

UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT



A-29, T/N PT-ZNV-221

586TH FLIGHT TEST SQUADRON

HOLLOMAN AIR FORCE BASE, NEW MEXICO



LOCATION: RED RIO BOMBING RANGE, NEW MEXICO

DATE OF ACCIDENT: 22 JUNE 2018

BOARD PRESIDENT: BRIG GEN KENNETH T. BIBB, JR.

Conducted IAW Air Force Instruction 51-503

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

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RED RIO BOMBING RANGE, NEW MEXICO
22 JUNE 2018**

On 22 June 2018, at 1133 hours local time (L), an A-29, Tail Number PT-ZNV-221, crashed after delivering a Guided Bomb Unit (GBU)-12 weapon on the Red Rio Bombing Range, part of the White Sands Missile Range, New Mexico. The mission was a continuation training sortie flown in support of the Light Attack Experiment Phase II. The mishap aircraft (MA) was owned by Embraer, operated and maintained by the Sierra Nevada Corporation, and also operated by the 586th Flight Test Squadron (FLTS), Holloman Air Force Base (AFB), New Mexico. The mishap crew (MC) was temporarily assigned to the 586 FLTS for the experiment. The MC consisted of the mishap pilot (MP), a United States Naval aviator with F/A-18 experience, and the mishap weapon systems officer (MW), a United States Air Force navigator with a special operations background in the U-28A. The MW ejected with minor injuries while the MP died instantly upon impact after a delayed ejection initiation. The MA was destroyed.

At 1103L, the MA departed Holloman AFB. The mission proceeded uneventfully until the first weapon delivery, a GBU-12 release from the left outboard pylon. The MP planned and attempted to execute a right 180-degree turn after the weapon delivery. The MP exacerbated the MA's right rolling tendency, caused by the GBU-12 release, by making right aileron and rudder inputs while applying 1.47 positive g's (gravitational force). This resulted in a rapid roll to the right followed by an uncontrolled spiral dive. The MC made four unsuccessful recovery attempts before initiating the ejection sequence below the A-29 Flight Manual recommended minimum altitude for uncontrolled flight.

The Accident Investigation Board (AIB) President found by a preponderance of the evidence that the cause of the mishap was the MP's overcontrol of the MA causing an inadvertent entry into an uncontrolled spiral dive, combined with his failure to apply adequate recovery control inputs. Additionally, the AIB President found by a preponderance of the evidence, that a specific cause of the MP's death was delayed initiation of the ejection sequence by the MC, not in accordance with established procedures.

The AIB President also found, by a preponderance of the evidence, that wrong choice of action by the MC in attempting a 180-degree turn maneuver, without compensating for asymmetry of weapon release at low airspeed, substantially contributed to the mishap. In addition, fixation, critical information not communicated between the MC during the recovery, and operation of the ejection seat selector as directed in SINGLE mode substantially contributed to the fatality.

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.

SUMMARY OF FACTS AND STATEMENT OF OPINION
A-29, T/N PT-ZNV-221
22 JUNE 2018

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ACRONYMS AND ABBREVIATIONS

ACC	Air Combat Command	CNO	Chief of Naval Operations
AEDC	Arnold Engineering Development Complex	COCOM	Combatant Commander
AETC	Air Education Training Command	Col (O-6)	Colonel
AF	Air Force	COMACC	Commander, Air Combat Command
AFB	Air Force Base	CONOPS	Concept of Operations
AFE	Air Flight Equipment	CPD	Capabilities Production Document
AFI	Air Force Instruction	CPG [sic]	should be CPD
AFLCMC	Air Force Life Cycle Management Center	CPT	Cockpit Trainer
AFMC	Air Force Materiel Command	CR	Compliance Report
AFOTEC	Air Force Operational Test and Evaluation Center	CSAR	Combat Search and Rescue
AFPAM	Air Force Pamphlet	CT	Continuation Training
AFRCC	Air Force Rescue Coordination Center	CTF	Combined Test Force
AFRL	Air Force Research Lab	DAF	Department of the Air Force
AFSOC	Air Force Special Operations Command	DASH-1 (or -1)	Aircraft Flight Manual
AFTC	Air Force Test Center	DASH-34	Weapons Delivery Manual
AFTO	Air Force Technical Order	DET	Detachment
AGL	Above Ground Level	DITs	Digital In-line Timers
AIB	Accident Investigation Board	DNIF	Duties Not Including Flying
AoA	Angle of Attack	DO	Director of Operations
AMO	Airfield Management Operations	DoD	Department of Defense
AOL	Aircraft Operating Limit	DOM	Director of Maintenance
APKWS	Advanced Precision Kill Weapons System	DOT&E	Director, Operational Test & Evaluation
A&P	Airframe and Powerplant	DT	Developmental Test
ASD	Average Sortie Duration	EMD	Engineering and Manufacturing Development
AWS	Aural Warning System	EN	Engineering
BDU	Bomb Dummy Unit	EO	Electro-Optical
BX	Base Exchange	EOD	Explosive Ordnance Disposal
Cal	Caliber	EOC	Emergency Operations Center
CAMS	Core Automated Maintenance System	EP	Emergency Procedure
Capt	Captain (USAF)	EPE	Emergency Procedures Evaluation
CAPT	Captain (USN)	EVADR (or VADR)	Electronic Voice and Data Recorder
CAS	Close Air Support	FAA	Federal Aviation Administration
CAT	Crisis Action Team	FAR	Federal Aviation Regulation
CCV	Command Control Valve	FARP	Forward Arming and Refueling Point
CFR	Code of Federal Regulations	FCA	Forward Controller Airborne
Chief	Air Force Chief of Staff	FCIF	Flight Crew Information File
		FLTS	Flight Test Squadron
		FQ	Flying Qualities
		FS	Fighter Squadron

ft		Feet	LCMC	Lifecycle Management Center
FTD		Flight Test Director	L/D	Lift over Drag
FTE		Flight Test Engineer	LGB	Laser Guided Bomb
G (or g)		Gravitational Force	Lt	Lieutenant
GBU		Guided Bomb Unit	Lt Col	Lieutenant Colonel
GCRMC		Gerald Champion Regional Medical Center	MA	Mishap Aircraft
GMP		General Minimizing Procedure	MACC	Modified Airworthiness Certification Criteria
GS		Government Service	Maj	Major
HAF		Headquarters Air Force	MAJCOM	Major Command
HFACS		Human Factors Analysis and Classification System	MC	Mishap Crew
HOTAS		Hands On Throttle and Stick	METAR	Meteorological Aviation Report
HQ		Handling Qualities	MFD	Multifunction Display
hr		hour	MFR	Memorandum for Record
HRI		Hazard Risk Index	MFR	Military Flight Release
HUD		Heads-Up Display	MIL	Military
IAW		In Accordance With	MIST	Mishap Investigation Support Team
ICS		Intercommunication System	mm	millimeter
IMDS		Integrated Maintenance Data System	MOA	Military Operating Area
IO		Investigating Officer	MOP	Measure of Performance
IOC		Initial Operating Capability	MP	Mishap Pilot
IOT&E		Initial Operational Test & Evaluation	MR	Mission Ready
IP		Instructor Pilot	MS	Mishap Sortie
IR		Infrared	MSL	Mean Sea Level
ISR		Independent Safety Review	MTC	Military Test Certification
ISR		Intelligence Surveillance and Reconnaissance	MW (or MWSO)	Weapon Systems Officer
ISS		Inter-Seat Sequencing System	NAS	Naval Air Station
JFIRE		Joint Application of Firepower	NATOPS	Naval Air Training and Operating Procedures Standardization
JTAC		Joint Terminal Attack Controller	NCDC	Net-Centric Data Cartridge
JTS		Joint Tactics Squadron	NCO	Non-commissioned Officer
K		Thousand	NM	New Mexico
KCAS		Knots Calibrated Airspeed	NORDO	No Radio
KIAS		Knots Indicated Airspeed	NOTAM	Notice to Airmen
KHMN		Holloman International Civil Aviation Organization Code	NVG	Night Vision Goggles
KTAS		Knots True Airspeed	OAFME	Office of the Armed Forces Medical Examiner
kts		Knots	OAM	Original Aircraft Manufacturer
L		Local	OCF	Out of Control Flight
LAE		Light Attack Experiment	OEM	Original Equipment Manufacturer
LAE I		Light Attack Experiment Phase One	OFP	Operational Flight Program
LAE II		Light Attack Experiment Phase Two	Ops	Operations
LAS		Light Attack Support	Ops Sup	Operations Supervisor
lb		pound	ORM	Operational Risk Management
			OSCA	Off the Shelf Capabilities Assessment

OSD	Office of the Secretary of Defense	TAD	Tactical Awareness Display
OT	Operational Test	TBA	Training Business Area
PA	Public Affairs	TCTO	Time Compliance Technical Orders
POC	Point of Contact	T/N	Tail Number
PCS	Permanent Change of Station	TN	Tennessee
Pickle	Release	TO	Technical Order
PID	Positive Identification	TOD	Tech Order Data
PIT	Rear Cockpit	TOLD	Take Off and Landing Data
PLF	Parachute Landing Fall	Top 3	Operations Supervisor
PMO	Program Management Office	TOT	Time on Target
PVI	Pilot-Vehicle Interface	TPS	Test Pilot School
QA	Quality Assurance	THA	Test Hazard Analysis
QRC	Quick Response Checklist	TMP [sic]	should be GMP
RAPCON	Radar Approach Control	TOLD	Takeoff and Landing Data
RFP	Request for Proposal	TPS	Test Pilot School
RIO	Radar Intercept Officer	TR1	Transition Sortie 1
ROC	Range Operations Center	TR2	Transition Sortie 2
RTB	Return-To-Base	TRB	Technical Review Board
SA	Situational Awareness	TTP	Tactics, Techniques, and Procedures
SA1	Basic Surface Attack 1	TTS [sic]	should be TPS
SA2	Basic Surface Attack 2	TX1	Transition Flight 1
SAF/AQ	Air Force Acquisition	TX2	Transition Flight 2
SAT1	Surface Attack Tactics 1	UHF	Ultra High Frequency
SAT2	Surface Attack Tactics 2	U.S.	United States
SCL	Standard Combat Load	USAF	United States Air Force
SDPE	Office of Strategic Development Planning and Experimentation	USN	United States Navy
SEAD	Suppression of Enemy Air Defenses	VA	Virginia
SECAF	Secretary of the Air Force	VFA	Navy Strike Fighter Squadron
SERE	Survival Evasion Rescue and Escape	VFC	Fighter Squadron Composite
SET	Test Safety	VFR	Visual Flight Rules
SIB	Safety Investigation Board	VOX	Voice Operated Exchange
SIL	Special Information Leaflet	V-Stall	Velocity Stall
SME	Subject Matter Expert	VVI	Vertical Velocity Indication
SMS	Stores Management System	VX	Navy Air Test & Evaluation Squadron
SMSgt	Senior Master Sergeant	WSMR	White Sands Missile Range
SNC	Sierra Nevada Corporation	WSO	Weapon Systems Officer
SOF	Supervisor of Flying	Z	Zulu
SOS	Special Operations Squadron	1C (1CO)	Squadron Aviation Resource Management Personnel
SRB	Safety Review Board	2VX	Software
SFO	Simulated Flame Out		
T&E	Test and Evaluation		

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).

