

UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT



T-6A, T/N 07-3890

89TH FLYING TRAINING SQUADRON
80TH FLYING TRAINING WING
SHEPPARD AIR FORCE BASE (AFB), TEXAS



LOCATION: 21 MILES NE OF SHEPPARD AFB, TEXAS

DATE OF ACCIDENT: 1 MAY 2019

BOARD PRESIDENT: COLONEL EDWARD S. BREWER

Conducted IAW Air Force Instruction 51-307

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EXECUTIVE SUMMARY UNITED STATES AIR FORCE AIRCRAFT ACCIDENT INVESTIGATION

T-6A, T/N 07-3890 21 MILES NE OF SHEPPARD AIR FORCE BASE, TEXAS 1 MAY 2019

At 1313 hours local time on 1 May 2019 a T-6A Texan II, tail number 07-3890, crashed 21 miles northeast of Sheppard Air Force Base (AFB), TX. The mishap crew (MC) included a mishap instructor pilot (MIP), 97th Flying Training Squadron (FTS), who supervised the mishap pilot (MP), 89 FTS. The MP was conducting a transition sortie in the Pilot Instructor Training course from the front seat. The MC ejected and sustained minor injuries. The mishap aircraft (MA) was assigned to the 80th Flying Training Wing, Sheppard AFB, TX.

While setting up a training maneuver with building cloud formations, the MIP flew the MA in an unintentional nose-high trajectory with decreasing airspeed. In an attempt to regain airspeed, the MIP tried to lower the nose of the aircraft towards the horizon and penetrated the weather. Next, the MIP attempted to roll wings level while still in a nose-high attitude with insufficient airspeed and high-power setting. As a result, the MA departed controlled flight in a power-on, inverted spin. The MC attempted to recover the MA until the MIP assessed the MA unrecoverable and commanded ejection at approximately 10,800 feet mean sea level. The MA, valued at approximately \$5.7 million, impacted the ground and was destroyed. There were no casualties and no loss of civilian property.

The Accident Investigation Board President, by a preponderance of evidence, determined the cause of the mishap to be pilot error. Specifically, the MIP flew the MA into an aerodynamic stall due to fixation on environmental factors. Then the MIP did not follow the prescribed memorized, critical-action checklist, inhibiting recovery.

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.

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SUMMARY OF FACTS AND STATEMENT OF OPINION

T-6A, T/N 07-3890

1 MAY 2019

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ACRONYMS AND ABBREVIATIONS

ADI	Attitude Display Indicator	ILS	Instrument Landing System
AETC	Air Education and Training Command	IMC	Instrument Meteorological Condition
AETCMAN	Air Education and Training Command Manual	IP	Instructor Pilot
AF	Air Force	ISB	Interim Safety Board
AFB	Air Force Base	ITAF	Italian Air Force
AFE	Air Flight Equipment	JX	Gravitational Awareness Exercise
AFI	Air Force Instruction	KAFW	Fort Worth Alliance Airport
AFMAN	Air Force Manual	KSPS	Sheppard Air Force Base
AFPET/PTPLA	Air Force Petroleum Office	L	Local Time
AFRC	Air Force Reserve Component	Lt	Lieutenant
AFTO	Air Force Technical Order	Lt Col	Lieutenant Colonel
AGL	Above Ground Level	MA	Mishap Aircraft
AIB	Accident Investigation Board	Maj	Major
ARMS	Aviation Resource Management System	MAJCOM	Major Command
ATC	Air Traffic Control	MC	Mishap Crew
ATIS	Automatic Terminal Information Service	min	minutes
Capt	Captain	MIP	Mishap Instructor Pilot
CAP	Commanders Awareness Program	MOA	Military Operating Area
CC	Commander	MP	Mishap Pilot
CB	Cumuluous Clouds	MS	Mishap Sortie
CBT	Computer Based Training	MSL	Mean Sea Level
CFS	Canopy Fracturing System	NATO	North Atlantic Treaty Organization
Col	Colonel	NE	Northeast
CT	Continuation Training	NM	Nautical Miles
DCS	Decompression Sickness	NOTAMS	Notices to Airmen
DME	Distance Measuring Equipment	OBOGS	On-Board Oxygen System
DNIF	Duties Not Including Flying	OCF	Out of Control Flight
DoD	Department of Defense	OG	Operations Group
DOG	Deputy of Operations Group Commander	Ops	Operations
EADI	Electronic Attitude Display Indicator	Ops Sup	Operations Supervisor
ELT	Emergency Locator Transmitter	ORM	Operation Risk Management
EMS	Emergency Medical Services	PA	Public Affairs
ENJJPT	Euro-NATO Joint Jet Pilot Training	PCL	Power Control Lever
FANIF	Flying Area Mission Forecast	PHA	Physical Health Assessment
FBO	Fixed Base Operator	PIREP	Pilot Reporting
FCF	Functional Check Flight	PIT	Pilot Instructor Training
ft	Feet	PLF	Parachute Landing Fall
FTS	Flying Training Squadron	Prof Advancing	Proficiency Advancing
FTW	Flying Training Wing	Pubs	Publications
G/g	Gravitational Force	P & W	Pratt and Whitney
GPS	Global Positioning System	QA	Quality Insurance
HFAC	Human Factors	RAPCON	Radar Approach
hrs	hours	RM	Risk Management
IAW	IN Accordance With	SA	Situational Awareness
IDARS	Integrated Data Acquisition Recording System	SAR	Search and Rescue
IFE	In Flight Emergency	SHEP 2	Sheppard Air force Base
IFF	Introduction to Flight Fundamentals	SIB	Safety Investigation Board
IFG	In Flight Guide	SIM	Simulator
		SOF	Supervisor of Flying
		Spatial D	Spatial Disorientation

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SPO	System Program Office	Tweet	T-38 Aircraft
Sup	Supervisor	TX	Texas
TC	Time Change	VFR	Visual Flight Rules
TCTO	Time Compliance Technical Order	VMC	Visual Meteorological Conditions
TO	Technical Order	VOR	Very High Frequency Omni-Directional Range
T/N	Tail Number	WIT	Witness
TP	Traffic Pattern		
TSgt	Technical Sergeant		

The above list was compiled from the Summary of Facts, the Statement of Opinion, the Index of Tabs, and Witness Testimony (Tab R and Tab V).

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SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 10 May 2019, Major General Mark E. Weatherington, Air Education and Training Command (AETC) Deputy Commander, appointed Colonel Edward S. Brewer as president of this Accident Investigation Board (AIB) to investigate the subject mishap under the provisions of AFI 51-307 (Tab Y-2 to Y-3). On 30 May 2019, the other members appointed to this AIB included a Major Medical Member, Captain Pilot Member, Captain Legal Advisor, Civilian Maintenance Member, and Technical Sergeant Recorder (Tab Y-4 to Y-5). They conducted this investigation at Sheppard Air Force Base (AFB), Texas (TX) from 17 June 2019 through 15 July 2019 (Tab Y-4 to Y-5). An Ophthalmologist was also appointed to provide additional expertise (Tab Y-6).

b. Purpose

In accordance with AFI 51-307, *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 1 May 2019, at 13:13:43 hours local time (L), a T-6A Texan II, tail number 07-3890, crashed 21 miles northeast of Sheppard AFB, TX, completely destroying the aircraft (Tab JJ-8). The mishap crew (MC) consisted of two pilots: the mishap instructor pilot (MIP) who occupied the rear seat as an instructor to the mishap pilot (MP) in the front seat (Tabs II-2 and V-1.7). The MC intended to conduct a local transition sortie in the Pilot Instructor Training (PIT) course (Tabs V-1.4 and II-2). The mishap aircraft (MA) was assigned to the 80th Flying Training Wing (FTW), Sheppard AFB, TX (Tab II-6). The MIP was assigned to the 97th Flying Training Squadron (FTS), and the MP was assigned to the 89 FTS (Tabs GG-6 and MM-12).

Following a weather-divert to Fort Worth Alliance (KAFW) the MC departed to complete their training mission and return to Sheppard AFB (KSPS) (Tab MM-13). After entering the Sheppard 2 Military Operating Area (MOA) at approximately 1300L the MIP penetrated cumulous clouds below safe flying airspeed in an unusual attitude (aircraft orientation in relation to the horizon) (Tabs JJ-8 and MM-14 to MM-15). As the MIP attempted to roll the aircraft wings-level with the horizon, the MA departed controlled flight and entered a power-on, inverted spin (Tabs JJ-8 and MM-14 to MM-15). The MIP assessed the MA unrecoverable and the MC ejected, sustaining minor injuries (Tabs V-1.11, X-2, JJ-8, OO-14 to OO-15). The MA, valued at \$5.7 million,

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impacted the ground and was destroyed (Tab Q-6). There were no casualties and no loss of civilian property (Tabs Q-6, OO-16 to OO-17, and X-2).

