TP stall practice maneuver as well, then depart the MOA and proceed to Mather Airport for an instrument approach and touch-and-go landing (Tab V-5.4 and V-6.4). Following the first approach at Mather Airport, the MP planned to execute a simulated single-engine approach at Mather Airport (Tab V-5.4 and V-6.4). The MP and MIP would then execute multiple overhead patterns and touch-and-go landings before flying back to Beale AFB for one approach to a full-stop landing (Tab V-5.4).

### **c. Preflight**

The MC received a final briefing from the OS before proceeding to the flight line (Tab V-3.1 and V-5.6). The MC verbally discussed ORM concerns with the OS since computer issues prevented access to the daily digital ORM sheet (Tab V-3.1 and V-5.6). The preflight inspections and engine start of the MA were uneventful (Tab V-5.6 and V-6.4). The MA maintenance forms included an in-flight operational check (IFOC) request for the landing gear system, the RCP (MIP) radio, and the FCP (MP) horizontal situational indicator (Tab U-25 and U-26).

### **d. Summary of Accident**

The MP conducted the engine start and taxi (Tab V-6.4). The MIP took control of the MA at the end of the runway to perform a flight control check, then gave aircraft control back to the MP (Tab V-6.4). The MP executed a static takeoff at approximately 0812L (Tabs V-6.4 and AA-3). The MP flew the departure to the China MOA and executed a TP stall, after which the MIP took control of the MA and executed a TP stall (Tab V-6.4).

At 0825L, the MIP departed the MOA toward Mather Airport (Tabs V-6.4 and AA-4). The MIP received vectors from local radar approach control, call sign NorCal Approach, to execute an Instrument Landing System (ILS) approach to Runway 22 Left (22L) at Mather Airport (Tab V-6.4). The MIP flew a simulated single-engine approach and executed a touch-and-go landing at 0839L (Tabs V-5.8, V-6.4 to V-6.5, and AA-5).



After the first touch-and-go the MP took control of the MA on departure and received vectors from NorCal Approach to execute a simulated single-engine ILS approach to Runway 22L at Mather Airport (Tab V-6.5). During the radar approach the MP verified the airspeed was below the 240 knot landing gear limit and stated “BELOW 240, GEAR CLEAR” as a challenge to the MIP, to which the MIP responded “CLEAR” (Tab V-6.6). The MP then lowered the landing gear lever and set the flaps switch to 60% (Tab V-5.10 and V-6.6). Once the MA was configured for landing, the MP stated “HANDLE DOWN, 3 GREEN, AND 60 CONFIRMED” on the intercom (Tab V-6.6). The MIP physically confirmed that the landing gear lever was down, visually confirmed that the landing gear was down and the flaps were at 60%, and responded “CONFIRMED” (Tab V-6.6). The MP made a radio call “GEAR DOWN” at approximately 7 miles from the end of Runway 22L (Tab AA-11). The MP then reduced the left throttle to approximately 65% rpm for a simulated single-engine approach in accordance with normal procedures (Tabs V-5.8 and BB-32).

The MLG touched down at approximately 153 knots and approximately 1,000 feet past the approach end of Runway 22L at 0848L (Tabs V-5.8, Z-2, and AA-6). In accordance with normal procedures, once the MP felt the MLG touch down the MP advanced the throttles to MIL and lowered the nose slightly (Tabs V-5.8 and BB-32). Following initial touchdown, when the MP perceived the MA had begun to climb, the MP raised the landing gear lever (Tab V-5.8 to V-5.9).



Figure 1: T-38A animation of suspected touchdown point (Tab Z-2)

As the landing gear started to retract the MP felt the MLG tires “tapping” on the runway (Tab V-5.9). The MP described this feeling as the MLG tires alternating contact with the runway between the left and right MLG tires (Tab V-5.9). The MA then began to sink, at which point the MP put the landing gear lever back down (Tab V-5.9). This caused the landing gear retraction sequence to

stop and immediately start extending again (Tab EE-10). The MP then perceived that the MA was flying away from the runway, at which point the MP put the landing gear lever back to the up position (Tab V-5.9). This stopped the extension sequence and immediately restarted the retraction sequence before the MP again perceived that the MA was descending to the runway (Tabs V-5.9 and EE-10). The MP then attempted to select MAX power (Tab V-5.9). The MIP recognized that the MP had placed the landing gear lever up, and observed the MP's additional cycling of the landing gear lever as the MA continued to sink toward the runway (Tab V-6.7). At some point during this sequence, the MIP put hands on the flight control stick and throttles in an attempt to maintain takeoff attitude while attempting to push the throttles forward (Tab V-6.7).



Figure 2: T-38A animation of touchdown +2 sec (Tab Z-3)

As the MA descended the MLG doors contacted the runway, then the partially retracted MLG wheels touched down at an approximate angle of 12 degrees open (Tab EE-32 and EE-34). The MA fuselage continued to descend, compressing the MLG under its weight and impacting the runway surface (Tab EE-41). According to extrapolated GPS data, approximately 5 seconds elapsed between initial wheel touchdown and MA impact (Tab Z-2 to Z-4). Upon recognition that the MA had impacted the runway, both the MP and the MIP selected idle power (Tab V-5.9 and V-6.8). The MIP verbally commanded the MP to place the throttles in “off” after the MA impacted the runway and started sliding on its fuselage, an action that can only be accomplished from the front cockpit (Tabs V-6.9 and BB-12). The MP initially struggled to shut off the throttles due to a stuck throttle guard (Tab V-5.9). Once the MA came to a stop, the MP was able to shut off the throttles (Tab V-5.9). The MIP directed aircraft egress actions and directed the MP to place the fuel shut-off switches to “off” (Tab V-6.8 to V-6.9).