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 27 June 2018, General Ellen M. Pawlikowski, Commander, Air Force Materiel Command (AFMC), appointed Brigadier General Kenneth T. Bibb, Jr., to conduct an aircraft investigation of the 22 June 2018 crash of an A-29 Super Tucano, Tail Number (T/N) PT-ZNV-221 at Red Rio Bombing Range, New Mexico (Tab Y-3 to Y-5). The investigation occurred at Holloman Air Force Base (AFB), New Mexico, from 31 July 2018 to 29 August 2018. The following board members were appointed: Medical Member (Colonel), United States Navy (USN) Representative (CAPTAIN), Legal Advisor (Lieutenant Colonel), Pilot Member (Major), Maintenance Member (Senior Master Sergeant), and Recorder (Staff Sergeant) (Tab Y-3 to Y-10). An A-29 pilot (Government Service (GS)-13) and a physiology expert (CAPTAIN, USN) were detailed as Subject Matter Experts (Tab Y-11 and Y-12).

b. Purpose

In accordance with Air Force Instruction (AFI) 51-503, *Aerospace and Ground Accident Investigations*, this accident investigation board (AIB) 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 22 June 2018, at 1133 hours local time (L), the mishap aircraft (MA), an A-29, T/N PT-ZNV-221, crashed after delivering a Guided Bomb Unit (GBU)-12 on the Red Rio Bombing Range (part of the White Sands Missile Range (WSMR)) in New Mexico (Tabs Q-6 and EE-199). The mishap sortie (MS) was a continuation training (CT) mission flown in support of the Light Attack Experiment Phase II (LAE II), under the authority of the 586th Flight Test Squadron (FLTS) at Holloman AFB, New Mexico (Tabs Q-6, R-78, and AA-3). The MA was owned by Embraer, operated and maintained by the Sierra Nevada Corporation (SNC), and also operated by the 586 FLTS (Tabs BB-3 and DD-8). The mishap crew (MC), temporarily assigned to the 586 FLTS for the experiment, consisted of the mishap pilot (MP) and the mishap weapon systems officer (MW) (Tab BB-3). The MP's home unit was Fighter Squadron Composite Twelve (VFC-12) at Naval Air Station Oceana, Virginia, and the MW's home unit was the 318th Special Operations Squadron (318 SOS), Cannon AFB, New Mexico (Tab G-3 and G-18). The MW was able to eject and sustained only minor injuries (Tab EE-183). The MP died instantly upon impact after a delayed ejection initiation (Tab EE-183). The MA was destroyed (Tab Q-7).

3. BACKGROUND

In March 2017, the Office of Strategic Development Planning and Experimentation (SDPE), AFMC, issued an invitation to industry to participate in a capability assessment of non-developmental light attack platforms (Tab CC-27). The first phase of the Light Attack Experiment (LAE I) took place in August 2017 at Holloman AFB, New Mexico, with four models of non-developmental light attack aircraft (Tab CC-24). Following LAE I, the Air Force announced its intention to continue experimenting with two aircraft, the Textron Aviation AT-6 Wolverine and the SNC/Embraer A-29 Super Tucano, from May to July 2018 (Tab CC-26). In May 2018, the United States Air Force (USAF) entered into an Other Transaction for Prototype Project Agreement with SNC under 10 U.S.C. §2371b (Tab CC-23). Flying began 7 May 2018, for the Air Force's second phase of the Light Attack Experiment at Holloman AFB, New Mexico (Tab CC-24). LAE II's purpose was to examine logistics and maintenance requirements, weapons and sensor issues, training syllabus validity, networking and future interoperability with partner forces (Tab CC-26).

a. Air Force Materiel Command (AFMC)

AFMC is located at Wright-Patterson AFB, Ohio (Tab CC-3). AFMC delivers expeditionary capabilities to the warfighter through development and transition of technology, professional acquisition management, exacting test and evaluation, and sustainment of all Air Force weapon systems (Tab CC-3). The MA was operated by AFMC while it was undergoing acquisition experimentation (Tab CC-23). AFMC oversees six centers including the Air Force Test Center (Tab CC-3).



b. Air Force Test Center (AFTC)

AFTC is located at Edwards AFB, California (Tab CC-7). AFTC leads the test and evaluation (T&E) mission, conducting developmental T&E and evaluation of air, space, and cyber systems to provide timely, objective, and accurate information to decision makers (Tab CC-7). AFTC has oversight of work accomplished at three primary locations across AFMC (Tab CC-7). Organizations include: 96th Test Wing, Eglin AFB, Florida; 412th Test Wing, Edwards AFB, California; and Arnold Engineering Development Complex, Arnold AFB, Tennessee (Tab CC-7).



c. Arnold Engineering Development Complex (AEDC)

AEDC is located at Arnold AFB, Tennessee, with operating locations at the Federal Research Center at White Oak, Maryland; Ames Research Center, Mountain View and Edwards AFB, California; Eglin AFB, Florida; Hill AFB, Utah; Holloman AFB and Kirtland AFB, New Mexico; and Wright-Patterson AFB, Ohio (Tab CC-9). AEDC strives to test and evaluate aircraft, missile and space systems and subsystems at the flight conditions they will experience during a mission to help customers develop and qualify the systems for flight, improve system designs and establish performance before production, and to help users



troubleshoot problems with operational systems (Tab CC-10). AEDC also conducts a research and technology program to develop advanced testing techniques and instrumentation and to support the design of new test facilities (Tab CC-10). AEDC oversees the 704th Test Group at Holloman AFB, New Mexico (Tab CC-41).

d. 704th Test Group (704 TG)

The 704th Test Group (704 TG) at Holloman AFB, New Mexico, is a unit of the AEDC which is part of the Air Force Test Center (Tab CC-41). The Test Group's mission is to operate world-class test facilities for high speed sled track testing, navigation and guidance system testing, radar signature measurements, weapon systems flight testing, and Air Force Liaison for all AF programs tested at White Sands Missile Range (Tab CC-41). The 704 TG oversees the 586 FLTS (Tab CC-41).



e. 586th Flight Test Squadron (586 FLTS)

The 586 FLTS plans, analyzes, coordinates and conducts flight tests of advanced weapons and avionics systems primarily on the White Sands Missile Range (Tab CC-11). It provides deployable operational support for test aircraft staging out of Holloman AFB (Tab CC-11). The squadron flight tests guidance systems, laser systems, air-to-air/air-to-ground systems, long-range and standoff weapons, live warheads, and provides target and photo/safety chase (Tab CC-11).



f. Embraer

Embraer is the world's largest manufacturer of commercial jets up to 130 seats, and one of Brazil's leading exporters (Tab CC-36). Founded in 1969, the company designs, develops, manufactures and sells aircraft and systems for commercial aviation, executive aviation, and defense and security segments (Tab CC-36). In 2014, Embraer Defense and Security and Sierra Nevada Corporation presented the United States Air Force with the first of 20 U.S.-built A-29 Super Tucano aircraft for its Light Air Support program to support the stability of Afghanistan (Tab CC-34).



g. Sierra Nevada Corporation (SNC)

SNC is a private company headquartered in Sparks, Nevada, with a workforce of over 3,000 personnel in 31 locations in 17 states and 2 locations in Europe (Tab CC-36). SNC has unique business areas to include Intelligence, Surveillance & Reconnaissance, Aviation, and Security (Tab CC-36).



h. Martin-Baker

Martin-Baker is a manufacturer of ejection seats and related equipment, headquartered in Middlesex, United Kingdom. Martin-Baker has delivered over 70,000 ejection seats to 93 air forces around the world (Tab CC-37). Martin-Baker has continuously manufactured ejection seats since 1946 and partners with major aircraft manufacturers to include Boeing, Lockheed Martin, and Embraer (Tab CC-40).



i. Embraer EMB 314 Super Tucano (A-29)

The A-29 Super Tucano is a turboprop aircraft made in the United States (US) by SNC and its partner, Embraer Defense & Security (Tab CC-14 and CC-18). The A-29 can provide close air support and execute other missions in permissive and semi-permissive environments (Tab CC-15 and CC-20). Its performance record includes more than 360,000 flight hours and more than 46,000 combat hours (Tab CC-15 and CC-20). The Super Tucano has over 150 certified load configurations and is equipped with advanced electronic, electro-optic (EO), infrared (IR), and laser system technologies, as well as secure radio systems with data links and munitions capacity (Tab CC-15 and CC-20).



j. Spiral

According to the Federal Aviation Administration’s Airplane Flying Handbook, a spiral dive is “a nose low upset... descending turn during which airspeed and G-load can increase rapidly (Tab DD-43 to DD-44).” The aircraft flies nose-down, at increasing airspeeds, and in ever-tightening circles (Tab DD-43 to DD-44). To recover, the Handbook recommends immediately reducing power to idle, applying forward elevator, opposite aileron (to counter the roll and get wings level), and then gently raising the nose back to level flight (Tab DD-43 to DD-44).

k. Spin

“A spin is an aggravated stall that typically... results in the airplane following a downward corkscrew path. As the airplane rotates around a vertical axis, the outboard wing is less stalled than the inboard wing... basically descending due to gravity, rolling, yawing, and pitching in a spiral path” (Tab DD-38). In order to prevent a spin, the “pilot must apply the correct amount of rudder to keep the nose from yawing and the wings from banking” (Tab DD-38). To recover from an inverted spin, the A-29 Flight Manual instructs: THROTTLE to idle, full, opposite RUDDER, and aft STICK, as required (Tab BB-38).

