UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT

A-10C, T/N 79-0204, AND A-10C, T/N 78-0657

66TH WEAPONS SQUADRON
57TH WING
NELLIS AIR FORCE BASE, NEVADA

LOCATION: NEVADA TEST AND TRAINING RANGE 65C

DATE OF ACCIDENT: 6 SEPTEMBER 2017

BOARD PRESIDENT: COLONEL BRUCE E. MUNGER

Conducted IAW Air Force Instruction 51-503

[Volume One of One]

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR COMBAT COMMAND
JOINT BASE LANGLEY-EUSTIS VA

OFFICE OF THE DEPUTY COMMANDER
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4 APR 2018

ACTION OF THE CONVENING AUTHORITY

The Report of the Accident Investigation Board, conducted under the provisions of AFI 51-503, that investigated the 6 September 2017 mishap involving two A-10C, T/Ns 79-0204 and 78-0657, 66th Weapons Squadron, 57th Wing, Nellis Air Force Base, Nevada, complies with applicable regulatory and statutory guidance; on that basis it is approved.

//Signed//

JOHN K. MCMULLEN
Major General, USAF
Deputy Commander

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION

A-10C, T/N 79-0204, AND A-10C, T/N 78-0657
NEVADA TEST AND TRAINING RANGE 65C
6 SEPTEMBER 2017

On 6 September 2017, at 19:44:09 local time (L), two A-10C aircraft, tail number 79-0204 (Mishap Aircraft 1 [MA1]) and tail number 78-0657 (Mishap Aircraft 2 [MA2]), assigned to the 66th Weapons Squadron, 57th Wing, Nellis Air Force Base (AFB), Nevada, collided over Range 65C on the Nevada Test and Training Range (NTTR), 55 miles northwest of Nellis AFB. The midair collision rendered both MA1 and MA2 uncontrollable and both pilots (Mishap Pilot 1 [MP1] and Mishap Pilot 2 [MP2]) ejected. Military search and rescue forces rapidly located MP1 and MP2. MP1 and MP2 suffered only minor injuries during the ejection or parachute landing. Both MA1 and MA2 were destroyed when they crashed on the NTTR. This resulted in the loss of $30,661,412.84 in aircraft and an environmental clean-up cost of $108,000.

The accident occurred during a night mission conducting close air support as part of the Weapons Instructor Course for MP1, with MP2 as the instructor of record. MP1 was the flight lead and briefed 1,000-foot (ft) altitude separation as the method to procedurally deconflict the mishap flight (MF), both within the formation and from other aircraft. This separation is in accordance with Air Force guidance for night operations. MP1 and MP2 both acknowledged the correct altimeter setting for the area of operations and flew at the correct altitudes from takeoff until 19:28L. Although night vision googles were worn and the MF was clear of clouds, mission tasks and environmental conditions did not allow the use of visual deconfliction procedures. As briefed, MP1 directed an altitude deconfliction plan for the MF with a 1,000-ft buffer zone between altitude blocks. MP1 directed MA1 would maintain below 10,000 ft Mean Sea Level (MSL) and MA2 would maintain 11,000 - 12,000 ft MSL. As the sortie progressed, increased radio communications, coordination with other participants and tasks related to weapons delivery diverted MP1's time and attention from effectively crosschecking aircraft altitude. MP1 stated he did not hear an audible notification indicating MA1 had climbed above the directed altitude and into the buffer zone established to separate MA1 and MA2. From 19:28L to 19:43L, MA1 progressively climbed 1,400 ft above the directed altitude block. MP1 and MP2 were unaware they were flying co-altitude at approximately 11,400 ft MSL. At 19:44:09L, while making final preparations to attack a Range 65C target, MA1 and MA2 collided.

The Accident Board President found by a preponderance of the evidence the cause of the accident was an unintentional failure to adhere to established altitude deconfliction procedures. Substantially contributing factors include task over-saturation, misperception of changing environment, breakdown in visual scan, and environmental conditions affecting vision.

SUMMARY OF FACTS AND STATEMENT OF OPINION
A-10C, T/N 79-0204, and A-10C, T/N 78-0657
6 SEPTEMBER 2017

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

"	Inches (of Mercury)
57 WG	57th Wing
66 WPS	66th Weapons Squadron
ACC	Air Combat Command
AFB	Air Force Base
AFE	Aircrew Flight Equipment
AFI	Air Force Instruction
AFTO	Air Force Technical Order
AGL	Above Ground Level
AIB	Accident Investigation Board
AIS	Advanced Instrumentation System
AMU	Aircraft Maintenance Unit
AO	Area of Operations
ARS	Attitude Reference System
ASOC	Air Support Operations Center
AWOL	Absent Without Leave
B-No	Be Nobody past point
BDU	Bomb Dummy Unit
CAS	Close Air Support
CCIP	Continuously Computed Impact Point
CCRP	Continuously Computed Release Point
CLS	Combat Life Support
CSAR	Combat Search and Rescue
CT	Continuation Training
DA	Direct Action
DoD	Department of Defense
DRS	Digital Recover Sequencer
DSMS	Digital Stores Management System
ELT	Emergency Locator Transmitter
ETA	Estimated Time of Arrival
FF	Friendly Forces
ft	Foot/feet
FS	Fighter Squadron
g	Gravitational Force
GAF	Ground Assault Force
GBU	Guided Bomb Unit
GPS	Global Positioning System
GSB	Ground Support Battalion
HAS	High Angle Strafe
HFACS	Human Factors Analysis and Classification System
HG	Hog
HMCS	Helmet Mounted Cueing System
HOTAS	Hands On Throttle and Stick
HUD	Heads-Up Display
IAW	In Accordance With
ICADS	Individual Combat Aircrew Display System
ID	Identification
IFF	Identification, Friend or Foe
IMDS	Integrated Maintenance Data System
IO	Investigating Officer
IOR	Instructor of Record
IP	Instructor Pilot
IR	Infrared
JOAP	Joint Oil Analysis Program
JTAC (I)	Joint Terminal Attack Controller (Instructor)
KIO	Knock It Off
L	Local Time
LA	Legal Advisor
lb	pound
LUU	Illumination Unit
MA	Mishap Aircraft
MDTC (or DTC)	Mega Data Transfer Cartridge
MF	Mishap Flight
MFCD	Multi-Function Color Display
MM	Medical Member
mm	millimeter
MP	Mishap Pilot
MSL	Mean Sea Level
MxM	Maintenance Member
NOTAMs	Notices to Airmen
NTTR	Nevada Test and Training Range
NV	Nevada
NVGs	Night Vision Goggles
Ops Tempo	Operations Tempo
PIZON	Common Frequency
PM	Pilot Member
PPLI	Precise Participant Location and Identification
PR	Pre-Flight Inspections
RD	Red Delta
ROZ	Restricted Operating Zone
RTE	Route
SA	Situational Awareness
SADL	Situational Awareness Data Link
SAR	Search and Rescue
SK	Shark
SME	Subject Matter Expert
SOF	Supervisor of Flying
SPINS	Special Instructions
TAD	Tactical Awareness Display
TCTO	Time Compliance Technical Order
TGM	Training Guided Missile
TGP	Targeting Pod
TGT	Target
TH	Thru-Flight Inspections
TO	Technical Order
TP	Training Practice
UPT	Undergraduate Pilot Training
U.S.	United States
USAFWC	U.S. Air Force Warfare Center
USAFWS	U.S. Air Force Weapons School
WD	Weapons Delivery
WIC	Weapons Instructor Course
WUG	Weapons Undergraduate