Figure 3: T-38A animation of ground impact of MLG doors and MLG (Tab Z-4)

#### e. Impact

At approximately 0848L, the MA's MLG wheels came into contact with the runway during the retraction sequence, approximately 2,320 feet from the approach end of Runway 22L (Tabs V-5.9, Z-4, EE-10, EE-19, EE-21, and EE-41). As the MA settled onto the runway, the weight of the MA forcibly collapsed the MLG, causing a hydraulic system failure that prevented the MLG from completing the retraction sequence to a locked position (Tab EE-17 and EE-19). The MA slid on its fuselage for approximately 3,850 feet, during which a fire ignited in the right MLG bay and both MLG doors were sheared off (Tab EE-19 and EE-31). The MA came to rest approximately 6,170 feet from the approach end of the runway with the fire still burning. (Tab EE-19 and EE-21).





Figure 4: Mishap points of interest (Tab EE-20)



Figure 5: Details of points of interest (Tab EE-20)

#### f. Egress and Aircrew Flight Equipment (AFE)

The MP and MIP's AFE were properly configured, performed as expected, and there is no evidence to suggest they were a factor in the mishap (Tabs T-11, T-23, and EE-19).

The MP and MIP were able to accomplish a ground emergency egress from the MA without injury after the MA came to a stop (Tabs V-6.9 and EE-19). The emergency egress system was not utilized, so the ejection seats were not removed for analysis. (Tab V-6.9)

#### g. Search and Rescue (SAR)

At 0848L, the MP made a radio call to Mather Tower, stating the MA was "on the ground" (Tab AA-11). Mather Fire and Rescue was dispatched, arrived at the MA, and put out the fire (Tab EE-19).

#### h. Recovery of Remains

Not applicable. The MP and MIP were able to accomplish a ground emergency egress from the MA without injury after the MA came to a stop (Tabs V-6.9 and EE-19).

## 5. MAINTENANCE

The AIB found no evidence that maintenance was a factor in this mishap. The maintenance history and documentation for the MA is below.

### a. Forms Documentation

A comprehensive review of the active and historical maintenance documentation forms between 8 August 2020 and the day of the mishap revealed a history of recurring maintenance on the MA landing gear system for failure to extend normally (Tab U-2 to U-14). Maintenance conducted a landing gear operational checkout without anomalies on 11 February 2021 (Tab U-12). All maintenance actions on the landing gear were accomplished in accordance with proper technical orders and procedures (Tab U-2 to U-14).

The AIB identified minor maintenance forms discrepancies related to operational checkouts (Tab U-2 to U-14). For example, when the Alternate Gear Release Control Mechanism Switches were replaced, the operational check was properly documented but was not properly referenced (Tab U-11). Also, on 17 February 2021, maintenance requested an IFOC of the landing gear as a follow-up to maintenance performed on 11 February 2021 (Tab U-25). This request was improperly referenced to the 11 February 2021 maintenance actions (Tab U-25).

Additionally, the AIB reviewed the Engine Trim Checklist, Air Force Technical Order Form 153, for both engines (Tab U-194). The form for Engine 1 listed a spool up time of 5 seconds from idle to MIL power, and 3 seconds from MIL to MAX power (Tab U-194). The form for Engine 2 listed a spool up time of 3 seconds from idle to MIL power, and 3 seconds from MIL to MAX power (Tab U-194).

### b. Inspections

The combined Pre-Flight/Basic Post Flight (PR/BPO) inspection is accomplished at the end of the specified flying period or prior to the first flight of the next specified flying period (Tab BB-36 to BB-39). The PR/BPO inspection consists of checking the aircraft condition by performing a visual examination and operational checks of certain components, areas or systems to ensure no defects exist that would be detrimental to flight (Tab BB-36 to BB-39). The Thru-Flight (TH) inspection is a between flights inspection and will be accomplished after each flight, when another flight is scheduled during the same flying period (Tab BB-38). The TH inspection consists of checking the aircraft for flight continuance suitability by performing a visual examination of certain components, areas or systems to ensure no defects exist which would be detrimental to further flight (Tab BB-38). T-38 phase inspections are accomplished upon accrual of 450 flying hours and are extensive inspections of the entire aircraft (Tab BB-41).

The last PR/BPO inspection of the MA occurred on 17 February 2021 at 1530L by Contractor 1 (CTR1) with no discrepancies noted (Tab U-14).

Prior to the mishap, all required inspections were completed in accordance with required maintenance procedures. (Tab U-25 to U-34).

### **c. Maintenance Procedures**

Contractors perform all T-38A maintenance at Beale AFB, adhering to Air Force guidance to conduct regular and unscheduled maintenance (Tab U-191 to 193). A thorough review of the MA's active and historical maintenance records revealed that maintenance actions complied with standard approved maintenance practices, procedures and technical orders (Tab U-25 to U-34).

Maintenance accomplished the last phase inspection on the MA on 13 February 2020 (Tab U-15). During the inspection, maintenance performed an operational checkout on the landing gear system, including normal operation of the landing gear retraction and extension sequences, associated indications and warning systems, and the functionality of the alternate gear release system (Tab U-16 to U-24). Additionally, the landing gear system inspection for foreign object debris was completed with no defects (Tab U-15).

### **d. Maintenance Personnel and Supervision**

Personnel involved with the MA's preparation for flight had proper and adequate training, experience, certification, and supervision to perform their assigned tasks (Tab U-35 to U-182).

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

The Air Force Petroleum (AFPET) Office at Vandenberg AFB, CA analyzed the sample for the fuel (Tab U-188 to U-189). The AFPET Office at Wright-Patterson AFB, Ohio tested the provided post-mishap engine oil and hydraulic fluid samples (Tab U-183 to U-187). The 9th Logistics Readiness Squadron (9 LRS) at Beale AFB provided liquid oxygen analysis (Tab U-190).

#### **(1) Fuel**

Technical analysis determined the fuel met requirements with no detectable volatile contamination (Tab U-188 to U-189).

#### **(2) Hydraulic Fluid**

Specification analysis indicated that no detectable volatility contamination was observed (Tab U-187).

#### **(3) Engine Oil**

Analysis of the oil samples on both engines were consistent with lubricating oil standards with no detectable volatile contamination (Tab U-183 to U-186).