3. BACKGROUND

a. Air Education and Training Command

AETC's mission is to recruit, train and educate Airmen to deliver 21st Century Airpower. AETC, with headquarters at Joint Base San Antonio-Randolph, TX, includes the Air University, two numbered Air Forces, and Air Force Recruiting Service (Tabs CC-2 to CC-4).



The command has more than 29,000 active-duty members, 6,000 Air National Guard and Air Force Reserve personnel, and 15,000 civilian personnel (Tabs CC-2 to CC-4). The command also has more than 11,000 contractors assigned (Tabs CC-2 to CC-4). AETC flies approximately 1,300 aircraft, operates at 12 major installations, and supports tenant units on numerous bases across the globe, encompassing 16 active-duty and 7 Reserve wings (Tabs CC-2 to CC-4).

b. The 80th Flying Training Wing

The 80 FTW is a tenant unit on Sheppard AFB (Tab CC-5). The 80 FTW hosts an internationally manned and managed pilot training program. Having celebrated 37 years of existence in 2018, the Euro-NATO Joint Jet Pilot Training (ENJJPT) program has now delivered more than 7,500 trained combat pilots to our North Atlantic Treaty Organization (NATO) allies (Tab CC-5). ENJJPT trains 50 percent of all U.S. Air Force fighter pilots and is the sole source of fighter pilot training for partner nations Belgium, Denmark, Germany, the Netherlands, and Norway (Tab CC-5).



The 80 FTW launches 50,000 sorties per year and is recognized as the busiest joint-use airfield in the Air Force. Its 201 aircraft flew about 250 training missions per day in 2017, which equates to more than 66,000 flight hours annually (Tab CC-5). The wing delivers more than 200 Undergraduate Pilot Training (UPT) graduates annually, along with 150 graduates of Introduction to Fighter Fundamentals and PIT graduates (Tab CC-5). Fourteen NATO countries participate in the unique ENJJPT Program (Tab CC-5).

c. The 89th Flying Training Squadron

The 89 FTS, comprised of approximately 60 personnel from 13 signatory NATO nations, trains more than 100 student pilots and 24 instructor pilots annually in support of ENJJPT (Tabs CC-6 to CC-8). The squadron employs 38 T-6A Texan II aircraft, flying 12,000 sorties and 16,000 hours annually to transition student pilots to advanced jet flying training (Tabs CC-6 to CC-8). The squadron also conducts PIT and maintains the readiness of more than 40 instructor pilots (Tabs CC-6 to CC-8).



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d. The T-6A Texan II

The T-6A Texan II is a single-engine, two-seat primary trainer designed to train students in basic flying skills (Tabs CC-9 to CC-12). Produced by Raytheon Aircraft, the T-6A Texan II is a military trainer version of Raytheon's Beech/Pilatus PC-9 Mk II (Tabs CC-9 to CC-12).



Stepped-tandem seating in the single cockpit places one crewmember in front of the other, with the student and instructor positions being interchangeable (Tabs CC-9 to CC-12). A pilot may also fly the aircraft alone from the front seat. Pilots enter the T-6A cockpit through a side-opening, one-piece canopy (Tabs CC-9 to CC-12).

The T-6A has a Pratt & Whitney Canada PT6A-68 turbo-prop engine that delivers 1,100 horsepower (Tabs CC-9 to CC-12). Because of its excellent thrust-to-weight ratio, the aircraft can perform an initial climb of 3,100 feet (944.8 meters) per minute and can reach 18,000 feet (5,486.4 meters) in less than six minutes (Tabs CC-9 to CC-12).

4. SEQUENCE OF EVENTS

a. Mission

On 1 May 2019, the Operations Supervisor (Ops Sup) (SIB WIT 10), representing the 89 FTS and the 459 FTS, authorized the MC to accomplish a single transition sortie in accordance with (IAW) the PIT Syllabus dated April 2018 (Tabs AA-10 and T-5). As the Instructor Pilot (IP), the MIP was in-command of the mission and responsible for training the MP to refresh proficiency in the T-6A (Tab II-2). The MP was executing the sixth sortie IAW the syllabus (Tabs BB-139 to BB-145 and GG-29 to GG-57). The planned sortie profile included instrument approaches and multiple maneuvers in the MOA (Tabs MM-4 to MM-10).

At approximately 0930L the Supervisor of Flying (SOF) (SIB WIT 11) initiated a weather recall and Radar Approach Control (RAPCON) subsequently directed the MC to divert to Fort Worth Alliance (Tabs MM-4 to MM-10 and MM-12 to MM-20). The MC landed and prepared for the return sortie (Tabs MM-4 to MM-10 and MM-12 to MM-20). On the return sortie, the MC planned to accomplish the contact and instrument maneuvers from the initial sortie before returning to Sheppard AFB (Tabs MM-4 to MM-10 and MM-12 to MM-20).

b. Planning

The MC reported to the squadron at approximately 0730L on 1 May 2019 (Tab MM-4). The MIP briefed the MP on the sortie at 0800L IAW Air Force Manual (AFMAN) 11-248, Air Force Instruction (AFI) 11-2T-6v3, and 80 Operations Group (OG) Standards, *T-6 Flying Standards*, dated 4 July 2015 (Tabs BB-110 to BB-115 and BB-122 to BB-126). The MC adequately planned and reviewed the forecast weather and intended training profile (Tabs MM-4 to MM-10).

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The MC also completed a Risk Management (RM) matrix IAW the Flying Standards and In-Flight-Guide (IFG) to identify and mitigate mission risks (Tabs AA-2, BB-122 to BB-126, and BB-128). Common risks include mission requirements, weather hazards, crew sleep-time, and operations tempo (Tab BB-128). Risks are categorized and assigned a numerical value to quantify the overall mission risk necessary to determine appropriate approval authority (Tab BB-128). The following scale quantifies mission risk and the associated approval official: Low (<29 RM points; Aircraft Commander), Moderate (29-39 RM points; Ops Sup), High (40-50 RM points; Squadron Commander), and Severe (>50 RM points; OG Commander) (Tab BB-128). For the initial sortie, the MIP assessed 23 RM points due to low ceilings, forecast thunderstorms, wet runways, and crew sleep-time at 6-7 hours (Tab AA-2).

While mission planning for the return flight from Fort Worth Alliance, the MC utilized phone applications to obtain current weather (Tabs MM-4 to MM-10). The MC also briefed the Ops Sup (SIB WIT 10) who relayed the status at Sheppard AFB and provided local weather updates (Tabs V-6.7 and MM-22 to MM-27). For the mishap sortie (MS) the MIP assessed two additional RM points on top of the initial RM score to account for their second sortie of the day and departure from an off-station location, for an overall score of 25 RM points (Tab BB-128). An RM score of 25 points, categorized as “Low,” allowed the MIP to accept the risk and approve the MS as the Aircraft Commander (Tab BB-128). The planned return sortie maneuvers included a unit-of-gravity (G) awareness exercise, Power-on Stalls, Traffic Pattern Stalls, Slow Flight, Wing-Over, Aileron Roll, and Contact Unusual Attitude Recoveries prior to landing at Sheppard AFB (Tabs MM-4 to MM-10).

c. Preflight

After mission planning and briefing at Sheppard AFB, the crew discussed their profile with the Ops Sup (SIB WIT 10) and stepped to their assigned aircraft (Tabs BB-122 to BB-126 and MM-35 to MM-37). The MC completed pre-flight actions and flew the initial sortie uneventfully until the weather diversion to Fort Worth Alliance (Tabs V-1.5 to V-1.6). All off-station planning was accomplished IAW Flying Standards without incident (Tabs V-1.5 to V-1.6 and BB-122 to BB-126). Notices to Airmen (NOTAMs) did not restrict planned operations for the MC (Tabs V-2.10 and AA-3 to AA-6).

d. Summary of Accident

The MC intended to fly the mission as one sortie until RAPCON diverted them to Fort Worth Alliance due to weather (Tabs MM-4 to MM-10). After landing and accomplishing post-ground servicing and mission planning, the MC departed at 1237L and flew the Fort Worth Alliance Stereo Route to the Sheppard 2 MOA (Tabs BB-130 and JJ-8). Enroute to the MOA the MC noticed developing cumulous clouds yet assessed conditions to be acceptable for training, and RAPCON cleared the MC into Area 10 Low (Tabs N-2, BB-129, and MM-4 to MM-10).

The MP accomplished the training profile once established in the MOA (Tabs JJ-8 and MM-4 to MM-10). The MIP supervised the MP performance of a G-awareness exercise, Power-on Stalls, Traffic Pattern Stalls, Slow Flight, Steep Turns, and instrument confidence maneuvers (Tabs MM-5 to MM-7 and NN-2).