4. SEQUENCE OF EVENTS

a. Mission

The mission was a continuation training (CT) sortie that consisted of weapons employment of two GBU-12s (500-pound laser guided bombs), rockets, and .50 Caliber (cal) ammunition on the Red Rio Bombing Range, under the call sign of DRAGON 21 (Tabs R-78 and AA-3 to AA-4). The mission changed the day prior from an Off the Shelf Capability Assessment (OSCA) mission to a CT sortie (Tab R-78 to R-79). OSCA missions assessed the aircraft capabilities in a tactical environment from an operational perspective, and they ranged from simple to complex in nature (Tab V-4.14 to V-4.15). CT sorties provided aircrew more time in the aircraft to build proficiency, gain experience in employing live weapons, and to get comfortable enough to know whether the aircrew or the aircraft were deficient during the OSCA missions (Tabs R-79 and V-4.13). The MS was the first time the MC flew together and the first time the MC flew without an instructor pilot (Tab G-15 and G-27). The LAE II Flight Operations Supervisor authorized the MS (Tab AA-6).

b. Planning

The MC planned the mission (Tab V-1.7). During the day prior, the MC discussed mission objectives for the MS and who was responsible for obtaining mission materials (Tab V-1.7). The MA configuration aligned with the MC's desired loadout for their MS (Tab V-1.9). The MC followed a normal planning process and briefed using the standard briefing guide (Tabs V-1.10 and AA-8 to AA-9). No squadron supervisory personnel were required nor present for the briefing (Tab DD-5).

On the day of the mission, the MC briefed the profile and the mission objectives, which included two GBU-12 attacks, high angle rocket launches, a high angle strafe, and a low angle strafe (Tab V-1.11). Specifically for the GBU-12 attacks, the MC planned to perform a post-release turn of 180 degrees to the right (Tab V-1.14). The MC acknowledged in the briefing that neither had performed the maneuver during their initial A-29 training (Tab V-1.14). The SNC instructors taught both the MP and the MW to turn approximately 30 degrees following a GBU-12 release using 30-45 degrees of bank (Tab V-1.14 to V-1.15). The maneuver was driven by both combat tactics as well as the capability of the sensor as it approached nadir, meaning directly overhead the target (Tab V-1.14). Additionally, fellow LAE II aircrew in the AT-6 had accomplished the 180-degree maneuver eight days prior to the mishap (Tabs R-80 and V-10.3). The AT-6 crew described it as an aggressive nadir avoidance maneuver of greater than 90 degrees of bank and greater than 4 g's (Tab V-10.3 to V-10.4). The AT-6 aircrew wrote up a rough account of the maneuver in a shared notebook that detailed lessons learned in tactics, techniques, and procedures (TTP) development as well as passed it along to the weapons and tactics division (Tab V-10.4 and V-10.6).

During the briefing, the MC planned a right turn based on previous weapon releases during training and the fact that a GBU-12 release off the left outboard station created momentum in the right roll direction (Tab V-1.15). The MW was expecting a 30-45 degree angle of bank roll to the right, not to exceed 90 degrees of bank, but no specifics of the maneuver were discussed (Tab V-1.15 and V-1.18). Also, there were no minimum or maximum airspeeds that were briefed for the weapon release, except that the MC wanted the fastest airspeed they could attain (Tab V-1.17). The LAE

II weapon attack card listed the desired airspeed at release as 210 knots indicated airspeed (KIAS) (Tab AA-5). The A-29 Flight Manual Supplement listed the minimum airspeed for weapon employment as 1.2V_S (stall velocity) (Tab BB-27 to BB-28). Finally, the MC briefed the standard items for controlled and uncontrolled ejection, including the minimum altitudes, “BAILOUT” command, and setting the ejection sequence selector to the SINGLE mode (Tab V-1.11 to V-1.12).

c. Preflight

On 22 June 2018, at approximately 0800L, the MC arrived at Building 1028, where the LAE II Flight operated (Tab V-1.9 to V-1.10). The MC had discussed the day prior who was responsible for obtaining the weather and Notices to Airmen (NOTAMs) (Tab V-1.7). Following the brief, the MC went to the SNC building to load their mission profile onto a cartridge before they proceeded to the aircraft (Tab V-1.10). The Operations Supervisor reviewed the MC’s sortie profile and approved their Operational Risk Management (ORM), which was yellow (medium risk) for inert weapon deliveries and moderate winds, and the MP signed the flight plan to the Red Rio Bombing Range (Tabs V-4.13 and AA-6 to AA-7). The MC performed a normal inspection of their aircrew flight equipment and donned it on their way to the aircraft (Tab DD-3). The aircraft configuration consisted of two GBU-12s, two rocket launchers, .50 Cal ammunition, and an EO/IR sensor (Tab AA-3 to AA-4). Nothing abnormal was observed during the aircraft preflight (Tab V-1.13).

d. Summary of Accident

(1) Flight to Red Rio Bombing Range

At 1103L, the MC took off from Holloman AFB and departed via left hand turn to the Red Rio Bombing Range (Tabs EE-199 and FF-3). The taxi, takeoff, and transit to the range were uneventful (Tab V-1.13). At 1122L, the MP contacted the Range Operations Center (ROC) for clearance onto the range (Tab N-2). The terrain inside the Red Rio Bombing Range consisted of rugged hills in a desert landscape (Tab S-2). Once the MA was established in the range, the MC completed their combat checklists and identified their assigned target (Target 1100) (Tab V-1.13).

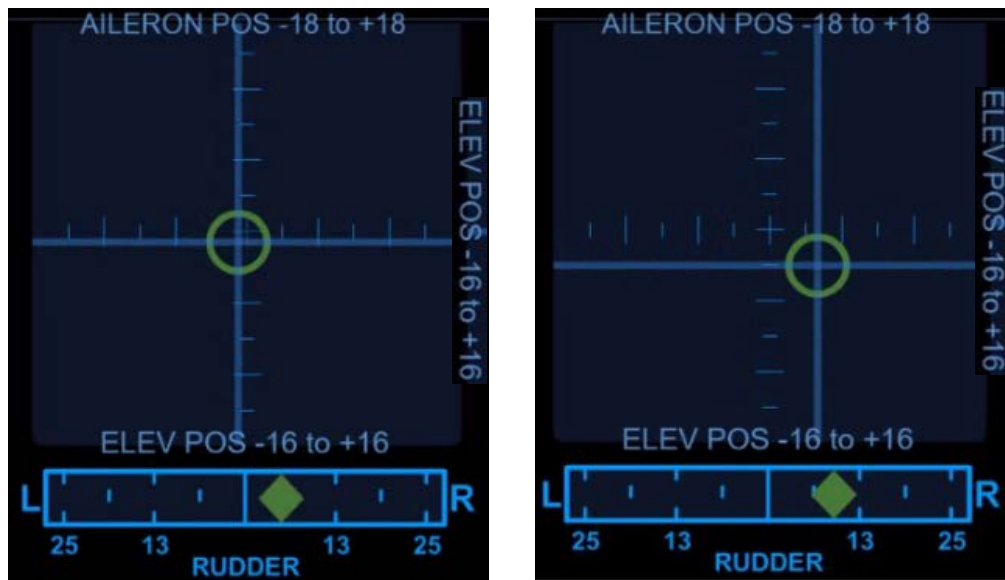
(2) Setup for GBU-12 Weapon Release

At 1126L, the MP climbed through 15,714 feet mean sea level (MSL) at 121 knots and flew further south to setup for a south-to-north run-in heading for the first GBU-12 release (Tabs N-3 and EE-199). This was slower than the recommended climb speed of 145 knots (Tab V-4.6 and V-11.9). At 1129L, the MW confirmed with the MP that the maneuver after weapon release was going to be a 180-degree turn to the right (Tabs N-3 and EE-199). Sixteen seconds later, the MP reiterated that he wanted to climb a little bit higher so that he could push nose down and accelerate to a faster airspeed prior to release (Tab N-3). At 1130L, the MP stated that the MC might have to accept being “kind of slow” for this weapon release (Tab N-3). Twenty-seven seconds later, the aural warning system (AWS) annunciated “Stall,” which alerted the aircrew that the aircraft was approaching a stall (Tabs N-3 and BB-20). The MA’s airspeed during this time was 124 knots (Tab EE-199). At 1131L, the MP called “in hot” with the weapon type and target number, and the ROC replied with a “cleared hot” radio call, which meant the MC could proceed with the weapon release (Tabs N-3 and EE-199). At 1132L, the MP pushed nose down to accelerate and began the

final portion of the weapon attack run (Tabs N-3 and EE-199). The MA reached an altitude of 16,561 feet MSL and 132 knots at the time the MA began to descend (Tab EE-199).

(3) GBU-12 Weapon Release

At 11:33:02L, the MC released a GBU-12 off the left wing, Station 1 (Tabs BB-22 and EE-199). The MA's parameters at the time of release were 166 knots, 15,903 feet MSL, 1.47 g's (gravitational force), and the MA's attitude was wings-level (Tab EE-199). Immediately following weapon release, the lateral asymmetry induced a right rolling tendency, which was amplified by nearly 50 percent as the aircraft experienced 1.47 g's (Tab GG-3). While the A-29 Flight Manual recommends countering the right roll with left aileron, the MP did the opposite with simultaneous inputs of 18-percent nose-up elevator, 21-percent right aileron, and 36-percent right rudder (Tabs BB-44, EE-199, and GG-4). The MA rapidly rolled to the right and quickly pitched nose down, entering into a downward spiral (Tab GG-3).