#### **(4) Liquid Oxygen**

The oxygen samples were tested by the 9 LRS and determined no odors and no particles present. (Tab U-190).

## **f. Unscheduled Maintenance**

A review of the MA's active and historical maintenance records revealed 11 unscheduled maintenance events during the 120 days preceding the mishap (Tab U-2 to U-14 and U-25 to U-34). However, there was no evidence to suggest any of these were related to the mishap (Tab U-2 to U-14 and U-25 to U-34). The 11 unscheduled maintenance events were as follows:

On 25 August 2020, the forms documented a landing gear malfunction (Tab U-2). Aircrew reported that the landing gear failed to extend with normal procedures using the landing gear handle, also known as the landing gear lever, with normal hydraulic pressure readings (Tab U-2). The alternate gear handle was required to extend the landing gear (Tab U-2). On 21 September 2020, maintenance personnel adjusted the Nose Door Switches, then performed operational ground checks with no defects noted (Tab U-2).

On 21 September 2020, maintenance requested an IFOC of the landing gear (Tab U-3). Aircrew reported proper functionality of the landing gear system with no defects on 22 September 2020 (Tab U-3).

On 29 September 2020, the landing gear failed to extend in flight and the alternate gear handle was used to successfully extend the landing gear (Tab U-4). Maintenance personnel adjusted the MA's right main landing gear door switches after landing and put the MA on jacks in accordance with operational ground check procedures for the landing gear (Tab U-4). However, maintenance did not document the ground check in the aircraft forms (Tab U-4).

On 29 September 2020, maintenance requested an IFOC of the landing gear system (Tab U-5). Aircrew reported five successful extensions of the landing gear on 30 September 2020 (Tab U-5). On a subsequent flight on 30 September 2020, another IFOC of the landing gear was requested and it was confirmed operational with no defects (Tab U-6).

On 2 October 2020, maintenance requested an IFOC of the landing gear system (Tab U-7). On 4 October 2020, the IFOC was complied with no defects (Tab U-7).

On 3 December 2020, aircrew reported that the landing gear did not extend normally and the alternate gear handle was used to ensure safe landing gear down with proper indications (Tab U-8). Maintenance replaced the forward cockpit landing gear handle on 8 December 2020 and accomplished a follow-on operational checkout on the ground with no defects (Tab U-8).

On 8 December 2020, maintenance requested an IFOC of the landing gear (Tab U-9). On 16 December 2020, the IFOC of the landing gear system was reported as a failure (Tab U-9). The landing gear did not extend normally during flight and the alternate gear handle was used to extend the landing gear (Tab U-9).

On 22 December 2020, maintenance replaced the FCP landing gear handle and the Landing Gear/Flap Control relay panels to fix the 16 December 2020 landing gear discrepancy (Tab U-10).

On 30 December 2020, maintenance replaced the Alternate Gear Release mechanical switches (Tab U-11).

On 11 February 2021, maintenance replaced the nose landing gear up/downlock switches, left main landing gear downlock switch, and left main landing gear uplock switch (Tab U-13). Maintenance conducted ground operational checkouts on the landing gear on 11 February 2021 with no defects (Tab U-12). The MA flew on 12 February 2021 with no defects noted for the landing gear system (Tab U-197).

On 17 February 2021, maintenance requested an IFOC for the landing gear system as a follow-on action for the maintenance performed on 11 February 2021 (Tab U-25). This checkout was not completed due to the mishap on 18 February 2021 (Tab U-25).

## **6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS**

### **a. Structures and Systems**

#### **(1) Rudder**

Upon visual inspection, the rudder surface and actuators exhibited no obvious defects and appeared fully functional (Tab EE-22). They were resting as would be expected from a neutral stick position (Tab EE-22).

#### **(2) Stability Augmenter System**

The Stability Augmenter System actuator was visually inspected and was found to exhibit no obvious defects (Tab EE-23). It appeared fully functional (Tab EE-23).

#### **(3) Horizontal Stabilator (“H-stab” or “Stab”)**

The stabilator surfaces on both sides were found with scraping damage on the lower faces of their leading edges (Tab EE-24). No other damage was visible on either surface (Tab EE-24). Measurements taken indicate that, at some point during the mishap, the left-hand (LH) stabilator surface experienced a forward slide on the runway surface with the centerline pitched approximately 6.06 degrees (°) downward from horizontal (counter-clockwise from the left looking inboard) (Tab EE-24). Scrape direction indicates an approximate 10° left yaw and is aligned with the scrapes on the underside of the fuselage (Tab EE-24). The right-hand (RH) stabilator surface experienced a forward slide at some point during the mishap with the centerline pitched approximately 6.35° downward from horizontal (clockwise from the right looking inboard) (Tab EE-24). Scrape direction is in line with nose of the MA, i.e. 10° right from the scrapes on the LH stabilator surface and the underside of the aft (rear) fuselage (Tab EE-24). This difference indicates that the RH stabilator surface slid on the runway surface at a different time than the LH stabilator surface (Tab EE-24). Both stabilators are in nearly the same orientation relative to the ground as they were when they were sliding, and were found with their leading edges further downward than would be expected from a neutral stick position (Tab EE-24). Upon visual inspection, the actuators exhibited no obvious defects and appeared fully



functional (Tab EE-24). They were tagged and sent to Holloman AFB, New Mexico to be inspected, but there are no indications that they malfunctioned during the mishap (Tab EE-24). A pulley under the cockpit was found to be jammed against a fastener (Tab EE-25). This pulley transfers pitch commands between the two control sticks (Tab EE-25). The fastener bound up the system and rendered the control sticks immovable in the forward-aft direction (Tab EE-25). It is likely that this occurred as the MA slid on its nose (Tab EE-25).