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Following power-on stalls facing a weather-obscured horizon, the MC became concerned about possible inaccuracies of the Electronic Attitude Display Indicator (EADI) (Tabs V-1.19 and MM-14). The MC believed the aircraft was experiencing pre-stall indications at an unusually low attitude in relation to the perceived horizon (Tabs V-1.8 to V-1.9 and V-2.10 to V-2.11). To verify the fidelity of the attitude indicator the MC turned west toward the unobstructed horizon and re-accomplished the stall maneuver (Tabs V-1.8 to V-1.9). The MC verified the EADI displayed correct attitude information before continuing operations (Tabs V-1.8 to V-1.9). Post mishap, the MIP described an up-sloping cloud horizon to the east where the perceived MA nose was lower than reality (Tab V-1.9 and V-1.19 to V-1.20).

After multiple training maneuvers, the MP transferred flight control to the MIP to set up contact unusual attitude recoveries, designed to teach students recovery procedures from unexpected attitude and airspeed situations in a safe and timely manner (Tabs V-1.9, V-2.10, and BB-141 to BB-142). The MIP began maneuvering at 11,000 feet Mean Sea Level (MSL) towards the eastern portion of Area 10 amid growing cloud formations (Tabs MM-5 to MM-7, MM-14 to MM-16, and NN-2). Simultaneously, the MP went heads-down to look at the mission tablet, intentionally losing orientation to enhance learning objectives (Tabs BB-139 to BB-145 and MM-5 to MM-6).

At 13:12:24L the MIP initiated a climb with maximum-power while moving left to right to avoid clouds (Tabs V-1.20, MM-14, and NN-2). At 13:12:52L the MA passed through 12,800 feet MSL, 60° nose-high with airspeed decreasing below 100 knots. (Figure 2).

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Figure 1: On the left, the MA maneuvering before loss of control effectiveness. On the right, the red circle represents the approximate aircraft location. Time is represented as Greenwich Mean Time (Tab NN-2).

Around 13:12:52L the MP recognized the extreme nose-high condition and alerted the MIP they were approaching the MOA ceiling with critically low airspeed (Tabs MM-4 to MM-10 and V-2.10). The MIP attempted to recover by letting the nose fall to gain airspeed (Tabs V-1.9 and V-1.21). During this maneuver, the MA entered a cloud and the MC lost all outside visual references (Tabs MM-14 and NN-2). At maximum-power and 30° nose-high, the MIP attempted to roll wings-level (Tabs JJ-8, MM-14, and NN-2).

Upon initiating a left roll, the MA departed controlled flight due to the combination of insufficient airspeed, a high angle of attack, and high power setting (Tab NN-2). This resulted in a left torque-roll, placing the MA into a power-on, inverted spin while still in Instrument Meteorological Conditions (IMC) (Tabs BB-135 to BB-136, JJ-8 and NN-2). A left torque-roll occurs when aerodynamic forces are insufficient to overcome the rolling motion induced by the propeller (Tabs BB-135 to BB-136).

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After departing controlled flight the MC applied neutral ailerons and slightly nose-down elevator (Tabs BB-146 to BB-147). The MC attempted to maintain neutral flight controls from spin entry through ejection but there were deviations, most noticeably in the elevator (Tabs BB-146 to BB-147). This slightly nose-down control input aggravated the spin condition and delayed recovery (Tabs BB-146 to BB-147).

The MIP initially attempted to counteract the left roll with right rudder application (Tabs BB-146 to BB-147). Once inverted, the MC attempted to maintain neutral controls; however, post mishap analysis revealed the rudder remained deflected to the right at varying degrees until ejection (Tabs BB-146 to BB-147). This delayed recovery (Tabs BB-146 to BB-147). Furthermore, the Trim Aid System, which automatically applies nominal rudder input based on variables such as torque, airspeed, and pitch rate, gave the rudder a minor propensity to the right (pro-spin rudder) due to the low airspeed and high power setting (Tabs BB-146 to BB-147).

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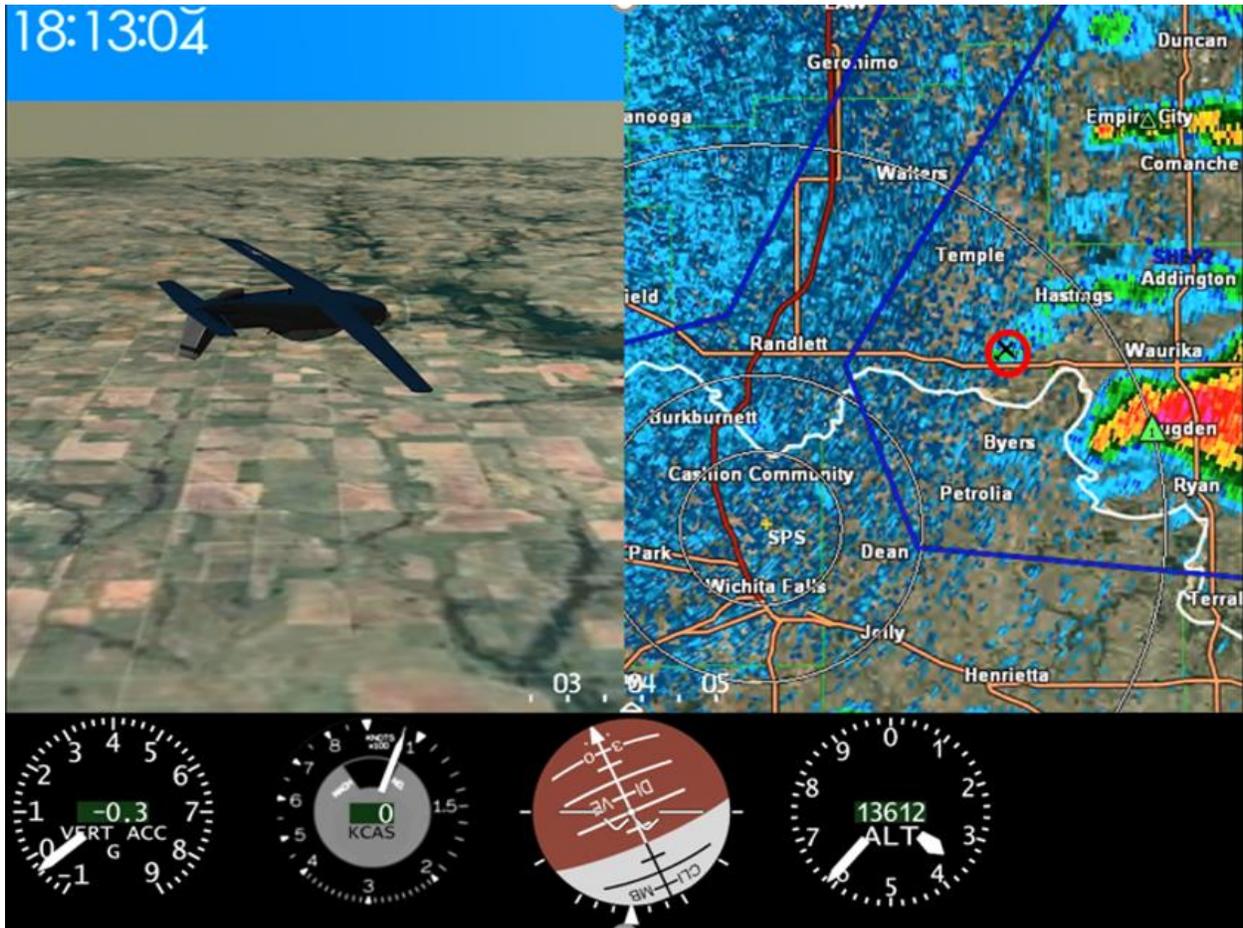


Figure 2: The left depicts the MA departing controlled flight. On the right, the red circle represents the approximate aircraft location (Tab NN-2).

The MIP recognized the inverted state of the aircraft but never completed the critical action of pulling the Power Control Lever (PCL) to IDLE (Tabs JJ-8, MM-4 to MM-10, and NN-2). Maintaining the high power setting prolonged the state of the spin and pushed the MA into a steeper nose-low attitude (Tabs JJ-8, MM-4 to MM-10, and NN-2).

The initial entry and subsequent spin match the aircraft flight characteristics experienced in T-6A flight tests conducted by the Air Force Flight Test Center U.S. Air Force and U.S. Navy Test Team, as documented in their March 2001 report (Tab BB-135). Further manufacturer analysis derived from IDARS data confirmed the MA's spin matched expected flight characteristics of the T-6A for the given environmental factors and flight control inputs (Tabs BB-146 to BB-147).

Due to the disorienting nature of the inverted spin entry, coupled with IMC, unusual negative gravitational forces, and the MA's propensity for pro-spin rudder, the MIP could not identify and input the appropriate controls for timely recovery (Tabs V-1.21 to V-1.25 and V-2.22 to V-2.23). Furthermore, due to the negative G's, the MIP's distorted body position affected the view of the altimeter, which was partially obscured by the glare shield (Tab V-1.10). This prevented the MIP

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from seeing the specific altitude displayed in the upper portion of the altimeter, but did allow recognition of the downward trend (Tabs MM-14 to MM-15).