Surface deflection just prior to weapon release and one second after weapon release (Tab Z-6)

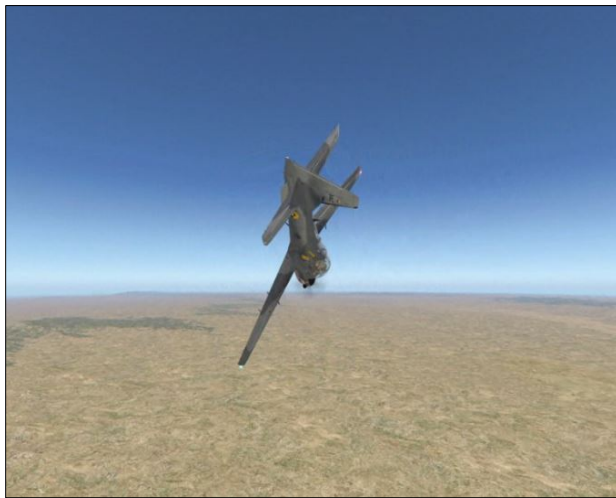
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(4) Recovery Attempts

The MC made four separate and distinct recovery attempts (Tabs GG-5). At 11:33:03L, during the first recovery attempt, the MP quickly countered the rapid right roll with a significant left aileron input one second after the weapon release, but continued to maintain nose up elevator and right rudder inputs (Tab GG-3). By 11:33:05L, the MA had rolled right to 128 degrees of bank and pitched down to 30 degrees nose low, while the AWS announced “Stall, Stall” (Tabs N-3 and EE-199). The MP reduced the throttle from maximum power to a mid-range position (Tab EE-199). At 11:33:08L, the MA had rolled completely inverted and pitched down to 70 degrees nose low (Tab EE-199). The MW was watching the target using the sensor pod and he felt the aircraft roll inverted (Tab V-1.19). The MW transitioned his focus from the pod to get his bearings and he recalled a buffet on the aircraft as well as a pull and roll to the right (Tab V-1.20). At that point, the MW thought the MA had departed controlled flight into a spin, which later was determined to be an uncontrolled spiral dive (Tab V-1.20). At 11:33:10L, the MA had accelerated to 181 knots, descended to 15,208 feet MSL, and had completed one spiral revolution, while the AWS announced “Over g, Over g” passing 3 g’s (Tabs N-3, EE-199, and GG-3).



Max aileron deflection during first recover attempt (Tab Z-6)



MA attitude 3 seconds after weapon release –
128 degrees angle of bank, 30 degrees nose low
(Tab Z-6)



MA attitude 6 seconds after weapon release –
Inverted, 70 degrees nose low
(Tab Z-6)

During the second recovery attempt, the MP made another left aileron input, which was effective at reducing the right roll rate, but was not persistent in duration to arrest the right roll rate and regain control of the MA (Tab GG-5). At 11:33:12L, the MC misidentified the motion of the

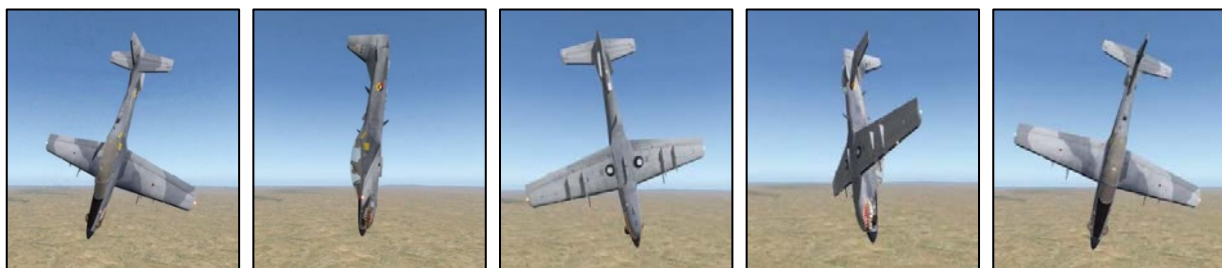
aircraft as a spin and the MW began verbalizing the steps of the emergency procedure for spin (Tabs N-4, BB-38, and EE-199). The MP accomplished the first step by pulling the throttle to idle (Tabs N-4, BB-38, and EE-199). Meanwhile, at 11:33:14L, the MA had accelerated to 216 knots, descended to approximately 13,700 feet MSL, and had completed its second spiral revolution (Tabs EE-199 and GG-3).

At 11:33:15L, during the third recovery attempt, the MW verbalized the second step of the emergency procedure for spin by calling for the left rudder in the opposite direction of the motion (Tabs N-4, BB-38, and EE-199). Immediately following, the MP made a sharp left rudder input with minimal aileron inputs (Tabs EE-199 and GG-7). At 11:33:17L, the MA experienced a spike in normal acceleration of greater than 5 g's, which continued to increase until impact and tightened the downward spiral (Tabs EE-199 and GG-10). At 11:33:20L, the MA was greater than 60 degrees nose low as it accelerated past 263 knots at 5.37 g's and descended below 11,320 feet MSL (Tab EE-199). This altitude was approximately 5,000 feet above the ground—the recommended ejection altitude for an uncontrolled situation (Tabs U-4 and EE-166).



Max rudder deflection during third recovery attempt (Tab Z-6)

At 11:33:24L, during the fourth recovery attempt, the MP made a full left aileron input and verbalized that he was “full left rudder,” however, the data recorder only showed 42 percent left rudder (Tabs N-4, EE-199, and GG-8). The maximum roll rate was 248 degrees per second, the maximum yaw rate was 49.3 degrees per second, and the maximum normal acceleration was 6.67 g's, increasing the asymmetric rolling tendency by a factor of six (Tab EE-199). Over the last recorded five seconds, the MA's average sink rate was in excess of 30,000 feet per minute (Tab EE-199).



MA trajectory in an established spiral over a two-second period (Tab Z-6)

For each recovery attempt, the MA responded appropriately to the commanded inputs, and both roll and yaw rates were reduced following each recovery attempt (Tab GG-5 and GG-9). However, the combination of partial inputs (not to maximum capability), the short duration of each recovery attempt, the persistent nose-up elevator deflection, and the increasing right rolling tendency due to

the lateral asymmetry at elevated g's, allowed the downward spiral to continue (Tab GG-5 and GG-9).

(5) Weapon Release Parameters

While the weapon release occurred within the weapon employment limitations listed in the flight manual, the airspeed was 44 knots below the target airspeed listed on the LAE II weapon attack card (Tabs AA-5 and BB-27 to BB-28). Additionally, fellow LAE II A-29 aircrew targeted release between 200-210 knots, but generally no less than 180 knots (Tab V-4.6 and V-5.5). One aircrew member said that he had released a GBU-12 at 140 knots, but limited his maneuvering post-release to 10-15 degrees of bank (Tab V-2.8).

(6) Establishing a Spiral Trajectory

The asymmetry resulting from the weapon release off the left wing and the MP's initial input into the heavy right wing combined to establish a right turning spiral dive (Tab GG-4 and GG-5). Of note, the MP did not change the elevator trim as the MA accelerated from 122 knots to 166 knots prior to weapon release and did not change it for the remainder of the MS (Tab EE-199). The nose-up trim setting made it more difficult for the MP to push forward on the stick (Tab GG-5). As the MA accelerated the nose-up elevator input caused the nose to pitch up faster, which increased the g's, making the spiral worse (Tab GG-5). As the g's increased, the right rolling tendency also increased, which tightened the spiral (Tab GG-5).

e. Impact

The MA impacted the ground at 1133L in the Red Rio Bombing Range, a part of the WSMR, 61 miles (98.5 km) north of Holloman AFB (Tabs S-1, Z-3 to Z-4, EE-199). Center of impact was at 5,919 feet MSL and coordinates were 33° 43' 59.2" N 106° 13' 45.9" W (Tab S-3).



The MA impacted the ground at an airspeed of 306 knots, an attitude of approximately 80 degrees nose low, and on an approximate magnetic heading of 345 degrees (Tab EE-173 and EE-199). Post-impact fire was minimal (Tab S-3 and S-5).

f. Egress and Aircrew Flight Equipment (AFE)

(1) AFE

A thorough review of all the 586 FLTS AFE technicians' training records was accomplished in Training Business Area (TBA) and all technicians were found to have been qualified on the equipment they inspected prior to the mishap (Tab EE-92). The MP and MW were current for Egress Training, AFE Equipment Training and Equipment Fit Check requirements (Tab EE-92, EE-106 to EE-108 and EE-141 to EE-142). There were no overdue inspections, time changes, or Time Compliance Technical Orders (TCTOs) that needed to be accomplished (Tab EE-92).

The MP's helmet along with fragments of the MP's G-suit were recovered from the mishap site (Tab EE-92 and EE-93). The MW's G-suit was recovered after the mishap (see physical evidence). The MW's helmet came off during the ejection and was located 80 yards northeast from where the MW touched down (Tabs EE-94 and V-1.26).

(2) Egress and Ejection Sequence

At 11:33:24L, the MW ejected from the MA (Tab EE-92, EE-165 to EE-166, and EE-199). The Mishap Investigation Support Team (MIST) analysis determined the MW ejected at approximately 8,600 feet MSL (2,600 feet AGL), which was approximately five seconds before the MA impacted the ground (Tab EE-165 to EE-166). The MA was accelerating past 295 knots at 66 degrees nose low (Tab EE-199). The MW survived with minor injuries (Tab EE-183). Analysis showed that the MP pulled the ejection handle 3 to 3.5 seconds after the MW, and approximately 1.5 seconds prior to ground impact, as the MA was passing 700 feet AGL (Tab EE-166). The ejection sequence was interrupted when the MA impacted the ground and the MP was killed upon impact (Tab EE-176 and EE-183). Due to the sink rate experienced during the MS, the MP needed to have ejected at least 1.5 seconds earlier for a reasonable chance of survival, which would have amounted to no lower than 900-1,000 feet AGL (Tab EE-167). The A-29 Flight Manual recommended ejection above 2,000 feet AGL and 150 KCAS under controlled conditions and at least 5,000 feet AGL in an uncontrolled situation (Tab U-4).

Post-mishap investigation noted all egress system components functioned as designed (Tab EE-138). Post-mishap investigation also noted that the ejection seat sequence selector (also known as the Command Control Valve) was set to the SINGLE mode (Tab EE-138, EE-161, and EE-187).

As background, beginning with the aircraft-mounted component, the inter-seat command ejection sequence was handled by a series of ballistic gas lines and a Command Control Valve (CCV), which allowed selection of three modes of operation: SINGLE, NORMAL, and AFT (Tab EE-159). The A-29 Flight Manual states, "The aircraft is flown in the SINGLE mode" as shown below:

<p>10. Ejection sequence selector</p>	<p>– The aircraft is flown in SINGLE mode,</p> <p>AFT Actuation of any firing handle causes the automatic ejection of the rear and front seats, in this sequence.</p> <p>SINGLE Each firing handle commands the independent ejection of the own seat. The rear seat pilot shall eject first, otherwise he may be hit by front seat ejection debris.</p> <p>NORMAL Actuation of the front seat firing handle causes the automatic ejection of the rear and front seats, in this sequence. Actuation of the rear seat firing handle causes the ejection of the rear seat only.</p> <p>– This handle must be turned counterclockwise to be unlocked and displaced and then, turned to lock in the selected position.</p>
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(Tab U-3)

Additionally, aircrew were instructed to operate the ejection sequence selector in the SINGLE mode (Tabs EE-161, EE-192, and V-1.11 to V-1.12).