#### **(4) Flap-stabilator Interconnect**

Upon visual inspection, the flap-stabilator interconnect mechanisms exhibited no obvious defects (Tab EE-25). They were actuated by hand to check for full range of motion and appeared fully functional (Tab EE-25). The trim actuator was found in the fully-retracted position, indicating maximum nose-up trim (Tab EE-26). Upon visual inspection, the actuator exhibited no obvious defects and appeared fully functional (Tab EE-26). The actuator was sent to Holloman AFB to be inspected and no anomalies were noted (Tabs U-195 to U-196 and EE-26). There were also no exterior indications that it malfunctioned during the mishap (Tab EE-26).

#### **(5) Flaps**

The flaps on both sides were heavily ground on the lower sides of the trailing edges (Tab EE-27). Both flaps were missing 1-2 inches (“) on their trailing edges and had similar wear patterns (Tab EE-27). The flaps were found to be 26° down from the wing centerline, corresponding to slightly less than 60% down; this matches the flap switches in the cockpit, which were at 60% (Tab EE-27).

#### **(6) Speed Brakes**

The speed brakes were found completely retracted with their trailing edges ground off (Tab EE-28). The LH speed brake was missing the bottom 4.25” but was otherwise intact (Tab EE-28). The RH speed brake was missing the bottom 5.25” and some of the remaining structure was broken and bent upward into the MA (Tab EE-28). Two metal pieces (ribs) found on the runway match the missing areas of the speed brakes (Tab EE-28). Upon actuation by hand, the speed brakes appeared to be functional and connected to hydraulics (Tab EE-28). The RH brake was not initially able to be actuated down out of the MA by hand because of a pinned rib (Tab EE-28). The rib was later cut off by a sheet metal crew from Beale AFB to remove the actuators (Tab EE-28). The LH speed brake grind angle was approximately 14° upward from the outer speed brake surface (Tab EE-28). The RH speed brake grind angle was approximately 15.5° for the main damage areas (Tab EE-28). The brakes showed no indication of being closed by the slide on the runway surface (Tab EE-28). The FCP switch was found to be in the forward (CLOSED) position (Tab EE-28). The RCP switch was found in the center (OFF) position, consistent with its spring loading (Tab EE-28). The speed brakes’ system design indicates that one or both of the cockpits’ switches were used to deploy and later retract the speed brakes (Tab EE-28). The speed brakes were not closed by air loads or ground scraping, indicating that the speed brakes were commanded closed after initially scraping the runway (Tab EE-13 and EE-28). Both actuator rods exhibited fire residue consistent with full retraction, implying that the speed brakes were fully closed during the fire (Tab EE-29).

## **(7) Ailerons**

Upon visual inspection, the ailerons exhibited no obvious defects and appeared fully functional (Tab EE-29). They were resting as would be expected from a neutral stick position (Tab EE-29). The actuators were not removed for inspection (Tab EE-29).

## **(8) Landing Gear**

Following the mishap, a recovery team was dispatched to take control of the MA (Tab EE-19). The team raised the MA off the ground using a crane and four-point sling, during which it was noted that the MLG automatically extended to a down position under the force of gravity (Tab EE-19). The recovery team activated the landing gear alternate release system to extend the nose landing gear, pinned the landing gear to ensure it did not collapse, lowered the MA onto the wheels and towed it to a nearby taxiway (Tab EE-19). Both MLG tires appeared to be flat and were changed by the recovery team before the MA was towed to Hangar 2 at Mather Airfield (Tab EE-19).

The RH MLG was covered in soot and charred material but appeared mechanically functional (Tab EE-31). A fire in the RH MLG bay appears to have had a hot spot near the area where the wheel is stowed under the fuselage (Tab EE-31). The LH MLG appeared functional and undamaged but the LH bay exhibited some fire damage in the inboard area (Tab EE-31). Neither gear strut door had any visible scraping or other mechanical damage (Tab EE-31). The Landing Gear Control, Safety, and Steering fuse was found to be popped in the forward-right circuit breaker panel (Tab EE-31). When this occurred all landing gear functionality would have ceased (Tab EE-31 and EE-32). The forward-right MLG uplock switch was found to have its insulation melted down to the bare wires as a result of the fire (Tab EE-32). It is plausible that electrical shorts upon meltdown tripped the circuit breaker mentioned above (Tab EE-32).

The MLG inboard doors and actuators were ground off, leaving approximately 2” of door and actuator rod left near the hinges (Tab EE-34). The actuators were extended and ground down to the same angle as the door remnants (Tab EE-34). Fragments from the lower portions of the doors were recovered from an indeterminate point on the runway by county airport staff (Tab EE-34). The RH door fragment exhibits smoke damage from the fire in the RH MLG bay, indicating that it was still attached for at least part of the fire (Tab EE-34). Remnants from the outboard edges of the MLG inboard doors indicate that the MLG wheels contacted the bottom edges of the doors at some point during the incident (Tab EE-35). The angles and lengths of the MLG struts and inboard doors indicate that the MA was pressing the doors down and outboard into the runway as the wheels came down on them (Tab EE-35).

The supply lines to the RH MLG torque cylinder were found to be leaking hydraulic fluid (Tab EE-36). These lines were inspected and were found leaking from one end of the line at 4 pounds per square inch (PSI) (Tab EE-36). The steel braids of the gear-extend line were cut open for inspection of the tube inside (Tab EE-36). The tube was found in small pieces under the leak (Tab EE-36). The damage indicates that the fire embrittled the blue Teflon layer and the black



inner rubber layer, which then fractured in multiple places and started leaking hydraulic fluid (Tab EE-36).

The nose landing gear (NLG) exhibited no damage and appeared fully functional (Tab EE-36).

### **(9) Wheels**

The outboard sidewall of the LH MLG tire exhibits a blowout approximately 8.75” long (Tab EE-32). The outboard rim of the LH MLG wheel exhibits a scrape approximately 4.125” long (Tab EE-32). Scrape direction indicates front-to-back, and the tire exhibits a larger, similarly-angled scrape (Tab EE-32). The angles of the scrapes indicate that the LH MLG impacted the ground momentarily at an angle of approximately 12° (Tab EE-32). Assuming level flight, this indicates that the ventral surface of the MA near the landing gear was approximately 8.5” above the surface of the runway during this impact (Tab EE-32).