Figure 3: The left depicts the MA established in spin. The red circle on the right represents the approximate aircraft location. (Tab NN-2)

After failing to regain control, the MIP announced the intention to eject (Tab MM-15). The MP recommended delaying the ejection, believing the trajectory could be rectified (Tabs V-1.11 and V-2.11 to V-2.12). Recognizing the MP's T-6 proficiency, the MIP assumed the MP had better situational awareness and transferred aircraft control (Tabs V-1.11, V-2.11 to V-2.12, MM-6, and MM-15).

The MP attempted to apply neutral controls and reduced power to IDLE while continuing to struggle with the negative G-conditions (Tab MM-6). Post mishap, the MP acknowledged difficulty centering the rudder pedals due to the negative gravitational forces (Tab V-2.12). Flight control analysis determined the rudder was marginally neutralized yet still deflected right, further preventing recovery of the MA (Tabs BB-146 to BB-147). The MIP did not observe sufficient change to the MA trajectory, commanded ejection, and pulled the ejection handle sequencing both

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seats at approximately 13:13:20L (Tabs JJ-8, MM-6, and MM-15). The MC ejected at 10,830 feet MSL as the MA continued to spin 60° nose-low with inconsistent airspeed indications (Tabs JJ-8 and NN-2).

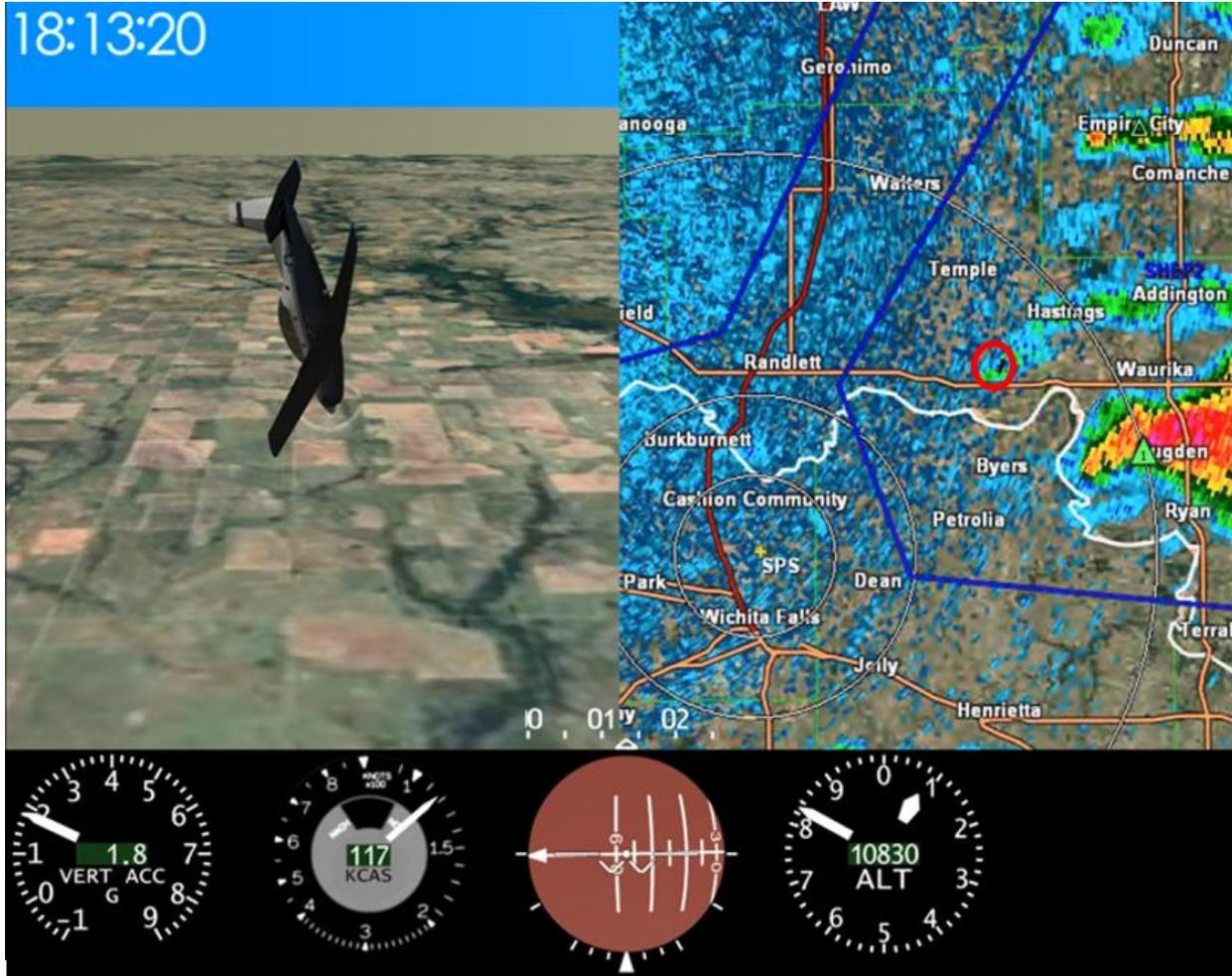


Figure 4: The left shows the MA condition at time of ejection. The red circle represents the approximate aircraft location. (Tab NN-2)

e. Impact

Post-ejection the unmanned MA transitioned out of the spin into a nose-dive reaching approximately 90° nose-low travelling at 309 knots when it crashed into privately-owned ranchland 1 mile north of Highway 70 near Temple, Oklahoma (21 miles northeast of Sheppard AFB) (Tabs NN-2 and OO-16 to OO-19). The crash coordinates identified post-mishap placed the MA at 34.1732° north latitude and 98.1885° west longitude (Tab OO-2). The MA debris field was contained within a 270-foot radius of the point of impact (Tabs OO-2 to OO-9). There was no post-crash fire and no firefighting agents were discharged (Tabs OO-16 to OO-19). The MC landed in a field five miles north of the MA point of impact (Tabs Z-2 to Z-4). Post-impact, the MA and both seat emergency locator transmitters functioned properly (Tab MM-16).

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Figure 5: View of the crash site (Tab S-2)

f. Egress and Aircrew Flight Equipment (AFE)

(1) Egress

The MC ejected safely, sustaining minor injuries (Tab OO-14). Both parachutes were recovered with the MC (Tab OO-18). Civil Air Patrol found the seats collocated within one mile of the MA's impact site on 4 May 2019 (Tab OO-15).

(2) AFE

All flight and survival equipment had current inspections and performed as designed (Tabs AA-7 to AA-8).

g. Search and Rescue (SAR)

At approximately 1315L, the SOF (SIB WIT 11) notified the T-6 Ops Sup (SIB WIT 10) that RAPCON had lost contact with the MA (Tab V-6.7). The Ops Sup (SIB WIT 10) initiated an accountability check to determine if the MA already landed (Tabs V-6.7 to V-6.8). Concurrently, the SOF (SIB WIT 11) initiated the Quick Reaction Checklist and notified the 80th OG Commander of a suspected downed aircraft (Tab V-3.6). At 1338L the Ops Sup (SIB WIT 10) received a call at the T-6 squadron duty desk from the MIP providing notice the MC ejected and were physically safe with only cuts and bruises (Tab V-6.8 and V-6.11).

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At about 1352L the MIP sent location coordinates to the Ops Sup (SIB WIT 10) (Tab V-6.8). The Ops Sup (SIB WIT 10) advised the MIP to dial 911 and request Emergency Medical Services (Tab V-6.8).

At approximately 1421L Oklahoma State Patrol officers made initial contact with the MC and transported the MC to the MA crash-site (Tab OO-16). At the crash-site, Comanche County EMS provided initial medical care to the MC (Tabs V-6.8 and OO-17). Sheppard Fire Emergency Services were at the crash site when the pilots arrived (Tab OO-16).

The Ops Sup (SIB WIT 10) notified the Sheppard Field Response Team of the MC's location, and the medical team departed Sheppard AFB at 1416L (Tabs OO-10 to OO-13). Deteriorating weather in the area and risk of tornadic activity delayed the MC's recovery (Tabs OO-16 to OO-19). The MC arrived back at Sheppard AFB at approximately 1557L (Tabs OO-10 to OO-13 and X-2).

h. Recovery of Remains

Not applicable (Tab X-2).

5. MAINTENANCE

The AIB analyzed and reviewed all pertinent maintenance records, as detailed below, and there is no evidence to suggest maintenance was a factor in this mishap (Tabs BB-137 to BB-138).

a. Forms Documentation

(1) Summary

On 1 May 2019, the MA's initial sortie diverted to Fort Worth Alliance with a flight time of 1.3 hours (Tab EE-3). The return flight crashed 0.9 hours into the sortie (Tab JJ-8). The MC observed no flight-control, avionics, or engine-related malfunctions (Tabs V-1.28, V-2.15, and V-2.17 to V-2.18).