In March 2014, Martin-Baker discovered a potential malfunction of the ejection seat when flown in the AFT mode (Tab U-9). Subsequently, Martin-Baker released a Special Information Leaflet (SIL) No. 731 advising customers to operate the CCV in the NORMAL or SINGLE modes only (Tab U-9).

In September 2014, Martin-Baker released a Modification Leaflet ES7586 on a repair for the issue and stated that it was safe to operate in the AFT mode (Tab U-11). The mishap rear ejection seat had modification ES7586 incorporated during initial build at Martin-Baker, and the seat identification plate confirmed that the part number of the rear seat was post-modification (Tab EE-192). Therefore, it was not necessary for the MA command system to be operated in the NORMAL or SINGLE modes only (Tab EE-192).

In September 2015, the USAF queried Embraer, who in-turn questioned Martin-Baker regarding the ISS Modification for technical clarification on ES7586 (Tab U-12). Martin-Baker responded by clarifying that after ISS Modification ES7586, the ejection sequence selector could be safely operated in the AFT mode (Tab U-12). The A-29 original bulletin (O.B. N: 314-001/14) that referred to SIL No. 731 was never superseded from use by the aircraft manufacturer (Embraer) after the Martin-Baker modification leaflet ES7586 was released (Tab U-15). At the time of the mishap, not all of the A-29 fleet had been updated with the ES7586 modification (Tab DD-14).

The MIST ejection seat simulation stated that, had the AFT mode been available to the MC, it would have increased the chances of MP survival (Tab EE-167). Of note, the MIST analysis did not account for aircraft roll, yaw, or significant angle of attack (AoA) in the ejection simulation (Tab EE-167).

The MW personal locator beacon was activated during survival kit deployment and transmitted coordinates 33 43.3N 106 12.8W (Tab EE-95). The AFE report showed first detection through

Air Force Rescue Coordination Center (AFRCC) on 22 June 2018 at 1235L (Tab EE-95). The MP personal locator beacon was destroyed upon the ejection seat's impact with the ground (Tab EE-94).

g. Search and Rescue (SAR)

Once on the ground, the MW sought to check on the status of the MP, but was deterred from doing so when he saw no indication that another parachute had deployed and live rounds were firing from the destroyed MA (V-1.26). Within a few minutes of impact (between 1133L and 1140L), the MW placed a cellular phone call to a fellow off-duty LAE aircrew member, who, in turn, notified the 586 FLTS Operations Supervisor of the mishap (Tab V-1.26). The 586 FLTS Operations Supervisor immediately called the Supervisor of Flying (SOF) at Holloman Tower, who then alerted emergency responders (Tab HH-5, HH-19, HH-24, and HH-33). By 1200L, Native Air (call sign NTV35) had launched from the Emergency Department at Gerald Champion Regional Medical Center (GCRMC), in Alamogordo, NM (Tab X-4).

Concurrently, the SOF redirected an MQ-9 (CLAW67) from a training mission to the south, requesting assistance in locating the MA and MC (Tab HH-33). CLAW67 arrived at Red Rio Bombing Range at 1217L (Tab M-1.3 at time 14:44). Meanwhile, a C-12 (VOODOO1) en route to Holloman, also diverted to assist with the search, arriving at Red Rio at 1231L (Tabs M-1.3 at time 22:31 and HH-34). At 1233L, a second civilian helicopter (PHI Med Air, call sign MED54) arrived at Red Rio (Tabs M-1.3 at time 24:55, HH-36 and HH-63).

Hindrances to locating the mishap site and MC included the lack of significant post-crash fire, a knoll obstructing the nearest remote range camera and the initial report from the MW that the mishap was approximately 1 mile *north* (not south) of the target (Tab HH-5 and HH-38). VODOO1 located the MW at 1238L, and then directed the other airborne assets (NTV35, MED54, and CLAW67) to the mishap site (Tab HH-34 to HH-35 and HH-63).

First to land, NTV35 reached the MW at 1245L (Tabs X-4, HH-35 to HH-36, and HH-63). With the MW on board, NTV35 departed Red Rio at 1302L (Tab M-1.2 at time 00:08).

Fire and medical assets from WSMR's nearest first responders were within 1 mile of the mishap site when NTV35 loaded the MW (Tabs M-1.3 at time 33:01, HH-63 to HH-64, and HH-67). However, the absence of a significant post-mishap fire, the successful evacuation of the MW, and concerns over the presence of unexploded ordinance, all delayed their entrance into the actual mishap area until 1323L (Tabs M-1.2 at time 13:58, HH-35, HH-63 to HH-64 and HH-67).

h. Recovery of Remains

Ground emergency response elements from Holloman AFB, including fire, crash recovery, security forces, Explosive Ordinance Disposal (EOD) and flight medicine, departed the base around 1243L, and arrived at WSMR at 1458L (Tab HH-4, HH-63, HH-65 and HH-73). A UH-60 military helicopter (RESCUE671), tasked out of Kirtland AFB by the Air Force Rescue Coordination Center (AFRCC), arrived with the Holloman convoy at the mishap site at 1534L (Tab HH-36, HH-63 and HH-65). Once Holloman EOD had conducted a preliminary assessment of risk, the Holloman AFB flight surgeon pronounced the MP as deceased at 1555L (Tab HH-36

and HH-63). With concurrence of the flight surgeon, the Holloman AFB Incident Commander cleared RESCUE671 to assist in recovering the MP's remains, which they then transported to Holloman AFB, departing the mishap site at 1701L (Tab HH-36 and HH-63). Upon arrival at the Holloman AFB Distinguished Visitor Ramp, RESCUE671 transferred the MP's remains directly to Alamogordo Funeral Home personnel, who then conveyed them to William Beaumont Army Medical Center, Fort Bliss, Texas (Tab X-5 to X-7).

5. MAINTENANCE

a. Forms Documentation

SNC maintained the MA (Tab V-13.2 to V-13.3). AFTO 781 Forms were not used for tracking maintenance, discrepancies, inspections, and status (Tabs D-1 to D-5 and U-16 to U-41). SNC used Discrepancy Record forms for tracking maintenance on the MA and all documentation was in order (Tabs D-3 and U-19 to U-41).

b. Inspections

The MA's last documented inspection recorded was a recurring 300-hour inspection on 30 October 2017 when the MA had 684.1 flight hours (Tab D-2). The aircraft received a preflight inspection by an SNC technician the morning of the mishap (Tab U-16). The AIB found no evidence to indicate that maintenance inspections were a factor in the mishap (Tabs D-1 to D-4 and U-16 to U-41).

c. Maintenance Procedures

In the 24 hours prior to the mishap, Pre-Flight, Thru-Flight and Post-Flight inspections were performed (Tab U-16 to U-17). Servicing of aircraft fuel and oil was also performed (Tab U-16 to U-17). Inspections and servicing were tracked on the SNC flight logs (Tab U-16 to U-17). Maintenance documentation stated the MA was in condition for safe operation (Tab D-3). The AIB found no evidence to indicate that maintenance procedures were a factor in the mishap (Tabs D-1 to D-4 and U-16 to U-41).

d. Maintenance Personnel and Supervision

SNC employees performed all base-level maintenance on the MA (Tab V-13.1 to V-13.3). Maintenance personnel involved in servicing or inspecting the MA within 24 hours of the mishap were licensed to complete their assigned tasks (Tab V-13.2). Nine SNC personnel conducted maintenance on the MA, while three of the nine personnel were licensed and certified airframe and powerplant mechanics and provided required supervision (Tab V-13.2). The AIB found no evidence to indicate that maintenance personnel and supervision were a factor in the mishap. (Tabs D-1 to D-4, U-16 to U-41 and V-13.1 to V-13.4).

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

Fuel samples from the truck that refueled the MA were tested (Tab U-18). All results passed in accordance with technical order (TO) 42B-1-1, *Quality Control of Fuels* (Tab U-18). Engine oil

samples were not available from Embraer (Tab D-2). The AIB found no evidence to indicate that fuels, hydraulic, oil or oxygen inspection analyses were a factor in the mishap (Tabs D-1 to D-4 and U-16 to U-41).

f. Unscheduled Maintenance

A comprehensive review of all discrepancy records since the last scheduled inspection was performed (Tabs D-1 to D-4 and U-16 to U-41). The AIB found no evidence to indicate a relationship between the unscheduled maintenance performed and the mishap (Tab U-19 to U-41).

6. AIRFRAME

a. Structures and Systems

The AIB found no evidence to indicate that structures and systems were a factor in the mishap (Tabs J-3 and EE-194 to EE-198).

(1) Engine Condition

The post-mishap engine condition report noted damage on the first four stages of the compressor indicative of the engine spinning at or near normal operating conditions upon impact with the ground (Tab J-3). Examination of data from the flight data recorder determined that the engine was operating normally and as commanded by the MC throughout the entire flight (Tab J-3).

(2) Flight Controls

A tail assembly flight control assessment was also conducted to assess aircraft controllability during the mishap flight. (Tab EE-194). Six cable tension adjustment turnbuckles were recovered from the mishap site (Tab EE-196). After examining the recovered turnbuckles, it was determined that all of the turnbuckles had their locking clips in place according to the required procedures in the aircraft maintenance manual (Tab EE-197). The Air Force Life Cycle Management Center (AFLCMC) assessment concluded that the aircraft flight control surfaces were maintained in accordance with appropriate technical orders, control cables were in good tension, and flight controls were functioning normally (Tab EE-194, EE-197 to EE-198).

The Voice and Data Recorder (VADR) did not directly record the MP stick or pedal inputs (Tab GG-3). However, since the A-29 flight control system is a fully mechanical and reversible system, and there is no evidence of a mechanical disconnect, the control surface positions, which are recorded by the VADR, directly reflected the MP input commands (Tab GG-3).

b. Evaluation and Analysis

The AIB found no evidence that any results of evaluation and analysis were a factor in the mishap.

c. Asymmetric Flight Characteristics

The A-29 had undergone significant airworthiness tests in the asymmetric condition by both Embraer and the USAF (Tab DD-31 to DD-33). During LAE I and LAE II, two separate developmental test pilots assessed the A-29 as having a significant right roll immediately following the release of a GBU-12 from the left outboard station, but sufficient control power existed to arrest the roll (Tab GG-13 and GG-18). The A-29 Flight Manual also described the asymmetric flight characteristics with external stores by stating that “the resultant roll...must be neutralized with ailerons...to avoid a continuous roll in the direction of the heavier wing” (Tab BB-44). LAE II aircrew were aware of the asymmetric flight characteristics of the A-29 during a weapon release (Tab V-1.28, V-2.7, V-4.6 to V-4.7, V-5.5, and V-6.2).