The RH MLG wheel suffered significant fire damage (Tab EE-33). The outboard sidewall of the tire exhibits a blowout approximately 5” long (Tab EE-33). The rims of the RH wheel exhibit no scrape marks or other mechanical damage (Tab EE-33).

### **(10) Fuselage**

The LH engine ejector assembly was found to be bent upward by approximately 2” (Tab EE-37). Scraping damage on the same side indicates a nose-up attitude upon impact (Tab EE-37).

The aft fuselage exhibited scraping from Fuselage Station (FS) 489.5 to FS 486 (Tab EE-38). Scrape directions indicated that the MA yawed approximately 10° to the left (Tab EE-38).

The forward fuselage exhibited scraping from FS 219 to FS 87.7 (Tab EE-39). Gouged door lines were found to be leaking hydraulic fluid; these lines serve to operate the NLG forward door (Tab EE-39).

The NLG forward door exhibited an asymmetric scrape pattern (Tab EE-39). The damage indicates that the door was open as the nose of the MA was sliding along the runway surface (Tab EE-39). When the hydraulic power is cut, the NLG door is designed to close (but not lock) under spring pressure, which is consistent with photographs from the recovery (Tab EE-39 to EE-40). This implies that the NLG door shut after hydraulic power was lost (Tab EE-40).

#### **b. Evaluation and Analysis**

The landing gear system is equipped with a locking solenoid designed to prevent landing gear lever retraction with the left MLG strut compressed, as it would typically be when the aircraft is on the ground (Tab BB-52). Following the touch-and-go landing attempt, the MP reported feeling the MA “unstuck,” describing this as a “seat of the pants” feeling where the nose of the MA rose and the MP felt a climb away from the runway (Tab V-5.8 to V-5.9). Proper operation of the locking solenoid deactivates when the left MLG strut is compressed 1.00-1.75” (Tabs BB-52, and

EE-10 to EE-11). Post-mishap analysis revealed that the locking solenoid was correctly installed and operational at the time of the mishap (Tab EE-35 to EE-36).

Engineering analysis determined potential factors that may have contributed to initial MLG strut extension after touchdown, including a control stick input from the MP, possibly exacerbated by nose-up elevator trim (Tab EE-4, EE-6, and EE-48). Due to the lack of a flight data recorder, video evidence or any cockpit recording data it is impossible to state with certainty what caused the left MLG strut to extend (Tab EE-46 to EE-47). Neither the MP nor the MIP perceived an aircraft bounce nor any abnormal wind effects (Tab V-5.10, V-5.13, V-6.6, and V-6.8).

Engineering analysis determined that drag from the opening of the MLG doors at the start of the initial landing gear retraction sequence was negligible (Tab EE-8). Furthermore, engineering analysis determined that the increase in drag from the slightly open speed brakes would not be sufficient to inhibit takeoff under normal thrust (Tab EE-6).

The mechanical systems of the MA showed no signs of malfunction during the mishap event (Tab EE-43).

## **7. WEATHER**

### **a. Forecast Weather**

The local Mission Execution Forecast (MEF) for Beale AFB at 0800L predicted winds out of the east (90°) at 6 knots, 10 statute miles visibility, and no ceiling (Tab W-2). There was no other significant weather reported at the time of the mishap (Tab W-2).

### **b. Observed Weather**

At the approximate time of the mishap, Meteorological Aerodrome Reports indicated weather at Mather Airport with winds out of the east (80°) at 8 knots, 10 statute miles of visibility, scattered clouds at 10,000 feet above ground level (AGL), 9° Celsius, and dew point at 0° Celsius (Tab W-4).

### **c. Space Environment**

Not Applicable.

### **d. Operations**

The MS was conducted within prescribed weather requirements and in accordance with published restrictions (Tab BB-15). The observed winds were reported at 8 knots out of the east approximately six minutes after the mishap (Tab W-4). The MP and MIP observed no significant wind effects (Tab V-5.10, V-5.13, and V-6.8). No weather hazards were reported, and there was no evidence to suggest weather was a factor in this mishap (Tabs V-5.8, V-5.13, V-6.5, V-6.8, and W-4).

## 8. CREW QUALIFICATIONS

### a. Mishap Pilot

At the time of the incident, the MP was current, qualified, and experienced in two aircraft: U-2S and T-38A (Tabs T-16 and AA-8). He was previously qualified as a KC-135 pilot and C-12 instructor pilot (Tab T-22). He had 5264.2 total flight hours, including 515.1 flight hours in the T-38A (Tab T-14 and T-15).

In addition to the basic T-38A qualification, at the time of the mishap the MP was qualified to accomplish the following tasks in the T-38A: 2-ship Flight Lead (2FL), Low-Altitude Step Down Training (LASDT) level 1 (L1), and Weather Category 2 (300-1/2) (Tab AA-8 and AA-9).

At the time of the mishap, the MP was an experienced Basic Mission Capable (BMC) U-2S and TU-2S Evaluator/Instructor Pilot and was qualified to accomplish the following tasks in the U-2S and TU-2S: Functional Check Flight (FCF) pilot, Egress Instructor, Operations Supervisor, SOF instructor, and Weather Category 2 (300-1/2) (Tab AA-8 and AA-9).

At the time of the mishap, the MP's recent flight time in the T-38A and U-2S were as follows (Tab T-26 to T-29).

| MP T-38A     | Hours | Sorties | MP U-2S      | Hours | Sorties |
|--------------|-------|---------|--------------|-------|---------|
| Last 30 Days | 5.9   | 5       | Last 30 Days | 8.4   | 4       |
| Last 60 Days | 8.3   | 7       | Last 60 Days | 8.4   | 4       |
| Last 90 Days | 14.9  | 13      | Last 90 Days | 11.6  | 6       |

The MP's most recent T-38A flight prior to the MS was 11 February 2021 (Tab T-16).