Active Air Force Technical Orders (AFTO) Form 781K series and historical record AFTO Form 781K for the period of 30 days prior to the MS indicate the MA was current on all inspections, to include Time Change (TC) and Time Compliance Technical Orders (TCTO) (Tabs U-73 and BB-137 to BB-138).

(2) 30-Day Discrepancies

During the 30 days preceding the mishap, the MA flew 22 sorties (52.2 hours) (Tabs U-75 to U-78).

The MA did not experience avionics or engine discrepancies in the 30-days preceding the mishap that were contributory to the mishap (Tabs U-161 to U-162).

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(3) 60-Day Discrepancies

An On-Board Oxygen System (OBOGS) FAIL light occurred three times in-flight on 6 March 2019 (Tabs U-7 to U-9). Maintenance accomplished appropriate corrective action and returned the MA to service (Tabs U-7 to U-9).

On 22 March 2019, an aircrew declared an In-Flight Emergency for a bird-strike (Tab U-12). The follow-on maintenance inspection revealed no visible damage and the MA returned to service (Tab U-12).

Next on 28 March 2019, the MA experienced an OBOGS FAIL light and returned to service after corrective maintenance action (Tabs U-13 to U-14).

(4) 90-Day Discrepancies

The MA did not experience avionics or engine discrepancies in the 90-days preceding the mishap that were contributory to the mishap (Tabs U-161 to U-162).

All inspections were completed in accordance with applicable guidance and directives (Tabs BB-137 to BB-138) There is no evidence to suggest any maintenance discrepancies or events were a factor in this mishap (Tabs U-161 to U-162).

b. Inspections

Inspection records and transcripts indicate maintenance personnel completed the Basic Post-Flight Operations/Pre-flight IAW technical data (Tabs U-79 to U-158). The crew chief's (SIB WIT 9) preflight inspection did not reveal mechanical issues with the aircraft and the aircrew did not relay concerns with the MA after their pre-flight walk-around inspection (Tabs V-9.4 to V-9.5). Maintenance personnel completed TCTO's, TC's, and Phase inspections items with no discrepancies (Tabs EE-3 and U-163).

The MA did not fly from 4 April 2019 to 22 April 2019 due to an in-depth mandatory Phase #1 Inspection encompassing major systems including the flight control system, engine components, ejection seats, and overall aircraft structure (Tabs U-157 to U-158 and BB-137 to BB-138). Following completion of Phase #1 Inspection, maintenance returned the MA to service (Tabs U-18 to U-32 and BB-137 to BB-138).

Maintenance accomplished all appropriate inspections and there is no evidence to suggest that any of the corrected discrepancies were a factor in this mishap (Tabs BB-137 to BB-138).

c. Maintenance Procedures

According to active and historical records, maintenance personnel followed procedures IAW official technical data processes (Tabs U-2 to U-73 and BB-137 to BB-138). There is no evidence to suggest that maintenance procedures were a factor in this mishap (Tabs BB-137 to BB-138).

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d. Maintenance Personnel and Supervision

Training records confirm all maintenance supervision and personnel from the servicing entity, M1 Support Services, had adequate training and were current and qualified to complete assigned tasks (Tab U-163). There is no evidence to suggest maintenance personnel were a factor in this mishap (Tab U-163).

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

The Air Force Petroleum Office (AFPET/PTPLA) tested the Jet A aviation turbine fuel, hydraulic fluid, and oil samples taken post-accident from the aircraft and servicing equipment (Tabs EE-583 to EE-590). AFPET/PTLA concluded that all fluid samples were within limits, with the exception of the fuel as detailed below (Tabs EE-583 to EE-590). There is no evidence to suggest any of the aircraft fluids were a factor in this mishap (Tabs BB-137 to BB-138).

The MA refueled at Fort Worth Alliance (Tab V-1.6 to V-1.7). Post-mishap fuel was acceptable and consistent with a reference sample (Tabs U-159 to U-160 and EE-585). While analysis did not discover volatile contaminants, it did fail workmanship for sediment water (Tabs U-159 to U-160 and EE-585). Regardless of sediment water (commonly found in aircraft crash samples), the propulsion system was operating normally according to IDARS data (Tabs BB-146 to BB 147 and JJ-8).

A hydraulic fluid sample taken from the T-6-427-418 servicing cart was acceptable and consistent with the reference sample (Tab EE-590).

Analysis of turbine oil samples taken from Sheppard AFB's only two oil carts that service the T-6A fleet, T-6-427-224 and T-6-427-567, indicates both carts contained a variety of MIL-PRF-23699 Standard that was acceptable and consistent with the reference sample (Tabs EE-587 to EE-588).

On 28 March 2019, the OBOGS system required a filter and switch replacement (Tabs U-13 to U-14). Maintenance checked the system with technical data and determined it operationally sound (Tabs U-13 to U-14). During the 28 preceding sorties there were no recorded OBOGS incidents (Tabs U-135 to U-158). The MIP recalled a momentary OBOGS FAIL light but could not specify whether this occurred on the date of the mishap or on a previous date altogether (Tab V-1.12). The MIP and MP did not recall any hypoxic symptoms or any other indication of an OBOGS failure during the MS (Tab V-1.33 and V-2.16). Post mishap, the System Program Office (SPO) was unable to analyze the MA's OBOGS due to physical damage sustained on impact (Tabs HH-126 to HH-127).

f. Unscheduled Maintenance

Unscheduled maintenance is typically a result of a Pilot Reported Discrepancy during flight operations or maintenance-personnel discovered discrepancy during ground operation (Tabs U-161 to UU-162). In the 90 days prior to mishap, the MA experienced 24 unscheduled maintenance actions (Tabs U-2 to U-36). These unscheduled maintenance actions included seven tire changes,

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a canopy that failed to close, a crushed front cockpit emergency oxygen hose-end, as well as several avionic instrumentation failures (Tabs U-2 to U-36). There is no evidence to suggest that minor mechanical issues contributed to the mishap (Tabs U-161 to U-162).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

(1) Flight Control Surfaces

The T-6A SPO analyzed the MA flight control surfaces (Tabs BB-137 to BB-138 and HH-4 to HH-30). The flight control surfaces include the ailerons, elevator, rudder, flaps, and speed break (Tabs BB-137 to BB-138 and HH-4 to HH-30). The SPO determined at the time of mishap that each of these flight control systems were installed, secured, and functioning as designed IAW appropriate technical data (Tabs HH-4 to HH-30 and BB-137 to BB-138).

The active historical AFTO 781 Series forms and digital documentation indicates the MA was fit and structurally sound for flight (Tabs BB-137 to BB-138 and EE-3 to EE-11). The MA's last Functional Check Flight (FCF) was on 21 March 2018 (Tabs BB-137 to BB-138). This special in-flight inspection tested the MA and verified critical actions to include recoveries from established left and right spins (Tab BB-136). The MA performed within acceptable limits (Tab BB-136).

On 31 July 2018, maintenance removed the MA from flying status and performed a mandatory Phase #2 inspection, removing and evaluating all flight control surfaces (Tabs U-161 to U-162). The Phase # 2 inspection found all components operationally sound (Tabs U-161 to U-162).

Analysis of the MA's IDARS data indicate the flight control trim systems (aileron, elevator, and rudder) were operating normally and in acceptable positions during the flight and attempted recovery (Tabs BB-146 to BB-147).

(2) Landing Gear System

SPO analysis of the MA landing gear system identified landing gear in the down position at ground impact (Tab HH-109). Neither the MP nor the MIP remembered moving the landing gear handle to the down position prior to ejection (Tab V-1.35 and V-2.24). Data indicates the landing gear extended to the down position as the MC ejected from the MA (Tab HH-109). The landing gear extension was initiated during the ejection sequence and there is no evidence to suggest it was a factor in this mishap (Tabs U-161 to U-162).

(3) Engine

Analysis of the MA's IDARS data indicate the propulsion system was operating normally based on pilot commands and flight conditions (Tabs BB-146 to BB-147 and JJ-8). Specifically these systems were assessed as operating within normal limits during the entirety of the flight: the propeller (based on propeller speed and torque), engine gas turbine section, fuel flow, engine oil

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pressure, and engine oil temperature (Tabs BB-146 to BB-147 and JJ-8). The data indicates the MA was attaining expected engine performance immediately prior to the mishap (Tabs BB-136 to BB-137 and BB-146 to BB-147).

The MA engine was last overhauled on 4 April 2016 (Tab U-164 and HH-31). Total Engine Operating Time was 5,706.0 hours (Tab EE-8). Since overhaul, the engine logged 1,212.9 hours (Tab HH-31). The mishap engine received an Air Force wide TCTO 552 for the fuel locking plate on 11 October 2018 (Tab HH-31).