7. WEATHER

a. Forecast Weather

At the time of the mishap flight, Holloman AFB’s weather forecast called for clear skies, winds 180 degrees at 15 knots with gusts up to 25 knots, 7 statute miles visibility, a temperature range of 91-102 degrees Fahrenheit, and no significant weather (Tab EE-79). The Lava/Mesa/Red Rio weather forecast called for clear skies, surface winds 250 degrees at 25 knots with gusts up to 35 knots, 7 statute miles visibility, and no significant weather (Tab EE-80). The flight level winds forecast at Lava/Mesa/Red Rio/Oscura ranged from 200-280 degrees at 13-16 knots, between the altitudes of 7,000 and 15,000 feet MSL (Tab EE-83). The WSMR forecast hazards were moderate turbulence over mountainous terrain, ranging from the surface to 18,000 feet MSL, and light to occasional moderate turbulence over the rest of the flying area, ranging from the surface to 18,000 feet MSL (Tab EE-85). The Holloman Range Fire Danger at Red Rio was Very High (Tab EE-90).

b. Observed Weather

On 22 June 2018, the observed weather was as follows:

- (1) At 1058L, the Holloman AFB (KHMN) automated meteorological aviation report (METAR) reported winds 160 degrees at 12 knots with gusts up to 18 knots, 10 statute miles visibility, a temperature of 35 degrees Celsius, and clear skies (Tab EE-79 to EE-91).
- (2) At 1132L, the MP verbalized the winds were showing 170 degrees at 6 knots (Tabs N-3 and EE-199).

c. Space Environment

Not Applicable.

d. Operations

There was no evidence to indicate weather was a factor in the mishap (Tabs F-2 and N-3).

8. CREW QUALIFICATIONS

a. Mishap Pilot

The MP had 11.0 hours in the A-29, 1,043.5 hours in the F/A-18, and 1,608.2 total primary pilot hours at the time of the mishap (Tab G-5 and G-10). The MP was a qualified US Navy pilot in the F/A-18 prior to LAE II (Tab G-13). The MP's home unit was Fighter Squadron Composite Twelve (VFC-12) at Naval Air Station Oceana, Virginia (Tab G-3). The MP's first sortie in the A-29 was on 18 May 2018 and he flew seven sorties in accordance with the Light Attack Aircraft Experiment Training Syllabus and Evaluation (Tab G-15). The MP had released six GBU-12s during his A-29 training (Tabs G-12, T-10, and T-12). The MP's sixth overall sortie was the qualification evaluation on 8 June 2018, on which he received a Q1 with no downgrades (Tab G-12). The MS was the MP's first sortie without an instructor pilot after completing the flying training syllabus (Tab G-15). LAE II Flight leadership and fellow aircrew described the MP as "very professional in the aircraft" and as "a wise soul, not prone to taking unnecessary risks" (Tab V-1.10 and V-4.18).

The MP's flight time during the 90 days before the mishap was as follows:

	Hours	Sorties
30 days	7.2	4
60 days	11.0	7
90 days*	19.5	13

*Includes F/A-18 hours
(Tab G-5 to G-8)

b. Mishap Weapon Systems Officer

The MW had 5.4 hours in the A-29, 3,178.3 hours in the U-28A, and 3,196.1 total flying hours at the time of the mishap (Tab G-20). The MW was a qualified US Air Force evaluator weapon systems officer in the U-28A prior to LAE II (Tab G-18 to G-20). The MW's home unit was the 318th Special Operations Squadron, Cannon AFB, New Mexico (Tab G-18). The MW had never flown in an ejection seat aircraft prior to the A-29 (Tab V-1.5). The MW's first sortie in the A-29 was on 19 May 2018 and he flew four sorties in accordance with the Light Attack Aircraft Experiment Training Syllabus and Evaluation (Tab G-27). The MW had released six GBU-12s during his A-29 training (Tabs G-25, T-20, and T-22). The MW's fourth sortie was the qualification evaluation on 21 June 2018, on which he received a Q1 with no downgrades (Tab G-25). The MS was the MW's first sortie without an instructor pilot after completing the flying training syllabus (Tab G-27). 586 FLTS leadership considered the MW to be a part of a group of highly motivated, experienced aircrew (Tab R-52).

The MW's flight time during the 90 days before the mishap was as follows:

	Hours	Sorties
30 days	2.8	2
60 days	5.4	4
90 days	5.4	4

(Tab G-21)

9. MEDICAL

The AIB reviewed the medical records of the aircrew members to assess overall health and determine whether any duty limiting conditions were present (Tab X-3 to X-4). Additionally, the AIB reviewed available 72 hour/14 day histories (Tab X-3 to X-4).

a. Qualifications

Both the MP and the MW were medically qualified for flying duties at the time of the mishap (Tab X-3 to X-4).

b. Health

The MW sustained multiple, minor injuries related to the mishap, including lacerations, contusions (bruising) and abrasions (Tab X-4). Civilian helicopter transported the MW from the mishap site to the Emergency Department of a regional medical center, where the MW was evaluated, treated and released (Tab X-4). All laboratory tests and radiographic imaging were negative or unrelated to the mishap (Tab X-4). The MW completed follow-up care for his wounds and returned to flying status (Tab X-4).

c. Pathology

Holloman AFB flight medicine collected blood and urine samples on June 22, 2018 from the MW, as well as multiple maintenance personnel and air traffic controllers (Tab X-4). The Office of the Armed Forces Medical Examiner (OAFME)'s Forensic Toxicology Laboratory, Dover AFB, Delaware, performed full spectrum toxicological analysis on the specimens (Tab X-4). All samples tested negative, except for that of the MW, whose blood was positive for morphine (Tab X-4). This was attributed to pain medication given at the emergency department after the mishap and prior to this blood draw (Tab X-4).

On 25 June 2018, OAFME personnel performed an autopsy while the MP remains were at William Beaumont Army Medical Center, Fort Bliss, Texas (X-3). Cause of death was blunt force trauma, consistent with high-energy impact with the ground (X-3). All MP toxicological tests were negative (X-3).

d. Lifestyle

There is no evidence to suggest lifestyle factors were relevant to the mishap (Tab X-3 to X-4).

e. Crew Rest and Crew Duty Time

AFI 11-202, Volume 3, *General Flight Rules*, requires aircrew members have at least 12 non-duty hours before the Flight Duty Period and will include an opportunity for at least 8 hours of uninterrupted sleep (Tab BB-225). The MC did not have any scheduled formal training or duty training for the 12 hours prior to arriving at the squadron on the day of the mishap (Tab G-15 and G-27). There is no evidence to indicate that the MC had insufficient crew rest (Tabs X-3, X-4 and X-8). The AIB reviewed a 72-hour history for the MP (provided by the 586 FLTS) and a 72-hour and 14-day history for the MW, and found no violations of crew rest or duty time requirements (Tab X-3 and X-8). The MC did not take any medications on the day of the mishap (Tab X-3 to X-4).

10. OPERATIONS AND SUPERVISION

a. Operations

The Light Attack Experiment Phase II Flight consisted of 17 aircrew members, each one dedicated to fly one of the two aircraft, either the A-29 or the AT-6 (Tab BB-3). The aircrew were selected from multiple services and commands in order to bring a broad range of experience and backgrounds to the experiment (Tab V-4.3). The customer for the experiment was the office of AFRL/SDPE (Strategic Development Planning and Experimentation) (Tab R-36). According to the test director, the four LAE II objectives in priority order were Capability Production Document (CPD) verification, maintenance sustainment data collection, AERO Net functionality, and OSCA missions (Tab R-103). The A-29 operations schedule included flying five days a week, three sorties per day, beginning on 16 May 2018 and continuing until the mishap (Tab AA-10). The initial ground and flight training was accomplished in accordance with the syllabus (Tab V-2.3 to V-2.4). After the aircrew became qualified in their respective aircraft, they began flying OSCA missions to develop TTPs on how to best employ the aircraft (Tab V-2.3 and V-2.5). During the time the aircrew started flying the OSCA missions, the DT pilots from the 586 FLTS began flying sorties aimed at verifying the requirements in the CPD (Tab V-6.6 to V-6.7).

b. Supervision

The Light Attack Experiment Phase II Flight operated under the authority of the 586 FLTS, 704th Test Group, Holloman AFB, New Mexico (Tabs R-69 and BB-3). The flight's leadership consisted of a flight commander and an assistant flight commander, along with several division chiefs for the various sections (Tab BB-3). Early on in the experiment, the LAE II Flight operated with significant assistance from the 586 FLTS, but once they were well established, the intent was to have the flight operate somewhat autonomously, with oversight from the squadron leadership (Tab R-68). The LAE II Flight was responsible for planning, scheduling, and executing the flying operations, as well as providing an operations supervisor (Tab V-4.12). The operations supervisor would sign the flight orders for the next day's schedule as well as review the sortie profiles and ORM of the aircrew that were flying that day (Tab V-4.12 to V-4.13). The organizational structure of the LAE II Flight was like a squadron within a squadron (Tab R-41). The commander of the 586 FLTS had oversight and ultimate authority in approving evaluation and training documents, and interacted with the flight every 48 hours on average (Tab V-3.10).