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

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 28 October 2017, Major General John K. McMullen, Deputy Commander, Air Combat Command (ACC), appointed Colonel Bruce E. Munger to conduct an aircraft accident investigation of the 6 September 2017* mishap involving two A-10C Thunderbolt II aircraft on Nevada Test and Training Range (NTTR) 65C (Tab Y-2 to Y-5). On 1 November 2017, the Accident Investigation Board (AIB) convened at Nellis Air Force Base (AFB), Nevada (NV) (Tab Y-2 to Y-5). The AIB also included a legal advisor (Captain), a pilot member (Captain), a medical member (Captain), a maintenance member (Master Sergeant), and a recorder (Staff Sergeant) (Tab Y-2 to Y-5). The ACC Judge Advocate, on behalf of the ACC Deputy Commander, appointed three additional subject matter experts (SME) in Aircrew Flight Equipment (AFE) (Master Sergeant), Maintenance (Civilian Employee), and Aircraft Instrumentation Systems (Civilian Employee) on 8 November 2017 (Tab Y-6 to Y-8). The accident investigation was conducted in accordance with (IAW) Air Force Instruction (AFI) 51-503, *Aerospace and Ground Accident Investigations*, dated 14 April 2015, and AFI 51-503, ACC Supplement, *Aerospace and Ground Accident Investigations*, dated 28 January 2016.

b. Purpose

IAW AFI 51-503, this 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 6 September 2017, at 19:44:09 local time (L) two A-10C aircraft, tail number 79-0204 (Mishap Aircraft 1 [MA1]) and tail number 78-0657 (Mishap Aircraft 2 [MA2]), assigned to the 66th Weapons Squadron (66 WPS), 57th Wing (57 WG), Nellis AFB, NV, collided over Range 65C on the NTTR, 55 miles northwest of Nellis AFB (Tabs K-3, Y-2, Z-3, AA-7, CC-8 and FF-4 to FF-5). This collision rendered both MA1 and MA2 uncontrollable, and both pilots (Mishap Pilot 1 [MP1] and Mishap Pilot 2 [MP2]) ejected (Tab V-1.17 and V-2.19). Military search and rescue forces rapidly located and recovered MP1 and MP2 (Tab DD-24 to DD-29). Both pilots suffered minor injuries during the ejection or parachute landing (Tab X-2). Both MA1 and MA2 crashed on the NTTR (Tab Z-3). This resulted in the loss of $30,661,412.84 in aircraft and an environmental clean-up cost of $108,000 (Tab P-2 to P-8).

* Due to differing time zones, the mishap date listed on the convening order differs by one day. This report provides facts based on the local date and time at the locations where the incidents occurred.

3. BACKGROUND

a. Air Combat Command (ACC)

ACC is the primary force provider of combat airpower to America's warfighting commands (Tab CC-2). To support global implementation of national security strategy, ACC operates fighter, bomber, reconnaissance, battle-management, and electronic-combat aircraft (Tab CC-2). It also provides command, control, communications, and intelligence systems, and conducts global information operations (Tab CC-2). ACC's mission is to support global implementation of national security strategy. ACC operates over 1,300 aircraft across 34 wings and 19 bases, comprising 94,000 active duty and civilian personnel (Tab CC-2).

b. United States Air Force Warfare Center (USAFWC)

The USAFWC's mission is to develop innovative leaders and full spectrum capabilities through responsive, realistic, and relevant testing, tactics development, and advanced training across all levels of current and future warfare (Tab CC-6). The USAFWC ensures deployed forces are well trained and equipped to conduct integrated combat operations (Tab CC-6). The USAFWC oversees the operations of four wings, two named units, and one detachment, comprising 11,000 personnel located in 23 states and 37 different locations (Tab CC-7).

c. 57th Wing (57 WG)

The 57 WG provides advanced aerospace training to worldwide combat air forces with innovative professionals leading advanced, realistic, multi-domain training focused on winning the fight (Tab CC-8). Their dynamic and challenging flying operations include flying and maintaining A-10C, F-15C/D, F-15E, F-16C/CG/CJ, F-22A, F-35A, MQ-9, and HH-60G aircraft (Tab CC-8). The 57 WG is comprised of seven distinct organizations (U.S. Air Force Weapons School [USAFWS], 57th Adversary Tactics Group, 57th Operations Group, 57th Maintenance Group, 561st Joint Tactics Squadron, U.S. Air Force Aerial Demonstration Squadron, and U.S. Air Force Advanced Maintenance and Munitions Operations School) (Tab CC-8). Through those organizations, they conduct advanced aircrew, space, logistics, and command-and-control training, to include the premiere Red Flag and Green Flag exercises (Tab CC-8 to CC-12).