During the 21 April 2019 Phase # 1 Inspection, maintainers performed a 1,200-hour inspection on the MA engine to change the ignitors (Tabs U-161 to U-162 and HH-31). Maintenance removed and replaced these ignitors IAW technical guidance (Tabs BB-137 to BB-138). The MC did not notice engine performance deficiencies prior to the mishap (Tab V-1.18 and V-2.17). There is no evidence to suggest engine discrepancies were a factor in this mishap (Tabs U-2 to U-36 and BB-137 to BB-138).

b. Evaluation and Analysis

Prior to mishap, maintenance personnel performed all actions IAW applicable technical data and regulations (Tabs BB-137 to BB-138). The flight control system and engine operated as designed (Tabs U-161 to U-162). Landing gear functioned as designed and maintenance personnel found no degradation to the airframe prior to mishap (Tabs U-161 to U-162, V-1.35, and V-2.24)).

7. WEATHER

a. Forecast Weather

Sheppard AFB (KSPS) weather brief (forecast) for the MA's initial takeoff at 0800L was overcast ceilings at 900 feet above ground level (AGL) and 4 miles of visibility with winds variable at 6 knots (Tab FF-2). No icing or turbulence was forecast for the MC's period of flight (Tabs FF-2 and FF-4).

Weather data foreshadowed variable ceilings from 700 to 1,000 feet AGL throughout the morning, with thunderstorms forecast in the vicinity (10 miles of Sheppard AFB) at approximately 1400L, with tops to 32,000 feet (Tab FF-2). Thunderstorms were forecast to intensify throughout the afternoon with possible hail at 1600L (Tabs V-4.2 to V-4.3, FF-2, and FF-4).

Prior to the return sortie, weather at Sheppard AFB called for broken ceilings between 700 and 2,500 feet AGL, 7 miles of visibility, and vicinity thunderstorms at 1400L (Tab FF-2). The Sheppard 2 MOA forecast had broken to scattered clouds between 3,500 and 7,000 feet AGL with thunderstorms predicted after 1600L (Tab FF-4).

b. Observed Weather

At 1237L, the time of the MC's departure from Fort Worth Alliance, the observed weather at Sheppard AFB was ceilings broken at 600 and overcast at 1,500 feet AGL (Tab FF-6). During the

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MC's flight from Fort Worth Alliance, multiple aircrew reported pop-up, avoidable thunderstorms within the vicinity of the Sheppard 2 MOA (Tab MM-23).

When the MC entered the Sheppard 2 MOA at approximately 1255L, ceilings and visibility were increasing over Sheppard AFB, while radar showed weather building in the eastern portion of Area 10 (Tabs BB-129, FF-6 to FF-74, and JJ-8). Convective activity persisted in the MOA over the next thirty minutes while continuing to move easterly with lightning observed east of Sheppard AFB (Tabs FF-6 to FF-74). These reports were consistent with post mishap interviews of the MC (Tabs MM-4 to MM-10 and MM-12 to MM-19).

c. Space Environment

Not applicable.

d. Operations

Review of the applicable weather data did not disclose any weather phenomena that met or exceeded any operational limitations for the MA (Tabs FF-2 to FF-6).

8. CREW QUALIFICATIONS

a. Mishap Instructor Pilot

The MIP had 2,153.6 total military flight hours on the date of the mishap, including 795.7 hours in the T-6A (Table 1). Prior to assignment as a T-6A Instructor, the MIP logged 440.4 hours in the F-15 and 917.5 hours in the T-38 (Table 1). Further, the MIP logged 1,238.5 instructor hours between the T-38 and the T-6A (Table 1) along with 193.8 simulator hours across various platforms (Tabs GG-21 to GG-22).

	Total Time (hrs)	Primary Time (hrs)	Instructor Time (hrs)	Evaluator Time (hrs)	Secondary Time (hrs)	Other Time (hrs)
T-6A	795.7	191.8	548.0	55.3	0.0	0.6
F-15D	49.0	42.9	0.0	0.0	1.3	4.8
F-15C	391.4	391.4	0.0	0.0	0.0	0.0
T-38CIFI	17.5	17.5	0.0	0.0	0.0	0.0
T-38A	663.5	150.8	509.5	0.0	1.1	2.1
T-38C	236.5	51.6	181.0	0.0	1.8	2.1
Total	2153.6	846.0	1238.5	55.3	4.2	9.6

Table 1: MIP Total Flight Time Breakdown (Tabs GG-21to GG-22)

	Total Time	Primary Time	Instructor Time	Total Sorties
30 Days	7.0	2.0	5.0	5
60 Days	16.2	3.7	12.5	12
90 Days	16.2	3.7	12.5	12

Table 2: MIP 30/60/90 Day Totals (Tabs GG-17 to GG-18)

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The MIP had a current instrument/mission qualification AF Form 8, *Certificate of Aircrew Qualification*, flying evaluation dated 14 December 2018, certifying the MIP's instructor qualification (Tabs GG-27 to GG-28).

According to the 459 FTS' Letter of X's, the MIP was qualified to fly PIT sorties and to act as a SOF and Operations Supervisor (Tabs GG-13 to GG-15). Furthermore, the MIP qualified as a certified Experienced IP in 2013 (Tabs GG-10 to GG-12). The MIP was also previously qualified as an Evaluator and an Advanced Handling Characteristics pilot (Tabs GG-10 to GG-12).

The MIP was on track for completion of all semi-annual maneuver requirements IAW the Individual Training Summary (Tabs T-2 to T-5). Specifically, the MIP accomplished four Out-of-Control Flight (OCF) maneuvers, the most recent on 29 April 2019 (Tabs T-2 to T-5). Additionally, the MIP most recently completed Contact Unusual Attitude Recoveries on 29 April 2019 (Tabs T-2 to T-5).

b. Mishap Pilot

As Table 4 illustrates, the MP had 4,846.6 total hours logged as a pilot in the Italian Air Force (Table 4). While previously assigned as a T-6A IP at Sheppard AFB from 2011-2013, the MP flew 1,290.2 hours in the T-6A (Table 4). Due to non-currency in the T-6A, the MP was enrolled in PIT as a student under the AETC/ENJJPT Syllabus F-V5N-C A-Track (Tab T-5). The MP was designated an unqualified student pilot and did not possess a current AF Form 8 in the T-6A at the time of mishap (Tab II-2).

	Total Time	Primary Time	Instructor Time	Total Sorties
30 Days	9.1	9.1	0	6
60 Days	9.1	9.1	0	6
90 Days	9.1	9.1	0	6

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

Note: Italian Air Force tracks flight times in the format of "hrs:min." For consistency, numbers referenced in this document are displayed in the American standard of "hrs."

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	Total Time (hrs:min)	Total Time (hrs)
T-339A	774:20	774.3
FT-339C	222:45	222.7
AT-339A	110:35	110.6
T-37	129:35	129.6
T-38	137:00	137.0
T-38C	1:05	1.1
SF260	1028:00	1028.0
G222	703:45	703.7
P-166DL	317:20	317.3
P-166DP	42:45	42.7
TB-30	1:35	1.6
T-6	87:40	87.7
T-6A	1290:10	1290.2
TOTAL	4846:35	4846.6

Table 4: MP Total Flight Time Breakdown (Tab GG-9)

The MP completed all syllabus events through T4005, progressing with above average assessments (Tabs GG-29 to GG-57). On the five previous sorties the MP earned an “Excellent” overall rating based on skills and knowledge of the T-6 (Tabs GG-29 to GG-57). The MP also completed 14 simulator events as part of PIT (Tabs GG-29 to GG-57). The MP previously accomplished three OCF recoveries during the training program, the most recent on 29 April 2019 (Tabs GG-29 to GG-57).

9. MEDICAL

a. Qualifications

At the time of mishap, the MIP and MP were medically qualified for flight duty (Tabs BB-32 to BB-57, BB-62 to BB-70, and PP-1 to PP-5). A review of their medical records, Aerospace Information Management System (ASIMS), and Aeromedical Information Management Waiver Tracking System did not show any discrepancies in the MC’s health qualifications (Tabs PP-4 to PP-5). In addition, the MP was medically qualified IAW established Euro-NATO agreements at Sheppard AFB (Tabs BB-2 to BB-4 and PP-3). The MIP and MP were up-to-date on all required medical examinations and had current DD Form 2992s, *Medical Recommendation for Flying or Special Operational Duty*, valid through 14 January 2020 and 18 June 2020, respectively (Tabs PP-2 to PP-5). The MIP was not wearing required prescription glasses or contact lenses during the mishap (Tabs PP-1 and V-1.27). When interviewed as a part of the investigation, the MIP confirmed seeing better, without glasses than with them and that there was no trouble seeing the aircraft ADI without glasses (V-1.27). Records of previous eye examinations indicate the MIP could see 20/20 with and without correction (Tab PP-7). The MIP’s last eye examination suggested the MIP had a form of corneal astigmatism, which was the reason for the correction

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(Tab PP-7). An Ophthalmology subject matter expert who reviewed the MIP's ophthalmology records confirmed the MIP's astigmatism is likely to have decreased since the previous eye examination thus validating the MIP's statement that the MIP's vision is better without corrective lenses (Tabs V-1.27 and PP-7). The expert review further indicated the MIP would likely be authorized to fly without corrective lenses with an updated eye examination (Tab PP-7). There is no evidence that medical factors contributed to the mishap (Tabs PP-2 to PP-7).

b. Health

A review of the MC's medical records, dental records, 72-hour and 14-day History forms, personal testimonies, ASIMS, and RM worksheet did not reveal duty-limiting conditions that contributed to the mishap (Tabs AA-2, PP-4 to PP-5, and PP-7).