### b. Mishap Instructor Pilot

At the time of the mishap, the MIP was current, qualified, and experienced in two aircraft: U-2S and T-38A (Tabs T-4 and AA-8). He was previously qualified as an instructor pilot in the B-1B and T-6 (Tab T-10). He had 2811.1 total flight hours, including 199.1 flight hours in the T-38A (Tab T-2 and T-3).

In addition to the basic T-38A qualification, at the time of the mishap the MIP was qualified to accomplish the following tasks in the T-38A: Instructor Pilot (IP), 4-Ship Flight Lead (4FL), Egress Instructor, and Weather Category 2 (300-1/2) (Tab AA-8).

At the time of the mishap, the MIP was an experienced Basic Mission Capable (BMC) U-2S instructor pilot and was qualified to accomplish the following tasks in the U-2S: Egress Instructor, SOF, Operations Supervisor, and Weather Category 2 (300-1/2) (Tab AA-8 and AA-9).

On the day of the mishap, the MIP's recent flight time in the T-38A and U-2S were as follows (Tab T-30 to T-31):

| MIP T-38A    | Hours | Sorties | MIP U-2S     | Hours | Sorties |
|--------------|-------|---------|--------------|-------|---------|
| Last 30 Days | 9.8   | 8       | Last 30 Days | 6.5   | 2       |
| Last 60 Days | 14.6  | 12      | Last 60 Days | 14.5  | 6       |
| Last 90 Days | 17.1  | 14      | Last 90 Days | 14.5  | 6       |

The MIP's most recent T-38A flight prior to the MS was 17 February 2021 (Tab T-4).

## 9. MEDICAL

### a. Qualifications

At the time of the mishap, both MP and MIP members were medically qualified for flight duty. (Tab DD-2 to DD-3). Both the MP and MIP were up-to-date on all required medical examinations and had current Department of Defense (DD) Form 2992s, *Medical Recommendation for Flying or Special Operational Duty* (Tab DD-2 to DD-23).

### b. Health

The MP received his most recent periodic health assessment on 2 November 2020, and revealed no disqualifying medical conditions (Tab DD-4 to DD-13).

The MIP received his most recent periodic health assessment on 7 August 2020, and revealed no disqualifying medical conditions (Tab DD-14 to DD-23).

### c. Pathology

The 9th Medical Group Laboratory at Beale AFB collected blood samples from the MP and MIP after the mishap. All toxicology testing resulted in negative findings (Tab DD-24 to DD-25).

### d. Lifestyle

The medical records, toxicology reports, 72-hour and 7-day History Forms for the MP and MIP contains no evidence to suggest any mishap-contributing lifestyle factors, to include unusual habits, behaviors, or stress (Tab DD-24 to DD-49). There is no evidence to suggest that lifestyle factors contributed to the mishap.

### e. Crew Rest and Crew Duty Time

United States Air Force pilots are required to have proper crew rest, as defined by AFI 11-202v3, paragraph 2.1, prior to performing in-flight duties (Tab BB-24). Crew rest consists of a minimum 12-hour non-duty period before the designated flight duty period begins (Tab BB-24). During this time, aircrew may participate in meals, transportation, or rest as long as there is an opportunity for at least eight hours of uninterrupted sleep (Tab BB-24). The MP and MIP verified that they had proper crew rest before the mishap flight (Tab V-5.6 and AA-10). Furthermore, the MC did not

indicate any noteworthy sleep issues or deficiencies before the mishap flight in their 72-hour and 7 day History Forms (Tab DD-26 to DD-47).

## **10. OPERATIONS AND SUPERVISION**

### **a. Operations**

AIB interviews with pilots and the 1 RS commander revealed that operations tempo was normal to slightly high in the squadron (Tab V-3.2, V-4.1, V-5.3, and V-6.2). Although aircraft availability often presents challenges for ensuring adequate sorties for 1 RS pilots, those interviewed stated they have adequate opportunities to remain safe and proficient in the T-38A as part of the CTP (Tab V-4.2, V-5.13, V-5.15, and V-6.9).

Airfield conditions at Mather Airport were in sufficient working order for the planned approaches and landings, and there were no identified airfield hazards (Tabs V-5.8, V-6.6, W-6).

The AIB found no evidence to suggest that operations tempo or other operational conditions were factors in this mishap.

### **b. Supervision**

The 1 RS scheduled the sortie in accordance with the CTP, and both the MP and MIP were current and qualified for the mission with the MIP as the pilot in command (PIC) (Tabs T-4, T-16, AA-2, and AA-8). The on-duty OS provided the step brief for the MC (Tab V-3.1). Of note, the MP signed the flight authorization for the MS, but 9 RW guidance dictates that the highest qualified pilot in the aircraft should have signed (Tabs AA-2 and BB-50). There is no evidence to suggest this minor oversight was a factor in the mishap.

The overall risk assessment for the MS was initially annotated as “Low Risk” on the unit’s digital ORM sheet, which is updated by pilots prior to their missions (Tab AA-10). When interviewed, the MP indicated that computer network issues prevented updating the ORM sheet digitally after determining that the MP’s duty day on the previous day increased the risk level from what was saved on the network (Tabs V-5.6 and AA-10). The MP and MIP discussed these changes verbally during the flight briefing and with the OS prior to the mission (Tab V-5.6). The MP, MIP and OS indicated a 1 RS culture in which they would have felt comfortable identifying issues to squadron leadership and removing themselves from the flight if warranted. (Tabs V-3.1, V-5.6 and V-6.3 to V-6.4).

The AIB found no evidence to suggest that supervision was a factor in the mishap.

## **11. HUMAN FACTORS ANALYSIS**

### **a. Introduction**

The Department of Defense Human Factors Analysis and Classification System 7.0 lists potential human factors that can play a role in aircraft mishaps and identifies potential areas of assessment

during an accident investigation (Tab BB-2). Three human factors were identified as relevant to the mishap as listed below.