d. 66th Weapons Squadron (66 WPS)

The 66 WPS falls under the USAFWS (Tab CC-8). The squadron trains A-10C and Joint Terminal Attack (JTAC) Weapons Officers with the tactical expertise and operational context needed for leadership roles within the joint force during both major conventional operations and special operations (Tab CC-16). Each year, the 66 WPS seeks to graduate A-10C and JTAC Weapons Officers who are tactical experts and leaders of Airmen (Tab CC-16). During the course, students receive graduate-level academics and participate in demanding combat training missions (Tab CC-13 to CC-15). The culmination of the course is the Advanced Integration phase in which all

USAFWS assets combine in challenging scenarios simulating current and future threat arenas (Tab CC-14). Students demonstrate the ability to lead and instruct while effectively integrating multiple weapons systems across the land, air, space, and cyber domains (Tab CC-14). Upon graduation, the new weapons officers return to the field to serve as weapons and tactics officers, leading combat missions and providing senior leaders and decision makers with tactical, operational, and strategic support (Tab CC-14).

e. A-10C

The A-10 Thunderbolt II was specifically designed for close air support (CAS) and fielded in 1975 as the A-10A (Tab CC-18). The aircraft has excellent maneuverability at low air speeds and altitude, and it is a highly accurate and survivable weapons-delivery platform (Tab CC-17). In 2007 the upgraded A-10C became fully operation capable and provides commanders with a large and varied ordnance load, long loiter time, precision engagement, austere field capability, and enhanced survivability (Tab CC-17 to CC-18). The A-10 has proven invaluable to the United States and its allies through participation in operations from Desert Storm to Inherent Resolve (Tab CC-18).

4. SEQUENCE OF EVENTS

a. Mission

The mishap flight (MF) was comprised of two pilots (Tab V-3.1). The mission flown was a USAFWS night CAS sortie for MP1 (Tabs V-2.2 and V-3.1). The MF planned to work with multiple participants in the same area of operations (AO) (Tabs V-2.8 and V-3.1). Other aircraft in the AO included: Shark 41 flight, two A-10Cs from the 75th Fighter Squadron (FS) and Clydesdale 01, one CH-47 from the U.S. Army 4th Infantry Division (Tabs V-1.9, V-2.8, and AA-6). The MF and Shark 41 flight operated in the western half of the AO (Tab V-2.8). Prior to the accident, the MF departed Nellis AFB at 18:46L and entered the NTTR at 18:56L (Tab FF-4). Soon after entering the NTTR, MP1 made contact with the JTAC and began the training scenario (Tabs V-5.1 and R-27). The portion of the NTTR utilized by the MF prior to the accident had elevations ranging from 4,000 to 6,500 feet mean sea level (MSL) (Tab AA-7).

b. Planning

The day prior to the accident, MP1 and MP2 met to discuss the mission (Tab V-2.3). MP1 and MP2 also spoke with the JTAC to discuss the scenario (Tab V-1.4 and V-2.3). MP2 was the instructor of record (IOR) for MP1 and coordinated with the JTAC instructor to finalize the scenario (Tab V-2.3 to V-2.4, and V-3.1). At 15:15L, MP2 and the JTAC instructor, with representatives from each participating flight, met to coordinate the training scenario timeline and events (Tabs R-5 and V-2.3 to V-2.4). At 15:45L, all available participants met for the JTAC briefing (Tab AA-6). This briefing covered initial altitudes to enter the airspace (Tab V-1.6). Following the JTAC brief, MP1 conducted a flight briefing with MP2 using the published A-10C *Warrior Guide*, Volume 2, Briefing Guide (Tab V-1.23). The flight briefing covered all required

topics including weather, illumination, expected tactics, and deconfliction (Tab V-1.5). MP1 briefed the primary form of deconfliction would be procedural, using a minimum 1,000-foot (ft) altitude separation (Tab V-1.7 to V-1.8). Any deviations from the briefed deconfliction plan were required to be immediately announced over the radio (Tab V-1.5, V-1.26, and V-2.6).

c. Preflight

The flight plan was filed appropriately and there were no applicable notices to airmen (NOTAMs) which affected the MF (Tabs K-2 and AA-2 to AA-5). MP1 and MP2 arrived at their aircraft with all appropriate equipment including night vision goggles (NVGs) (Tab V-1.12, V-2.7, and V-2.12). Both aircraft were heavily loaded with training munitions (Tabs P-4 to P-8). Movement to the aircraft, preflight inspections, and engine start were uneventful (Tab V-1.6 and V-2.7).

d. Summary of Accident

The MF requested to taxi at 18:26L and was cleared for takeoff at 18:46L (Tab N-2 and N-5). The takeoff and enroute portions of the sortie were uneventful (Tab V-1.12). The MF entered the NTTR with the correct altimeter setting of 29.85 inches of mercury (") and climbed to the planned altitude of 15,000 - 17,000 ft MSL (Tabs N-8 and FF-4). The MF began communicating with the JTAC at 19:10L (Tab R-27). At 19:19L, the MF entered the western AO and requested approval from the JTAC to descend below a thin layer of clouds, located at 16,000 ft MSL, which was obstructing views of the target area (Tabs R-27, V-1.11 and FF-4). The JTAC approved the MF to descend to 8,000 - 12,000 ft MSL (Tab R-27). MP1 established altitude deconfliction from MP2 by directing separate altitude blocks within the MF; the assigned altitude block for MP2 was 11,000 - 12,000 ft MSL, and the assigned altitude block for MP1 was 8,000 - 10,000 ft MSL (Tab V-1.24 and V-2.10).

At 19:22L both MP1 and MP2 reached their assigned altitude blocks (Tab FF-5). External lighting for the MF was off, and MP1 and MP2 wore NVGs to facilitate target attacks (Tab V-1.11 to V-1.14 and V-2.12). The pilots noted illumination levels were high, but environmental conditions negatively impacted NVG use in some viewing directions; specifically, light from the setting sun made it difficult to distinguish detail when looking west (Tab V-2.11 to V-12). MP1 established the MF in a north/south holding pattern west of the planned target area (Tabs V-1.14 and FF-4). MP1 directed MP2 to begin looking for targets along the JTAC's planned route while MP1 provided observation of the JTAC's current position (Tab V-1.14). MP2 used the TGP to find enemy vehicles and then passed this information to MP1 (Tab V-1.14 to V-1.15). MP1 then relayed the enemy coordinates to the JTAC (Tab V-1.15).