Post-mishap, the MC was transported to Sheppard's Flight Medicine Clinic and received comprehensive evaluations with minor injuries noted (Tabs X-2 and OO-10 to OO-15). The MIP and MP were released from medical care the same day without any duty limiting conditions (Tab X-2). Flight medicine medically cleared both pilots to flying status on 3 May 2019 (Tab X-2).

c. Pathology

Not applicable (Tab X-2).

d. Lifestyle

The medical records, toxicology reports (illicit drug screens), personal and witness testimonies, 72-hour and 14-day History forms, and RM worksheet for the MC do not reveal mishap-contributing lifestyle factors, to include unusual habits, behaviors, or stress (Tabs V-1.27, V-2.7, V-2.14, V-7.9 to V-7.11, AA-2, and PP-2 to PP-7)

e. Crew Rest and Crew Duty Time

U.S. 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-109). Crew rest consists of a minimum 12-hour non-duty period before the designated flight duty period begins (Tab BB-109). 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-109). The MC complied with crew rest and duty time requirements (Tabs PP-4 to PP-5).

10. OPERATIONS AND SUPERVISION

a. Operations

The MC accomplished all pre-requisites authorizing them to fly (Tabs T-6 to T-7). The T-6 Ops Sup (SIB WIT 10) and the MIP signed the AF IMT 4327 Flight Authorization at step-time (Tabs AA-10 and II-2). The T-6 Ops Sup (SIB WIT 10) reviewed pertinent data concerning the MC's sortie to include go-no-go spreadsheets, planned profile, weather, Index of Thermal Stress Status,

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bird status, and RM matrix (Tabs V-6.3 to V-6.4). There is no evidence operations tempo contributed to this mishap.

b. Supervision

The MIP, as the aircraft commander, was qualified to act as the MP's instructor (Tabs T-6 to T-7 and GG-27 to GG-28). The T-6 Ops Sup (SIB WIT 10), a qualified T-6 IP, assisted the SOF while monitoring airfield conditions and daily T-6 flying operations while providing assistance to operating T-6s (Tabs V-6.2 to V-6.4 and BB-118 to BB-121).

The SOF (SIB WIT 11) during the mishap was a qualified T-6 instructor charged with managing flying operations as per Operations Group directives while coordinating with the respective Ops Sups (Tabs BB-118 to BB-121). Furthermore, the SOF (SIB WIT 11) was responsible for setting flying status based on environmental factors while also responding to emergencies as required (Tabs BB-118 to BB-121). On the day of the mishap the SOF (SIB WIT 11) monitored weather and made multiple changes in flying status in response to aircraft reports and weather radar data (Tab V-3.2).

11. HUMAN FACTORS

a. Introduction

The AIB considered all human factors as prescribed in the Department of Defense Human Factors Analysis and Classification System 7.0 (DoD HFACS) (Tabs BB-85 to BB-107). The DoD HFACS is divided into four main categories: acts, preconditions, supervision, and organizational influences (Tabs BB-85 to BB-107). The DoD HFACS uses sources such as witness testimony, medical records, toxicology results, video and audio recordings, and flight reconstructions to identify potential human factors that may be causal or contributory in the mishap (Tabs BB-85 to BB-107).

b. Fixation (PC102)

Fixation occurs when an individual is focusing all conscious attention on a limited number of environmental cues to the exclusion of others (Tab BB-98).

Flying towards the clouds, the MIP attempted to set up a contact unusual attitude using a climbing right turn towards the discernable horizon (Tabs V-1.9 and V-1.20 to V-1.21). Simultaneously, the MP went heads-down to look at the mission tablet, intentionally losing orientation to enhance learning objectives (Tabs BB-139 to BB-145 and MM-5 to MM-6). Approaching the MOA ceiling, the MP observed the nose-high, right bank, with deteriorating airspeed and advised the MIP to monitor altitude and airspeed (Tabs V-2.10 to V-2.11).

Post mishap, the MIP reported focusing attention over the right shoulder at the horizon (Tab V-1.9). Due to fixation on the environmental cues, when the MIP returned focus to the aircraft instruments, the MIP was surprised to see the slow airspeed and nose-high attitude (Tab V-1.9).

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c. Environmental Factors Affecting Vision (PE101)

This factor includes obscured windows; weather, fog, haze, darkness; smoke, etc.; brownout/whiteout (dust, snow, water, ash or other particulates); or when exposure to windblast affects the individual's ability to perform required duties (Tab BB-93).

As the MC flew into the MOA, the MC noticed weather build-up yet deemed it useable for their training profile (Tabs V-1.7 to V-1.8 and V-2.10). The MP then performed multiple maneuvers before the MIP took control of the MA to set up contact unusual attitude recoveries (Tabs V-1.9 and V-2.10). After an excessive climb, the MIP attempted to correct the MA's attitude by lowering the nose (Tabs V-1.9 and V-1.21). During this attempted recovery, the MA entered the weather, lost outside visual references, and departed controlled flight (Tabs V-1.10, V-1.23, V-2.11, and V-2.18). The MC remained in the weather throughout the inverted spin, with no outside visual references to aid recovery (Tabs 1.10, V-1.22 to V-1.23, V-2.18 to V-2.19, and V-2.25).

d. Checklist Not Followed Correctly (AE102)

This factor occurs when the individual, either through an act of commission or omission, makes a checklist error or fails to run an appropriate checklist (Tab BB-90).

Both inverted spins and spins in IMC are prohibited maneuvers in the T-6A; therefore, MC did not have practical experience recovering under these flight conditions (Tabs V-1.10, V-1.24, V-2.23, and BB-136). Notwithstanding, there is a documented checklist of recovery procedures in the TO 1T-6A-1 (Tab BB-136).

The MIP did not pull the PCL back to IDLE, the first step in the memorized, critical-action *Inadvertent Departure from Controlled Flight* checklist, perpetuating the nose-low spin of the MA (Tabs V-1.10, V-2.11, and BB-136). Negative G forces lifted the MC towards the canopy during the inverted spin, complicating their efforts to accurately position the flight controls due to the unfamiliar body position (Tabs V-1.10, V-1.24 to V-1.24, and V-2.11). The result of the high power setting and spin-perpetuating flight control inputs prevented the MC from recovering in a timely manner (Tabs BB-146 to BB-147).

e. Spatial Disorientation (PC508)

Spatial disorientation occurs when an individual fails to accurately sense a position, motion, or attitude of the aircraft/vehicle/vessel or of oneself (Tab BB-97). Spatial Disorientation may be unrecognized and/or result in partial or total incapacitation (Tab BB-97).

During maneuver setup, the MIP focused on the weather and did not crosscheck attitude with the MA's flight instruments (Tabs V-1.8 to V-1.9 and V-1.22 to V-1.23). Upon entering the spin, the MC could not recognize turn-direction and roll rate (Tabs V-1.8 to V-1.9 and V-1.22 to V-1.23). As documented in flight tests, power-on, inverted spins to the right are disorienting due to rapid roll and pitch oscillations (Tab BB-135). Despite efforts, the MIP was unable to regain control of the MA (Tabs V-1.11 and V-2.12). The MIP recognized the complete loss of orientation and transferred flight controls to the MP (Tab V-1.11). After the MA completed two additional 360°

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rotations, the MIP, still disoriented, commanded and initiated ejection (Tabs V-1.10 to V-1.11 and V-2.11). The MIP likened the experience to “Mr. Toad’s Wild Ride” (Tab V-1.23).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

- (1) AETCMAN 11-248, *T-6 Primary Flying*, Dated 17 August 2016
- (2) AFI 11-2T-6, Volume 3, *T-6A Aircrew Training*, Dated 18 July 2016
- (3) AFI 11-418, *Operations Supervision* Dated 14 October 2015
- (4) AFI 21-101 (AETC Supplement), *Aircraft and Equipment Maintenance Management*, Dated 5 November 2018