**b. Applicable Factors**

- (1) **AE103 Procedure Not Followed Correctly:** is a factor when a procedure is performed incorrectly or accomplished in the wrong sequence (Tab BB-3).
- (2) **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-4).
- (3) **PC104 Confusion:** is a factor when the individual is unable to maintain a cohesive and orderly awareness of events and required actions and experiences a state characterized by bewilderment, lack of clear thinking or (sometimes) perceptual disorientation (Tab BB-5).

**12. GOVERNING DIRECTIVES AND PUBLICATIONS**

**a. Publicly Available Directives and Publications Relevant to the Mishap**

- (1) AFI 51-307\_AFGM2020-01, *Aerospace and Ground Accident Investigations*, 26 February 2020
- (2) AFI 91-204\_AFGM 2020-01, *Safety Investigation and Hazard Reporting*, 7 July 2020
- (3) AFMAN 11-250, Volume 1, *T-38 Flying Fundamentals*, 23 June 2009
- (4) Department of Defense (DoD) Human Factors Analysis and Classification System, Version 7.0

**NOTICE:** The DoD HFACS may be found at:  
<https://www.safety.af.mil/Divisions/Human-Factors-Division/HFACS/>.

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

**b. Other Directives and Publications Relevant to the Mishap**

T.O. 1T-38A-1, *USAF Series T-38A Aircraft Flight Manual*, 1 April 2020

**c. Known or Suspected Deviations from Directives or Publications**

- (1) T.O. 1T-38A-1, *USAF Series T-38A Aircraft Flight Manual*, 1 April 2020, page 2-22, “TOUCH-AND-GO LANDINGS” states: “To make a touch-and-go landing, perform the desired approach and landing. After touchdown, follow the normal go-around procedure.” Page 2-21 states: “1. Throttles—MIL (MAX if necessary); 2. Landing gear lever—LG UP [landing gear up] (WHEN DEFINITELY AIRBORNE); 3. Wing Flap lever—UP.” Page 2-23, Figure 2-9. Landing and Go-Around Pattern describes the following actions after touchdown of the main wheels: “THROTTLES – MIL, LANDING GEAR – UP WHEN POSITIVE RATE OF CLIMB IS ESTABLISHED” (Tab BB-13 to BB-14, and BB-57).
  
- (2) AFMAN 11-250v1, paragraph 3.10 states: “At touchdown, advance power to MIL (or MAX, if required) and smoothly lower the nose to the takeoff attitude or slightly below. Do not release back stick pressure abruptly. Attempt to keep the nosewheel from contacting the runway. Momentary contact is acceptable. Check the engine instruments and accelerate to takeoff airspeed. When reaching takeoff speed (approximately 10 knots below final approach speed to final approach speed, establish the takeoff attitude and allow the aircraft to fly off the runway. Then follow initial takeoff procedures (Tab BB-32).

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ROBERT T. RAYMOND, Colonel, USAF  
President, Accident Investigation Board



## STATEMENT OF OPINION

### T-38A, T/N 64-13304 SACRAMENTO MATHER AIRPORT, CALIFORNIA 18 FEBRUARY 2021

*Under 10 U.S.C. § 2254(d) the opinion of the accident investigator as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report, if any, may not be considered as evidence in any civil or criminal proceeding arising from the accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.*

#### 1. OPINION SUMMARY

On 18 February 2021 at approximately 1648 Zulu, or 0848 Local Time (L), a T-38A aircraft (referred to as the mishap aircraft or MA) impacted Runway 22 Left (22L) at Sacramento Mather Airport, California without its landing gear fully extended following an attempted touch-and-go landing.

The mishap pilot (MP) and mishap instructor pilot (MIP), flying a T-38A assigned to the 1st Reconnaissance Squadron (1 RS), Beale Air Force Base, CA engaged in a local continuation training mission that included training maneuvers in the China military operating area (MOA) followed by practice approaches and landings at nearby Mather Airport. Both the MP and MIP were dual-qualified and experienced in the U-2 and the T-38A. Following the MOA maneuvers, the MIP flew a simulated single-engine Instrument Landing System (ILS) approach and touch-and-go landing from the rear cockpit (RCP) at Mather Airport Runway 22L. The MP then took control of the mishap aircraft (MA) for a simulated single-engine ILS approach and attempted a touch-and-go landing to Runway 22L. Shortly after the MA touched down on its main landing gear (MLG) wheels, the MP began the takeoff phase of the maneuver, advancing the throttles to military (MIL) power.

The MP reported feeling the MA “unstuck,” indicating the MP perceived an initial climb away from the runway with the nose rising. The MP then raised the landing gear lever, believing the MA was established in a climb. Post-mishap analysis revealed that the locking solenoid designed to prevent landing gear retraction on the ground was correctly installed and operational at the time of the mishap, indicating an initial climb away from the runway was experienced. Due to the lack of a flight data recorder, video evidence or any cockpit recording data, it is impossible to state with certainty what caused the MA’s initial upward movement. Neither the MP nor the MIP perceived an aircraft bounce after initial touchdown, nor any abnormal wind effects at Mather Airport. Regardless, the MP perceived the initial upward movement was a normal climb away from the runway, and then raised the landing gear lever.

As the landing gear began to retract, the MP described what he believed to be the MLG wheels “tapping.” The MP indicated it felt like the left and right MLG tires were alternately contacting the runway during the initial portion of the retraction sequence. The landing gear doors opened during the retraction sequence, creating a slight increase in drag. Additionally, post-mishap

analysis revealed that the speed brakes were in a slightly extended position when they later contacted the runway. This configuration would have added slightly more drag to the MA as the MP continued the takeoff attempt. The level of additional drag experienced in this scenario would normally be overcome by engine thrust at MIL power as the aircraft accelerates down the runway. However, at the time the MP initially raised the landing gear lever the engines were most likely still increasing from idle to MIL power thrust. Review of the MA's engine trim checklist revealed the engines were documented to take between 3 and 5 seconds to increase from idle to MIL power thrust after MIL is selected. Extrapolated global positioning system data shows that approximately 5 seconds elapsed from initial landing touchdown to the point that the MA's fuselage impacted the runway.