At 19:28L, while in the holding pattern west of the target area, MP1 climbed above the 10,000 ft MSL ceiling of the altitude block for MA1 and continued a slow climb of approximately 100 feet per minute, reaching 10,500 ft MSL at 19:33L (Tab FF-4 to FF-5).

At 19:31L, Shark 41 flight requested entry into the western AO (Tab DD-17). MP1 directed Shark 41 flight to enter above 13,000 ft MSL (Tab DD-17). At 19:33L, MP2 verified Shark 41 flight had the correct altimeter setting of 29.85", and verified Shark 41 flight understood their altitude assignment was 13,000 ft MSL and above (Tab DD-17). MP2 then transmitted a situation update to Shark 41 flight providing known friendly and enemy locations (Tab DD-18). At 19:35L, the

JTAC gave a target attack briefing, or "nine-line," to the MF and Shark 41 flight (Tab DD-18). The JTAC then requested the A-10Cs to attack the targets (Tab DD-18).

From 19:35L until 19:43L, the MF continued to operate in the holding pattern west of the target area with less than the directed 1,000 ft vertical separation between directed altitude blocks (Tab FF-4 to FF-5). Radar and AIS data shows MA1 was at approximately 10,800 ft MSL and MA2 was at approximately 11,500 ft MSL (Tab FF-4 to FF-5).

By 19:37L, both the MF and Shark 41 flight had completed required read-backs to the JTAC and were preparing to attack the targets (Tab DD-19). The mission required MP1 to develop a plan that enabled both the MF and other aircraft to attack a target area (Tab V-3.1). MP1 developed a coordinated attack plan and then informed the JTAC the A-10Cs would strafe the targets (Tabs V-2.24 and DD-19).

At 19:41L, the JTAC transmitted the A-10Cs needed to conduct attacks immediately (Tab DD-20). At 19:42L, the JTAC emphasized the need for an attack by transmitting the enemy was in close proximity to friendly forces (Tab DD-21).

MP 1 informed MP2 the MF would attack targets from a 20 degree dive attacked called 20 High Angle Strafe (20 HAS) (Tab V-1.16). MP2 recommended to MP1 the attack should instead be a 30 HAS delivery (Tab V-2.15).

At 19:43:08L, MP1 started to climb above 10,800 ft MSL; this soon resulted in MP1 and MP2 operating at or near the same altitude but still not visual with each other (Tabs V-1.14, V-1.23, V-2.18, and FF-4 to FF-5,). At 19:43:30L both aircraft were flying at approximately 11,400 ft MSL with 1.7 miles horizontal separation and proceeding southbound in the holding pattern (Tab FF-4).

At 19:43:48L, MP2 directed Shark 41 flight to proceed to the southwest of the target area and to report upon arrival (Tab DD-21). MP2 then passed a plan for the MF to sequentially attack the targets from the west and then fly to the northwest (Tab DD-21). Once the MF was established northwest of the target, Shark 41 flight would attack the targets (Tab DD-21).

At 19:43:52L, while still transmitting this attack plan, MP2 began a 60-degree right bank turn towards the west to setup for the MF attack (Tabs V-2.18 and FF-4). MP1 was co-altitude and offset 1 mile to the northwest of MP2 (Tab FF-4). MA1 was in a slight right bank on a southbound heading (Tab FF-4). 17 seconds later the flight paths of MA1 and MA2 converged as depicted in Figures 1 and 2 (Tabs Z-2 and FF-4 to FF-5).

At 19:44:09L, MA1 (heading 200 degrees in a 10-degree right bank) and MA2 (heading 300 degrees in a 60-degree right bank) collided at approximately 11,400 ft MSL (Tab FF-4 to FF-5).