11. HUMAN FACTORS ANALYSIS

a. Introduction

According to the Department of Defense (DoD) Human Factors Analysis and Classification System (HFACS), version 7.0, “human factors describe how our interaction with tools, tasks, working environments, and other people influence performance” (Tab BB-45). Incorporating the most current DoD HFACS, version 7.0 lists human factors that can potentially play a role in mishaps (Tab BB-45 to BB-67). DoD HFACS helps investigators accurately perform a complete investigation, record all aspects of human performance associated with an individual and the mishap event, and classify particular actions (or inactions) that sustained the mishap sequence (Tab BB-45). The DoD HFACS classification taxonomy divides the failures into active failures and latent failures (Tab BB-45). Active failures, or “Acts,” are the actions or inactions of individuals that most immediately lead to a mishap (Tab BB-45). Latent failures may remain undetected for some time prior to their manifestation as an influence on an individual’s actions during a mishap (Tab BB-45). Latent failures and conditions are divided into *Preconditions*, *Supervision*, and *Organizational Influences* (Tab BB-45). The discussion below lists the human factors directly involved in this mishap (Tab BB-45 to BB-67).

b. Over-controlled/Under-controlled Aircraft (Weapon Release and Spiral Dive Recovery)

Over-controlled/Under-controlled aircraft (AE104) is a factor when an individual responds inappropriately to conditions by either over- or under-controlling the aircraft (BB-49). The error may be a result of preconditions or a temporary failure of coordination (Tab BB-49).

As the MA approached its target, the MP verbally affirmed his intention to make a 180-degree turn to the right immediately after weapon release from the left wing (Tab N-1.3). Prior to the weapon release, the MP flew the MA at a relatively slow airspeed (122 to 166 knots) and did not change elevator trim, while maintaining a wings-level attitude (Tab EE-199). Immediately following weapon release, the MP made simultaneous inputs of nose-up elevator, right aileron, and right rudder (Tab GG-3 to GG-4). The A-29 was expected to roll towards the heavy (right) wing in response to the sudden asymmetry induced when the 500-pound GBU-12 was released from the opposite (left) wing (Tab GG-3 to GG-5). However, the MP’s control inputs exacerbated the already-expected roll toward the heavy wing, eventually leading to a nose down, inverted aircraft (Tab GG-3 to GG-5). As the MA continued to roll right, it entered into an uncontrolled spiral dive (Tab GG-3). Insufficient control inputs by the MP resulted in an ever-tightening downward spiral until ground impact, approximately 28 seconds after weapon release (Tab GG-3 to GG-10).

c. Delayed a Necessary Action (Initiation of Ejection Sequence)

Rushed or Delayed a Necessary Action (AE107) is a factor when an individual takes the necessary action as dictated by the situation, but performs these actions too quickly or too slowly (Tab BB-49).

The A-29 Flight Manual, Section III Emergency Procedure, states "It is recommended to eject above 2,000 feet AGL and 150 KCAS under controlled conditions and at least 5,000 feet AGL

under uncontrolled situation... DO NOT DELAY THE EJECTION BELOW 2,000 FEET AGL FOR ANY REASON..." (Tab BB-36 to BB-37).

The MW initiated ejection at approximately 2,600 feet AGL and the MP initiated ejection at approximately 700 feet AGL, both below the 5,000-foot AGL minimums recommended by the A-29 Flight Manual for an uncontrolled situation (Tabs BB-36 to BB-37 and EE-166 to EE-167). While the MW sustained minor injuries, the MP ejected too close to impact to survive (Tab EE-166 to EE-167). Analysis of the ejection seat and mishap site concluded that the MP ejected approximately 1.5 seconds before impact, long enough to egress the aircraft and deploy the drogue, but without enough time to deploy the main parachute (Tab EE-166 to EE-167, EE-185 to EE-190).

d. Wrong Choice of Action (Attempting 180-Degree Turn Maneuver Without Compensating for Asymmetry of Weapon Release)

Wrong Choice of Action During an Operation (AE206) is a factor when the individual, through faulty logic or erroneous expectations, selects the wrong course of action (Tab BB-50).

In the briefing, the MC planned the sortie profile which involved releasing a 500-pound GBU-12 from the left wing (weapon attack card annotated the desired airspeed was 210 knots), followed immediately by a 180-degree right turn into the direction of the heavy wing (Tab V-1.13 to V-1.14). This was the MC's first sortie flown without an instructor in the A-29 (Tab G-15). An AT-6 aircrew had flown the 180-degree turn eight days before the mishap (Tab V-1.14). However, it was largely untested in the A-29, particularly at relatively slow airspeeds (V-1.14, V-11.4 to V-11.8). The MC made a wrong choice of action when they decided just prior to the initial weapon delivery to accept a slower than normal airspeed and proceed with the planned weapon release followed by a 180-degree turn in the direction of the heavy right wing, without compensating for the asymmetry (Tab GG-3 to GG-5).

e. Provided Inadequate Procedural Guidance or Publications (Flight Manual Guidance Directed Use of Ejection Seat in SINGLE Mode)

Provided Inadequate Procedural Guidance or Publications (OP003) is a factor when written direction, checklists, graphic depictions, tables, charts or other published guidance is inadequate, misleading or inappropriate (Tab BB-64).

In addition, A-29 aircrews were flying under published and verbal guidance to avoid using the ejection sequence selector in the AFT mode (Tabs V-1.12 to V-1.13, V-4.17 to V-4.18, V-5.4, BB-33, EE-161 and EE-192). Martin-Baker manufactured the ejection seats for the MA in 2015, after a 2014 modification that enabled safe operation in all three modes (Tab EE-138, EE-176, EE-189, and EE-192). At the time of the mishap, not all of the seats in the A-29 fleet had been modified, and Embraer had not released an Operational Bulletin that allowed all three modes to be used in the MA (Tab BB-33). Had the MC been allowed to fly in the AFT mode, MP ejection would have been activated automatically 0.4 seconds following the MW, which would have been at least 2.5 seconds earlier than when he pulled his ejection seat handle, increasing the likelihood of survival (Tab EE-165 to EE-167 and EE-189 to EE-190).

f. Fixation (MC Focus on Recovery Procedure Prohibited Awareness of Passing Ejection Altitude)

Fixation (PC102) is a factor when the individual is focusing all conscious attention on a limited number of environmental cues to the exclusion of others (Tab BB-57).

Within a few seconds of releasing the GBU-12, the MA entered a right-rolling, uncontrolled downward spiral (Tab GG-3). The loss of the horizon, combined with the stress of glare and increasing airspeed and g's, all contributed to the MC's fixation on aircraft recovery and identifying altitudes (Tab V-1.21 to V-1.24). Fixation thus interfered with the MC recognizing the MA location and closure rate, and opting for ejection above a minimum safe altitude (Tab V-1.21 to V-1.24).

g. Critical Information Not Communicated (MC Did Not Communicate Altitude or "BAILOUT" Command)

Critical Information Not Communicated (PC106) is a factor when known critical information was not provided to appropriate individuals in an accurate or timely manner (Tab BB-58).

The MP and MW failed to communicate "BAILOUT" once the MA descended below 5,000 feet AGL (Tab N-3 to N-4). The MW, then the MP, pulled their respective ejection handles once each independently recognized that the MA was extremely close to impact, but failed to communicate altitudes and the briefed "BAILOUT-BAILOUT-BAILOUT" command (Tabs N-3 to N-4, V-1.22, V-5.4, EE-161 to EE-162, EE-166 to EE-167, V-1.21 to V-1.24).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

- (1) AFI 51-503, *Aerospace and Ground Accident Investigations*, 14 April 2015
(Updated per AFI 51-503_AFGM2018-01, 12 March 2018)
- (2) AFI 91-204, *Safety Investigation and Hazard Reporting*, 27 April 2018
- (3) AFI 11-202, Volume 3, *General Flight Rules*, 10 August 2016
(Updated per AFI 11-202V3_AFGM2017-01, 2 October 2017)
- (4) AFI 11-214, *Air Operations Rules and Procedures*, 14 August 2012
(Incorporating Change 1, 23 March 2016)
- (5) AFI 11-301V1, *Aircrew Flight Equipment (AFE) Program*, 14 August 2012
(Incorporating Change 1, 23 March 2016)
- (6) JFIRE, *Multi-service Tactics, Techniques and Procedures for Joint Application of Firepower*, January 2016

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>.

EXCEPTION: *Limited Distribution to DoD and DoD contractors only


b. Other Directives and Publications Relevant to the Mishap

- (1) TO 1A-29B(LAS)-1, *Flight Manual, Aircraft A-29* (Revision 7), 22 September 2017
- (2) TO 1A-29B(LAS)-1-1, *Avionics System Supplemental Manual* (Revision C), 19 April 2018
- (3) TO 1A-29B(LAS)-1-2, *Performance Data Supplemental Manual* (Revision 4), 22 August 2016
- (4) 0329-0100-0025, *Flight Manual Supplement for the OA-X Demonstration Aircraft* (Revision C), 20 June 2018
- (5) *A-29 Aircraft Maintenance Manual* (Revision 6), 22 February 2016
- (6) TO 14P3-4-151, *Operation and Maintenance Instructions with Illustrated Parts Breakdown HGU-55/P Flyer's Helmet*, 7 July 2018
- (7) TO 14P3-1-161, *Combined Advanced Technology Enhanced Design "G" Ensemble (COMBAT EDGE Equipment)*, 7 July 2018
- (8) TO 14P3-6-121, *Use, Operation, and Maintenance. Anti-G Cutaway Garment Type CSU-13B/P*, 23 June 2018
- (9) TO 42B-1-1, *Quality Control of Fuels and Lubricants*, 13 August 2012
- (10) MIL-STD 1797B, *Flying Qualities of Piloted Aircraft*, 15 February 2006
- (11) MIL-HDBK-516C, *Airworthiness Certification Criteria*, 12 December 2014

c. Known or Suspected Deviations from Directives or Publications

- (1) TO 1A-29B(LAS)-1, *Flight Manual, Aircraft A-29* (Revision 7), 22 September 2017, pages 3-20 to 3-21, Ejection

4 October 2018


KENNETH T. BIBB, JR.
Brigadier General, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

A-29, T/N PT-ZNV-221 RED RIO BOMBING RANGE, NEW MEXICO 22 JUNE 2018

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

1. OPINION SUMMARY

On 22 June 2018, at 1133 hours local time (L), an A-29, Tail Number PT-ZNV-221, crashed after delivering a Guided Bomb Unit (GBU)-12 weapon on the Red Rio Bombing Range, part of the White Sands Missile Range, New Mexico. The mishap crew (MC) consisted of the mishap pilot (MP) and the mishap weapon systems officer (MW). The MW ejected with minor injuries while the MP died instantly upon impact after a delayed ejection initiation. The mishap aircraft (MA) was destroyed.