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

b. Other Directives and Publications Relevant to the Mishap

- (1) T-6 Flying Standards, Dated 4 July 2015
- (2) AF TO 1T-6A-1, *Flight Manual*, Dated 1 December 2019
- (3) AFFTC-TLR-00-24, *Joint Primary Aircraft Training System Additional Spin Test*, Dated March 2001
- (4) T-6 In-Flight Guide, 80 FTW, Sheppard AFB, Dated 1 September 2018
- (5) AETC/ENJJPT Syllabus F-V5N-C, Dated April 2018
- (6) TO 00-20-1, *Technical Manual Aerospace Maintenance Inspection, Documents, Policies and Procedures*, Dated 1 June 2018
- (7) TO 1T-6ABD-2-5, *Maintenance Manual Time Limits/Maintenance Checks*, Dated 1 June 2018
- (8) TO 1T-6ABD-2-27, *Maintenance Manual Flight Controls*, Dated 9 April 2019
- (9) TO 1T-6ABD-2-35, *Maintenance Manual Oxygen*, Dated 18 December 2018
- (10) TO 1T-6ABD-74, *Maintenance Manual Ignition*, Dated 4 June 2018

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(11) TO 1T-6ABD-6WC-1, *Inspection Workcards, Preflight, Thruflight, Postflight Inspection*, Dated 12 February 2019

(12) TO 1T-6ABD-6WC-1, *Inspection Workcards Phase Inspection T-6ABD Aircraft*, Dated 28 January 2019

(13) TO 1T-6ABD-6, *Scheduled Inspection and Maintenance Requirements Manual*, Dated 28 April 2019

(14) TO 1T-6A-6CL-1, *Acceptance and/or Functional Check Flight Checklist*, 1 December 2017

c. Known or Suspected Deviations from Directives or Publications

The MIP failed to apply the memorized critical-action checklist for inadvertent departure from controlled flight IAW Air Force TO 1T-6A-1, *Flight Manual*, Dated 1 December 2019.

18 October 2019

EDWARD S. BREWER, Colonel, USAF
President, Accident Investigation Board

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Class A, Sheppard AFB

STATEMENT OF OPINION

T-6A, T/N 07-3890 21 MILES NE OF SHEPPARD AFB, TEXAS 1 MAY 2019

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

This Accident Investigation Board was conducted in accordance with (IAW) Air Force Instruction (AFI) 51-307.

The mishap involving a T-6A, tail number 07-3890, occurred at approximately 1313 local time (L) on 1 May 2019. The mishap aircraft (MA) was assigned to the 89th Flying Training Squadron, 80th Flying Training Wing, Sheppard Air Force Base (AFB), Texas. The mishap crew (MC) consisted of the mishap instructor pilot (MIP), occupying the rear seat, who was supervising the Mishap Pilot (MP). The MP was conducting a transition sortie in the Pilot Instructor Training (PIT) course from the front seat. The MC departed Sheppard AFB on a local transition sortie emphasizing proficiency in instrument approaches and area maneuvers. After a weather diversion to Fort Worth Alliance, ground personnel serviced the aircraft and the MC departed on the return sortie to Sheppard AFB at 1237L.

The MC entered the Sheppard 2 Military Operating Area (MOA) to complete required training objectives. The MP flew multiple maneuvers and then transferred control of the MA to the MIP to accomplish contact unusual attitude recoveries. While attempting to maneuver away from a building cloud formation and towards a discernible horizon, the MIP became so fixated on avoiding the clouds that the MIP failed to recognize the MA's nose-high attitude and decreasing airspeed. After realizing the slow airspeed, the MIP attempted to build airspeed by letting the nose of the aircraft fall through the horizon at 90° of bank. Soon after, the MA inadvertently entered the weather. Believing the MA's nose was approaching level with the horizon, the MIP rolled out prematurely, still 30° nose-high with airspeed below 50 knots. Upon initiating the rollout, the forces of the propeller overcame the aerodynamic pressures of the flight controls and rapidly rolled the aircraft upside down.

After departing controlled flight, the MA proceeded in a right, power-on, inverted spin with negative gravitational forces (G forces). The MIP attempted to place the flight controls (ailerons, elevator, and rudder) to neutral but was only successful with the ailerons. Further, the MIP failed to reduce the Power Control Lever (PCL) to IDLE IAW the memorized critical-action checklist. The continued right rudder and slightly nose-down elevator inputs, combined with a high-power

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setting, perpetuated the inverted spin, further disorienting the MIP. Due to complete loss of situational awareness, the MIP announced intentions to eject. The MP had better situational awareness and opposed ejection, so the MIP gave aircraft control to the MP. The MP then placed the PCL to IDLE while attempting to neutralize the flight controls. However, post mishap analysis determined the MA continued with pro-spin, right rudder deflection. Not seeing an immediate correction to the MA's movement, the MIP commanded and sequenced the safe ejection of the MC.

Both pilots were highly trained and experienced. Nonetheless, inverted spins are prohibited maneuvers and as such, neither the MIP nor the MP had experience recovering from this condition, let alone in the weather. In this case, the prescribed memorized, critical action procedure to recover from an inadvertent departure from control flight called for a reduction in power to IDLE and neutral flight controls. Any incorrect input would delay recovery.

The flight characteristics exhibited during the mishap event matched the expected result given the initial power-on entry and progressive pilot inputs. Specifically, in response to the left torque roll, the MIP applied right rudder. This right rudder became spin perpetuating once inverted and was never neutralized prior to ejection. Furthermore, the MIP maintained the Power Control Lever at MAX-power for 2 ¼ turns, resulting in a steeper and more prolonged spin.

I find, by a preponderance of evidence, four factors substantially contributed to the accident. First, the MIP's loss of situational awareness while fixated on the outside environment and maneuvering around clouds placed the MA in an extreme nose-high attitude at an unsafe airspeed. Second, spatial disorientation of the MIP upon entering the weather in an inverted spin, which the MC had never experienced, contributed to the slow and incomplete application of the inadvertent departure from control flight recovery procedure. This incomplete application proliferated the spin, increasing the time needed to recover.

I find, by a preponderance of the evidence, this mishap was caused by pilot error induced by the human factors Fixation, Environmental Conditions Affecting Vision, Checklist Not Followed Correctly, and Spatial Disorientation.

I developed my opinion after analyzing flight data, witness testimony, animated simulations, expert analysis, video and audio recordings, and AFI, Directives and Technical Orders.

2. CAUSE

I find by the preponderance of evidence that the cause of the mishap was the MIP's fixation on the outside environment, not recognizing the nose-high attitude and slow airspeed, then failure to apply the memorized critical-action Inadvertent Departure from Controlled Flight Procedures checklist in a timely manner.

While setting up the MA for a contact unusual attitude recovery, the MIP incorrectly assessed the nose-high attitude and failed to recognize the decaying airspeed. Failure to reach a flyable airspeed

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prior to the MIP leveling the wings resulted in the MA rolling inverted and departing controlled flight in instrument meteorological conditions (IMC) at approximately 13,600 feet mean sea level.

The MIP was fixated on environmental cues outside the cockpit and not aware of the MA's true orientation until the MIP returned attention back inside to look at the flight instruments. This predicated an aerodynamic stall that resulted in an inadvertent departure from controlled flight.

The MIP failed to complete the memorized critical-action checklist for an inadvertent departure from controlled flight in a timely manner, prolonging the spin. The MC's suboptimal body position and miscues as to which direction was control-neutral inhibited attempts to correct the flight pattern.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

I find, by a preponderance of the evidence that the following two factors substantially contributed to the mishap: environmental conditions affecting vision and spatial disorientation.

a. Environmental Conditions Affecting Vision

While commonly practiced during continuation training and in the Euro-NATO Joint Jet PIT syllabus, out-of-control flight is only performed in airspace clear of clouds. Once in the clouds, the MC lost the ability to recognize altitude, turn direction, and rate of turn by using the horizon as a visual cue. This coupled with inverted flight contributed to the MC's failure to remedy the out-of-control flight condition.

b. Spatial Disorientation

The MIP lost situational awareness of the MA's flying condition while fixated on setting up the unusual attitude recovery. The cumulous clouds in the MOA created a sloping cloud deck, which induced a visual illusion of a horizon well above the actual, level horizon. The MIP perceived that the MA was traveling at 15° to 20° nose-high, when, in-fact, it was 65° nose-high. The MIP attempted to correct for the decreasing airspeed and inevitable stall, but the flight control inputs resulted in a power-on, inverted spin into the clouds. The disorienting nature of the rapid spin onset, followed by the MA's oscillation and negative Gs exacerbated the MIP's spatial disorientation. This spatial disorientation incapacitated the MIP and prevented the MIP from safely piloting the MA.

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4. CONCLUSION

I find, by a preponderance of the evidence, that the cause of the mishap was pilot error. The MIP lost situational awareness while setting up a training scenario for the MP, which resulted in an extreme nose-high, low-airspeed situation. Incorrect action by the MIP in attempting to roll wings-level prior to attaining sufficient airspeed resulted in an inverted departure from controlled flight in IMC. Spatially disoriented, the MIP failed to apply the correct memorized critical-action recovery procedure IAW the technical order and prolonged the spin to a potentially unrecoverable state.

18 October 2019

EDWARD S. BREWER, Colonel, USAF
President, Accident Investigation Board

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