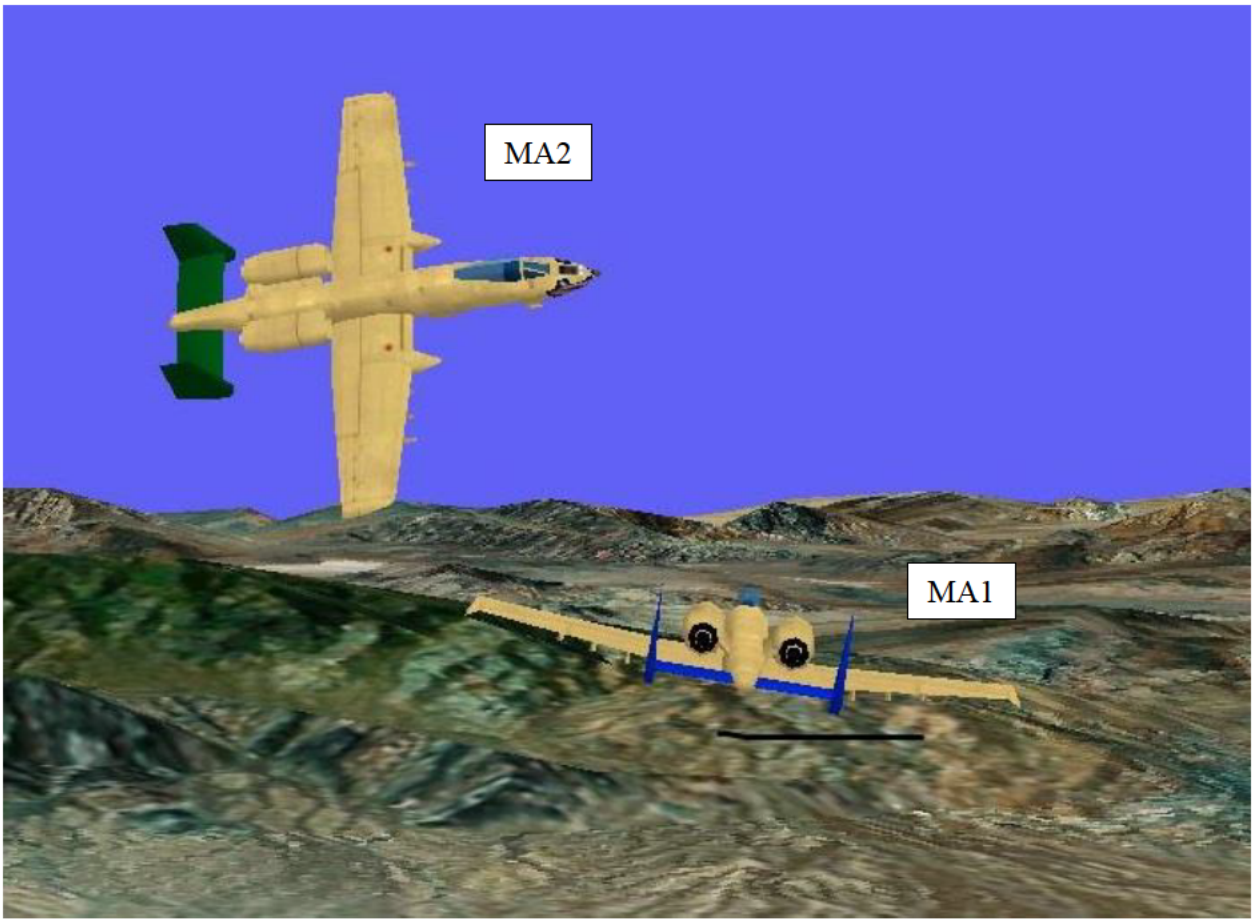

Figure 1. MF simulation (viewed from the north) 0.2 seconds prior to collision (Tab Z-2)

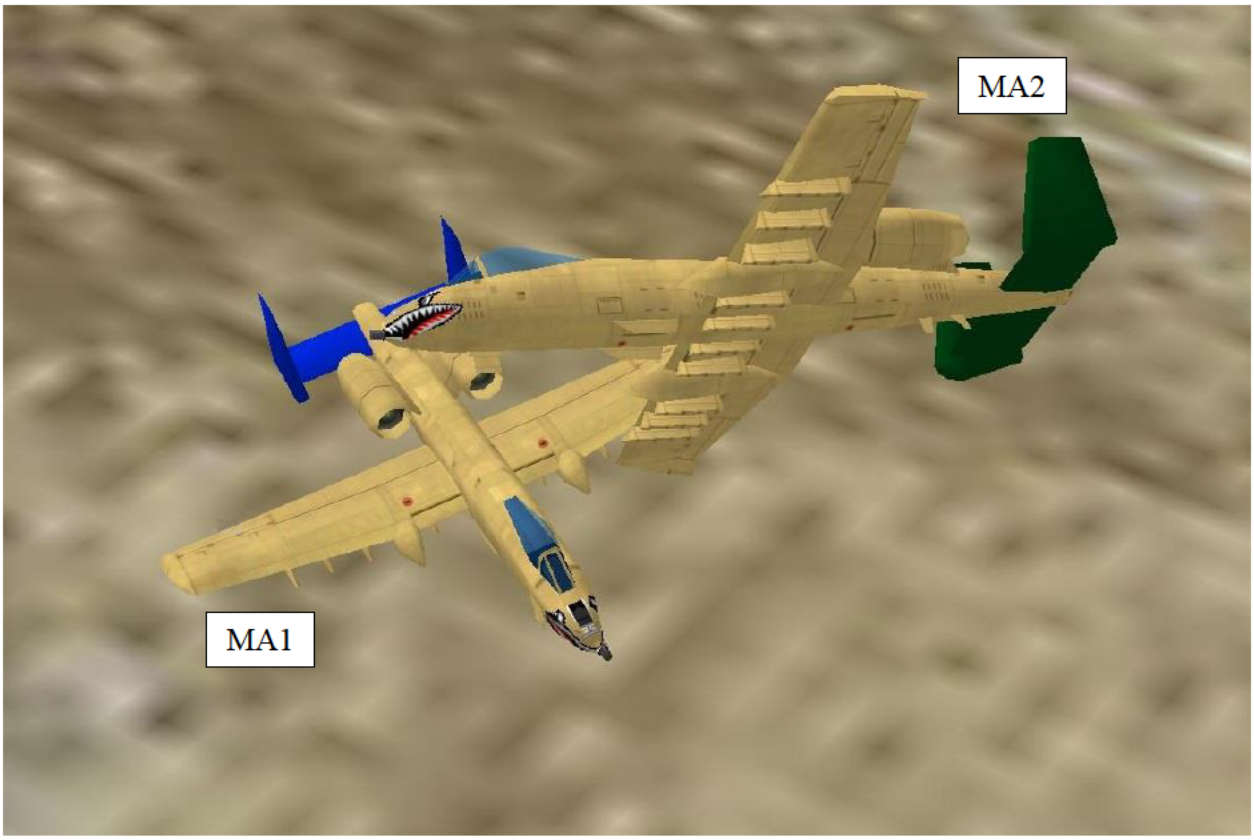

Figure 2. MF simulation (viewed from above) 0.1 seconds prior to collision (Tab Z-2)

The midair collision caused the outermost 10 feet of the left wing as well as the left engine and the left vertical stabilizer to separate from MA1 (Tabs S-14, S-16, S-18, U-3, and Z-3). Additionally, the outermost five feet of the right wing was separated from MA2 during the midair collision (Tabs U-3 and Z-3).


Figure 3. MA1 left wing separated in collision (Tabs S-14 and U-3)

Figure 4. MA1 left vertical stabilizer separated in collision (Tabs S-16 and U-3)

Figure 5. MA2 right wingtip separated in collision (Tab Z-3)

Following the midair collision, MP1 observed fire on the left side of MA1 (Tab V-1.17). To counter the rolling motion, MP1 applied control inputs, but these were ineffective at stopping the roll (Tab V-1.17).

Unable to control the aircraft, MP1 made the decision to eject (Tab V-1.17). At 19:44:25L, MA1 transmitted an emergency radar code signifying ejection had occurred (Tab FF-5).