Following the initial movement of the landing gear lever to the up position, the MP felt the MA begin to sink. The MP then put the landing gear lever down, perceived that the MA had started flying normally again, and then placed the landing gear lever back up while maintaining a slight nose high pitch attitude. At that point, the MP attempted to select maximum power (MAX), or afterburner, as the aircraft descended toward the runway. However, based on the compressed timeline it is unlikely the afterburners ever lit prior to the MA impacting the runway. The MIP recognized that the MP had prematurely placed the landing gear lever up, and observed the MP's subsequent cycling of the landing gear lever as the MIP felt the MA sink toward the runway. At some point during this sequence, the MIP attempted to take control of the MA, maintaining takeoff attitude while advancing the throttles just prior to ground impact.

The partially extended MLG wheels and the open MLG doors contacted the runway approximately 2,320 feet from the approach end of the runway. The MA settled toward the runway, collapsed the MLG prior to completing the retraction sequence, then the MA slid on its fuselage for approximately 3,850 feet. The force of the MA on the partially extended MLG and subsequent contact with the runway caused a hydraulic system failure and fire in the right MLG bay. At some point during the slide and after the fire began, the MLG doors were ground off. Upon recognition that the MA impacted the runway, both the MP and the MIP selected idle power. The MIP then commanded the MP to place the throttles in "off," an action that can only be accomplished from the front cockpit. Once the MA came to a stop, the MP was able to shut off the throttles. The MIP directed aircraft egress actions and directed the MP to place the fuel shut-off switches to "off." Both pilots egressed the MA with no injuries as emergency response crews extinguished the fire.

Both the MP and MIP were current and qualified to fly the mission, and both were experienced in the T-38A and U-2 aircraft. I found no substantially contributing factors in operations supervision, unit culture, risk management, mission preparation, planning, or briefing. Ground operations, departure, area work in the China MOA, navigation to Mather Airport and the first practice approach flown by the MIP were uneventful. The weather at Mather Airport was clear and winds were within limits. All airfield systems at Mather Airport were in sufficient working order for the planned approaches and landings, and there were no identified airfield hazards. A thorough review of maintenance actions, documentation and engineering analysis revealed no aircraft system problems that contributed to the mishap. The landing gear system, engines, hydraulics and flight controls operated normally. In short, the mishap event occurred during a basic mission profile with experienced aircrew, favorable conditions, and no aircraft system problems that contributed to the mishap.

## 2. CAUSE

I find by a preponderance of evidence the cause of the mishap was the MP prematurely raising the landing gear lever during the touch-and-go landing maneuver. The MP failed to execute correct touch-and-go landing procedures. In accordance with the T.O. 1T-38A-1 flight manual and Air Force Manual 11-250v1, to properly execute a touch-and-go-landing, the landing gear lever should be placed up when “DEFINITELY AIRBORNE” and “WHEN POSITIVE RATE OF CLIMB IS ESTABLISHED.”

The MP executed a proper landing, but when transitioning to the takeoff portion of the touch-and-go procedure the MP retracted the landing gear prior to checking the engine instruments, accelerating to takeoff airspeed and allowing the MA to fly off the runway with an established a positive climb rate. The initial upward movement described by the MP immediately after touchdown was sufficient to decompress the left MLG strut, deactivating the locking solenoid that prevents landing gear retraction on the ground. However, based on the compressed timeline and maintenance documentation, it is unlikely the MA ever achieved MIL thrust prior to the MP raising the landing gear lever. The premature landing gear retraction placed the MA in an unrecoverable situation, resulting in the MA impacting the runway without its landing gear fully extended, and with no opportunity for the MIP to either put the landing gear back down or execute a successful takeoff prior to ground impact.

## 3. SUBSTANTIALLY CONTRIBUTING FACTOR

I find by a preponderance of evidence the MP’s misperception of an established positive climb rate following the touch-and-go landing attempt substantially contributed to the mishap.

### **MP misperception and failure to verify an established positive climb rate following the touch-and-go landing.**

It is my opinion that the MP incorrectly perceived that the MA had established a positive climb rate following the second touch-and-go landing attempt. This misperception led him to raise the landing gear lever after feeling that the MA had begun to climb away from the runway. The MP relied on a “seat of the pants feel” without verifying the MA was definitely airborne with a confirmed positive rate of climb. Verification of a positive climb rate includes a cross-check of cockpit performance instruments, along with visual cues outside the cockpit when appropriate. When the MP decided to put the landing gear lever back down the MP reported feeling that the MA had started flying adequately to climb away from the ground. This confusion prompted the MP to put the landing gear lever back up, but in reality the MA still had not established a positive climb rate with adequate engine thrust to continue the takeoff. The MP’s reliance on “feel” rather than verification of available performance instruments and visual cues substantially contributed to the premature landing gear retraction.

## 4. CONCLUSION

Following analysis of available data, review of the T-38 System Program Office analysis, witness testimony, engineering analysis, Air Force technical orders, regulations, and guidance, I find by a

preponderance of evidence the cause of the mishap was the MP prematurely raising the landing gear lever during the touch-and-go landing maneuver. The MP failed to execute correct touch-and-go landing procedures, which state that the landing gear lever should be raised when “DEFINITELY AIRBORNE” and “WHEN POSITIVE RATE OF CLIMB IS ESTABLISHED.” The premature landing gear retraction resulted in the MA impacting the runway without its landing gear fully extended, and with no opportunity for the MIP to intervene to prevent the mishap. Additionally, the AIB President found by a preponderance of evidence the MP’s misperception of an established positive climb rate following the touch-and-go landing attempt substantially contributed to the mishap.

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ROBERT T. RAYMOND, Colonel, USAF  
President, Accident Investigation Board

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