The mission was a continuation training sortie flown in support of the Light Attack Experiment Phase II. The MA was owned by Embraer, operated and maintained by the Sierra Nevada Corporation, and also operated by the 586th Flight Test Squadron (FLTS), Holloman Air Force Base (AFB), New Mexico. Prior to the Light Attack Experiment Phase II, the MP was a qualified US Naval aviator in the F/A-18, assigned to Fighter Squadron Composite Twelve (VFC-12) at Naval Air Station Oceana, Virginia. The MW was a qualified US Air Force evaluator weapon systems officer in the U-28A, assigned to the 318th Special Operations Squadron (318 SOS), Cannon AFB, New Mexico. The MC was temporarily assigned to the 586 FLTS for the experiment.

This was the first A-29 flight for both the MP and the MW without an instructor on board and it was their first flight together. The mission proceeded uneventfully until the first weapon event, a GBU-12 release from the left outboard pylon. The MC planned and attempted to execute a right 180-degree turn after the weapon delivery. In training, SNC instructors taught the MC to execute approximately 30 degrees of turn after weapon delivery using 30 to 45 degrees of bank.

The MA's parameters at weapon release were 166 knots, 15,903 feet mean sea level (MSL), 1.47 g's (gravitational force), and wings-level. Immediately following weapon release, the MP made simultaneous inputs of nose-up elevator, right aileron, and right rudder. Of note, the MP did not change the elevator trim as the MA accelerated from 122 knots to 166 knots prior to weapon release and did not change it for the remainder of the mishap sortie (MS). While the release was within the A-29 Flight Manual limits, the MA was 44 knots below the target airspeed annotated on the LAE II weapon attack card.

The weapon release caused a lateral asymmetry that was amplified as the rolling maneuver was performed at 1.47 g's, increasing the rolling tendency by nearly 50 percent. The MP quickly countered the abrupt and rapid right roll with left aileron input as the MA continued to roll right through 180 degrees of bank and pitched down to 70 degrees nose low. Roll and pitch rates steadily increased in an oscillatory fashion, despite several pilot-commanded corrective actions. The Electronic Voice and Data Recorder (EVADR) data showed the MA in a continuous roll, while the pitch attitude became more nose low to near vertical, and the airspeed and normal acceleration (g) steadily increased. The MA entered a tightening downward spiral. The completion of the first spiral took about 8 seconds, and the completion of the second spiral took about 4 seconds. In a 28-second period, the MA descended almost 10,000 feet, and nearly doubled its airspeed from 166 to 306 knots. The maximum roll rate was 248 degrees per second, the maximum yaw rate was 49.3 degrees per second, and the maximum normal acceleration was 6.67 g's, increasing the asymmetric rolling tendency by a factor of six.

The constant nose-up elevator trim setting caused continuous nose-up elevator deflection. As the airspeed increased, the nose-up elevator deflection resulted in increased normal acceleration (g). This, combined with the amplified effect of the weapon asymmetry at elevated g's, were dominant factors in tightening the spiral dive. The MC made four unsuccessful recovery attempts. The MP's left aileron and rudder commands appeared to be effective in reducing the right roll and yaw. However, the corrective actions were short in duration and were not consistent enough to completely neutralize the right roll.

The MW initiated the ejection sequence at 2,600 feet above ground level (AGL), landing with minor injuries. The MP initiated ejection at 700 feet AGL and did not survive. Both ejections were below the 5,000-foot AGL altitude recommended by the A-29 Flight Manual for uncontrolled flight. The MP was also below the 2,000-foot AGL minimum altitude for any ejection.

Of note, the MA's ejection sequence selector was set to the SINGLE mode in accordance with the A-29 Flight Manual, due to a previous issue with the ejection seat in the AFT mode. The AFT mode would have allowed either the MP or MW to initiate the ejection sequence with a 0.4-second separation. The SINGLE mode required that the MP and MW each initiate their own ejection sequence separately. Further analysis revealed that both MA ejection seats had the appropriate modifications and could have safely been operated in the AFT mode. The AFT mode would have likely ejected the MP more than 2.5 seconds sooner, increasing the MP's chance of survival.

By a preponderance of the evidence I find that the cause of the mishap was the MP's overcontrol of the MA causing an inadvertent entry into an uncontrolled spiral dive, combined with his failure to apply adequate recovery control inputs. Additionally, I find by a preponderance of the evidence, that a specific cause of the MP's death was delayed initiation of the ejection sequence by the MC, not in accordance with established procedures.

I also find, by a preponderance of the evidence, that wrong choice of action by the MC in attempting a 180-degree turn maneuver, without compensating for asymmetry of weapon release at low airspeed, substantially contributed to the mishap. In addition, fixation, critical information not communicated between the MC during the recovery, and operation of the ejection seat selector as directed in SINGLE mode substantially contributed to the fatality.

I developed my opinion and determined the mishap sequence of events by analyzing factual data from the EVADR, video animation, engineering analysis, witness testimony, simulation of the mishap sequence, information provided by technical experts, the A-29 Flight Manual, and Air Force directives and guidance.

2. CAUSES

The cause of the mishap was the MP's overcontrol of the MA causing an inadvertent entry into an uncontrolled spiral dive, combined with his failure to apply adequate recovery control inputs. Additionally, a specific cause of the MP's death was the delayed initiation of the ejection sequence by the MC, not in accordance with established procedures.

a. Overcontrolled/Undercontrolled Aircraft (Post Weapon Release and Spiral Dive Recovery)

As the MA approached its target, the MP verbally affirmed his intention to make a 180-degree turn to the right immediately after weapon release from the left wing. Prior to the weapon release, the MP flew the MA at a relatively slow airspeed (122 to 166 knots) and did not change the elevator trim, while maintaining a wings-level attitude. Immediately following weapon release, the MP made simultaneous inputs of nose-up elevator, right aileron, and right rudder. The A-29 was expected to roll towards the heavy (right) wing in response to the sudden asymmetry induced when the 500-pound GBU-12 was released from the opposite (left) wing. However, the MP's control inputs exacerbated the already-expected roll toward the heavy wing, eventually leading to a nose down, inverted aircraft. As the MA continued to roll right, it entered into an uncontrolled spiral dive. Insufficient control inputs by the MP resulted in an ever-tightening downward spiral until ground impact, approximately 28 seconds after weapon release.

b. Delayed a Necessary Action (Delayed Initiation of Ejection Sequence)

The A-29 Flight Manual, Section III Emergency Procedure, states "It is recommended to eject above 2,000 feet AGL and 150 KCAS under controlled conditions and at least 5,000 feet AGL under uncontrolled situation... DO NOT DELAY THE EJECTION BELOW 2,000 FEET AGL FOR ANY REASON...".

The MW initiated ejection at approximately 2,600 feet AGL and the MP initiated ejection at approximately 700 feet AGL, both below the 5,000-foot AGL minimums recommended by the A-29 Flight Manual for an uncontrolled situation. While the MW sustained minor injuries, the MP ejected too close to impact to survive. Analysis of the ejection seat and mishap site concluded that the MP ejected approximately 1.5 seconds before impact, long enough to egress the aircraft and deploy the drogue, but without enough time to deploy the main parachute.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

Wrong choice of action by the MC in attempting a 180-degree turn maneuver, without compensating for asymmetry of weapon release at low airspeed, substantially contributed to the mishap. In addition, fixation, critical information not communicated between the MC during the

recovery, and inadequate guidance on the use of the ejection seat in the AFT mode substantially contributed to the fatality.

a. Wrong Choice of Action (Attempting 180-Degree Turn Maneuver at Low Airspeed Without Compensating for Asymmetry of Weapon Release)

In the briefing, the MC planned the sortie profile which involved releasing a 500-pound GBU-12 from the left wing (weapon attack card annotated the desired airspeed was 210 knots), followed immediately by a 180-degree right turn into the direction of the heavy wing. This was the MC's first sortie flown without an instructor in the A-29. An AT-6 aircrew had flown the 180-degree turn eight days before the mishap. However, it was largely untested in the A-29, particularly at relatively slow airspeeds. The MC made a wrong choice of action when they decided just prior to the initial weapon delivery to accept a slower than normal airspeed and proceed with the planned weapon release followed by a 180-degree turn in the direction of the heavy right wing, without compensating for the asymmetry.

b. Provided Inadequate Procedural Guidance or Publications (Flight Manual Guidance Directed Use of Ejection Seat in SINGLE Mode)

A-29 aircrews were flying under published and verbal guidance to avoid using the ejection sequence selector in the AFT mode. Martin-Baker manufactured the ejection seats for the MA in 2015, after a 2014 modification that enabled safe operation in all three modes. At the time of the mishap, not all of the seats in the A-29 fleet had been modified, and Embraer had not released an Operational Bulletin that allowed all three modes to be used in the MA. Had the MC been allowed to fly in the AFT mode, MP ejection would have been activated automatically 0.4 seconds following the MW, which would have been at least 2.5 seconds earlier than when he pulled his ejection seat handle, increasing the likelihood of survival.

c. Fixation (MC Focus on Recovery Procedure Prohibited Awareness of Passing Ejection Altitude)

Within a few seconds of releasing the GBU-12, the MA entered a right-rolling, uncontrolled downward spiral. The loss of the horizon, combined with the stress of glare and increasing airspeed and g's, all contributed to the MC's fixation on aircraft recovery and identifying altitudes. Fixation thus interfered with the MC recognizing the MA location and closure rate, and opting for ejection above a minimum safe altitude.

d. Critical Information Not Communicated (MC Did Not Communicate Altitude or "BAILOUT" Command)

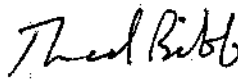
The MP and MW failed to communicate "BAILOUT" once the MA descended below 5,000 feet AGL. The MW, then the MP, pulled their respective ejection handles once each independently recognized that the MA was extremely close to impact, but failed to communicate altitudes and the briefed "BAILOUT-BAILOUT-BAILOUT" command.

4. CONCLUSION

By a preponderance of the evidence, I find that the cause of the mishap was the MP's overcontrol of the MA causing an inadvertent entry into an uncontrolled spiral dive, combined with his failure to apply adequate recovery control inputs. Additionally, I find by a preponderance of the evidence, that a specific cause of the MP's death was delayed initiation of the ejection sequence by the MC, not in accordance with established procedures.

I also find, by a preponderance of the evidence, that wrong choice of action by the MC in attempting a 180-degree turn maneuver, without compensating for asymmetry of weapon release at low airspeed, substantially contributed to the mishap. In addition, fixation, critical information not communicated between the MC during the recovery, and operation of the ejection seat selector as directed in SINGLE mode substantially contributed to the fatality.

4 October 2018


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