Immediately following the midair collision, MA2 began an uncommanded descent towards the northwest (Tab V-2.18 to V-2.19). MP2 applied control inputs that helped counter, but did not stop the descent (Tab V-2.18 to V-2.19). Because of the continued descent of MA2 towards high terrain, MP2 made a decision to eject (Tab V-2.19). At 19:44:21L, MP2 made a radio call of "[callsign] bailing out" (Tab DD-21). Immediately following this radio call, MP2 commanded an ejection (Tabs V-2.19).

e. Impact

Wreckage from the collision of MA1 and MA2 landed in a mixed debris field near the midair collision location (between the two crash sites) as depicted in Figure 6 (Tabs S-14, S-16, S-18, U-3 and Z-3).

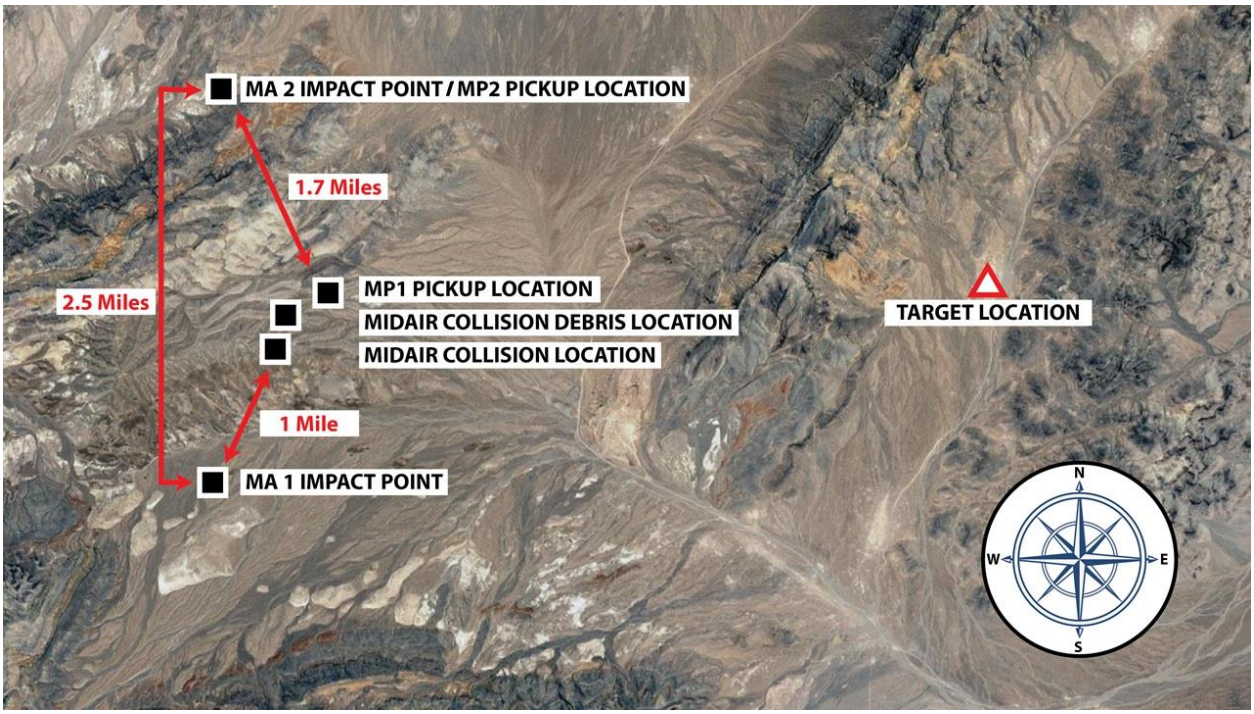

Figure 6. Map of crash and recovery sites (Tab Z-3)

MA1 crashed into the ground 1 mile southwest of the midair collision location depicted in Figures 6 and 7 (Tabs S-8, S-23, Z-3, and FF-5). Based upon an inspection of the crash site, MA1 crashed in a left-wing-low orientation (Tab S-8 to S-12). At the time of the crash, MA1 was carrying training munitions (Tab P-4 to P-5).

Figure 7. MA1 crash site (looking north) (Tabs S-8 and Z-3)

MA2 crashed shortly after MA1, 1.7 miles northwest of the midair collision location and 2.5 miles from the MA1 crash site as depicted in Figures 6, 8, and 9 (Tabs S-3 to S-7, S-23, V-2.20, Z-3, and FF-4). Based upon an inspection of the crash site and witness testimony, MA2 crashed while northbound in an 80 - 90 degree, nose-low orientation (Tabs S-3 to S-7, S-23, and V-2.20). At the time of the crash, MA2 was carrying training munitions (Tab P-6 to P-7).

Figure 8. MA2 crash site (looking southwest) (Tabs S-3 and Z-3)

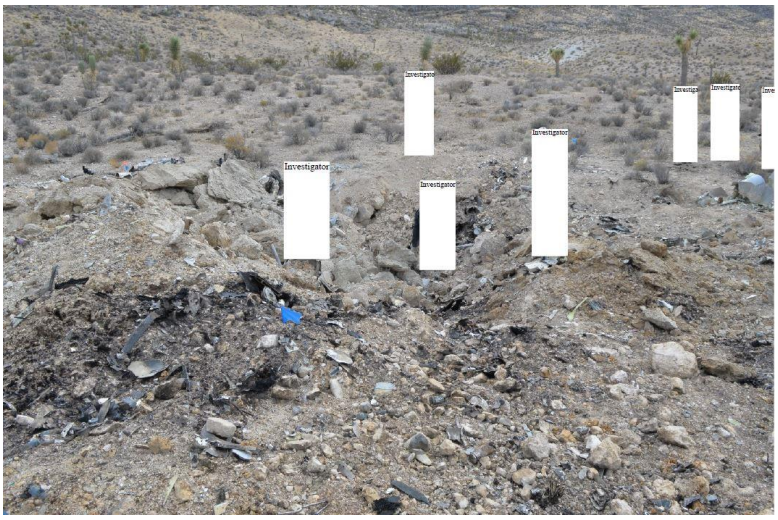

Figure 9. MA2 crash site (looking south) (Tab S-4 and Z-3)

f. Egress and Aircrew Flight Equipment (AFE)

When MP1 ejected at 19:44:25L, the seat mounted Digital Recover Sequencer (DRS) selected a Mode I ejection sequence (Tabs H-8 to H-9, BB-4, and FF-5). The Mode I ejection sequence is for speeds below 250 knots equivalent airspeed and for altitudes from ground level to 15,000 ft MSL (Tab H-3). In a Mode I ejection the pilot is under an inflated parachute canopy approximately 2 seconds after commanding ejection (Tab BB-4). Analysis of the canopy and ejection seat indicate the ejection was fully successful, and that the DRS properly selected a Mode I ejection (Tab H-9).

When MP2 ejected at 19:44:23L, the DRS selected a Mode II ejection sequence (Tabs H-8 to H-9 and DD-21). The Mode II ejection sequence is for speeds between 250-650 knots equivalent airspeed and for altitudes from ground level to 15,000 ft MSL (Tab H-3). In a Mode II ejection, a drogue chute fires to slow the ejection seat and the pilot is under an inflated parachute canopy approximately 3 seconds after commanding ejection (Tabs H-3 and BB-4). Analysis of the canopy and ejection seat indicate that the ejection was fully successful and that the DRS properly selected a Mode II ejection (Tab H-9).

There were no overdue inspections on AFE equipment relevant to the accident (Tab EE-2 to EE-5). After the accident, the egress equipment used by MP1 and MP2 was recovered and sent off for evaluation by the Air Force Life Cycle Management Center, which determined that all subsystems relevant to the accident functioned as designed (Tab H-2).

g. Search and Rescue (SAR)

At 19:44:21L, MP2 made a radio call of "[callsign] bailing out" (Tab DD-21). This radio call was not heard or not understood by personnel monitoring the radio frequency (Tab V-4.1). At 19:44:25L, Air Traffic Controllers received an emergency Identification, Friend or Foe (IFF) code transmitted from MA1 (Tab FF-5). At 19:44:27L, Shark 41 observed a burning object falling to the ground (Tabs V-4.1 and DD-21). Shark 41 initially perceived the burning object to be an IR flare released by the MF to illuminate the target area (Tabs V-4.1 and DD-21). At 19:44:36L, Shark 41 observed the burning object hit the ground and start a large fire (Tabs V-4.1 and DD-21). Based upon the flight path of Shark 41, the fire observed by Shark 41 was later determined to be the crash of MA1 (Tab Z-5). At 19:44:44L, Shark 41 heard an emergency beacon sounding over the radio (Tab DD-21). Radio beacons known as Emergency Locator Transmitters (ELTs) automatically transmit to alert rescue forces of an ejection (Tabs BB-4 and DD-21). Shark 41 heard a second emergency beacon sounding over the radio at 19:45:18L (Tab DD-21). With two beacons heard, no MF symbology on the TAD, and unable to contact the MF on the radio, Shark 41 halted the training scenario at 19:49L by making a "Knock-it-Off" radio call (Tabs V-4.1 to V-4.2 and DD-22).

Shark 41 was a qualified search and rescue (SAR) pilot and immediately took on-scene command of all forces to conduct the search for MP1 and MP2 (Tabs AA-8 and DD-23). Shark 41 directed the JTAC and aircraft in the AO to contact relevant command and control agencies while Clydesdale 01 moved towards the crash sites (Tab DD-23). At 19:53L, MP1 used a survival kit radio to make contact with Shark 41 (Tab DD-23). MP1 provided an assessed location north of the southernmost crash site and confirmed there were no apparent injuries (Tab DD-23 to DD-24). At 19:56L, Shark 41 visually identified light signals from MP1 (Tab DD-24). As depicted in Figure 6, MP1 was northeast of the MA1 crash site (Tabs Z-3 and DD-25 to DD-27). Shark 41 determined precise coordinates for MP1 and then radioed this information to Clydesdale 01 prior to starting the search for MP2 (Tab DD-25). Clydesdale 01 visually identified MP1 at 20:07L and landed to recover MP1 at 20:09L (Tab DD-27).

Shark 41 was unable to contact MP2 via radio because MP2 had intentionally jettisoned the survival kit in order to stabilize an oscillating parachute (Tabs V-2.21 and DD-27). Upon reaching the ground and completing a self-assessment, MP2 moved toward the crash site, pointed a light signal skyward, and began to walk back and forth near the MA2 crash site (Tabs V-2.21 and DD-

26 to DD-29). Observing this movement and the light signal near MA2, Shark 41 visually identified MP2 at 20:04L (Tab DD-26). Shark 41 then passed the coordinates for MP2 to Clydesdale 01 (Tab DD-27). At 20:13L, Clydesdale 01 reported enroute to MP2 (Tab DD-28). Clydesdale 01 visually identified MP2 at 20:17L (Tab DD-29). At 20:20L, Clydesdale 01 reported that both MP1 and MP2 were onboard and had no apparent injuries (Tab DD-29). Soon after, Clydesdale 01 departed the NTTR enroute for Nellis AFB (Tab DD-30 to DD-31). After Clydesdale 01 landed at Nellis AFB at 20:48L, emergency medical personnel escorted MP1 and MP2 to the hospital for further evaluation (Tab DD-14 to DD-16).

h. Recovery of Remains

Not applicable.

5. MAINTENANCE

a. Forms & Documentation

The Air Force Technical Order (AFTO) 781 series forms collectively documented maintenance actions, inspections, servicing, configuration, status, and flight activities for the maintained aircraft (Tabs D-2 to D-48 and U-2 to U-3). The Integrated Maintenance Data System (IMDS) is a comprehensive database used to document maintenance actions, flight activity, and schedule future maintenance (Tab BB-21). Review of active 781 series forms and IMDS revealed no overdue inspections or open Time Compliance Technical Orders (TCTOs) that would affect MA flight operations (Tabs D-2 to D-48 and U-2 to U-3). There was a requirement to perform Joint Oil Analysis Program (JOAP) sample testing after the first flight of the day and maintenance personnel properly performed the test at Non-Destructive Inspection; no relevant testing errors were discovered (Tab D-18). While some minor discrepancies were noted, there was no evidence of documentation errors that contributed to the accident (Tabs D-17 to D-18, D-25, and U-2 to U-3).

b. Inspections

The total airframe operating time of MA1 at takeoff of the mishap sortie was 11,408.2 hours (Tab D-2). The total airframe operating time of MA2 at takeoff of the mishap sortie was 11,940.3 hours (Tab D-3). The last pre-flight inspection (PR) for MA1 occurred on 05 September 2017 at 01:00L, and the last thru-flight inspection (TH) on MA1 on 06 September 2017 at 14:00L (Tab D-26). Maintenance personnel performed the last PR inspection for MA2 on 05 September 2017 at 0030L, and there was no TH required (Tab D-46). The PR and TH inspections were conducted IAW approved maintenance procedures and the AFTO Form 781A did not identify any discrepancies left un-repaired for either MA1 or MA2 prior to the accident (Tab D-14 to D-25 and D-34 to D-45).

c. Maintenance Procedures

Civilian contractors staff and manage the Thunder Aircraft Maintenance Unit (AMU) (Tab BB-22). Maintenance training records for all technicians that performed tasks on MA1 or MA 2 were complete (Tab U-2 to U-3).

d. Maintenance Personnel and Supervision

The Thunder AMU is comprised of civilian contractors who adhere to all AFIs governing maintenance (Tab BB-22).

e. Fuel, Hydraulic, and Oil Inspection Analyses

99th Logistics Readiness Squadron performed an analysis of samples taken from the fuel trucks that serviced MA1 and MA2, and no abnormalities were identified (Tab U-4 to U-7). Because A-10 engines are serviced using one-time-use containers; there were no samples of oil that could be collected for testing (Tab U-2 to U-3). Post-accident, no fuel, hydraulic fluid, or oil samples were available at the crash sites, but there was no evidence that fuel, hydraulic fluid, or oil contributed to the accident (Tab U-2 to U-3).

f. Unscheduled Maintenance

There was no significant unscheduled maintenance performed on either MA1 or MA2 prior to the accident and no evidence that unscheduled maintenance practices contributed to the accident (Tabs D-2 to D-48 and U-2 to U-3).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

Shortly after a midair collision, MA1 and MA2 crashed on NTTR 65C, destroying both A-10C aircraft (Tabs S-3 and S-8, Z-3, AA-7, and FF-4 to FF-5). The crash site for MA1 was 1 mile southwest of the midair collision location (Tabs FF-4, S-8, and S-23). A detailed inspection of the crash site by the AIB revealed MA1 was largely intact when it crashed in a left-wing-low orientation (Tab S-9 to S-12 and S-25). A post-crash fire destroyed a large percentage of the aircraft (Tab S-9 to S-12). The right wing was in close proximity to the remains of the fuselage with the wingtip intact (Tab S-8 to S-10 and S-25). The right vertical stabilizer and horizontal tail were connected to the fuselage and in close proximity to the right engine (Tab S-8 to S-10 and S-25). The seven-barrel cannon GAU-8 Avenger had broken free from its mountings, but the muzzles (which extend beyond the nose of the aircraft) did not exhibit significant damage (Tab S-8 to S-10 and S-25). Ten feet of the left wing, the left engine, and left vertical stabilizer were not at the MA1 crash site (Tabs S-15 to S-20, S-23, and U-3). These were located approximately one mile northeast, among aircraft debris near the midair collision location (Tabs S-15 to S-20, S-23, U-3, and Z-3).

The crash site for MA2 was 1.7 miles northwest of the midair collision location (Tabs S-3 to S-7, S-23, Z-3, and FF-4). A detailed inspection of the crash site by the AIB revealed MA2 was largely intact when it crashed while heading northbound in an 80 - 90 degree, nose-low orientation (Tabs S-3 to S-4 and V-2.20). A post-crash fire destroyed a large percentage of the aircraft (Tab S-3 to S-7). Large sections of MA2, including the GAU-8 Avenger, were found in and just north of a six-foot-deep crater caused by the force of the crash (Tab S-4 and S-24). The left and right engine

were near the northern edge of wreckage thrown from MA2 (Tab S-24). Five feet of the right wing was not at the MA2 crash site (Tabs S-24, U-3 and Z-3). This was located approximately 1.7 miles southeast of the MA2 crash site among aircraft debris near the midair collision location (Tabs U-3 and Z-3).

The cockpit altimeter for the A-10C provides an indication of -1,000 to +80,000 ft MSL (Tab J-2). The barometric setting is adjusted using the baroset knob (Tab J-2). In the event of electrical failure or a servo error, a warning flag appears in the altimeter (Tab J-2). MP1 and MP2 reported they experienced no malfunctions prior to takeoff or during the flight (Tab V-1.12, V-1.16, and V-2.13)

b. Evaluation and Analysis

According to maintenance records as well as interviews with MP1 and MP2, all systems on MA1 and MA2 operated properly until the time of the midair collision (Tab V-1.12, V-1.16, and V-2.13). The cockpit altimeter from MA1 was recovered from the crash site and submitted for analysis (Tab J-2). The altimeter analysis was conducted at Tinker AFB, Oklahoma and determined the following: It could not be determined if the altimeter was fully functioning prior to being damaged (Tab J-4). It could not be determined if the physical damage sustained by the altimeter occurred prior to, or during the crash of MA1 (Tab J-2 to J-4). Based on the damage to the altitude counter dial assembly, it was determined that the altitude reading at the time of damage to the altimeter was 5,600 ft, plus or minus 1,100 ft (Tab J-4). The elevation of the crash site for MA1 was 4,459 ft MSL (Tab Z-4).

7. WEATHER

a. Forecast Weather

On 6 September, sunset at Nellis AFB was at 19:05L, the end of evening civil twilight was at 20:03L, and moonrise was at 19:38L (Tab F-2).

The MF had a planned takeoff of 18:45L (Tab AA-6). The forecast weather at takeoff time for Nellis AFB was variable winds at 20 knots gusting to 30 knots (Tab F-2). There was a weather watch in effect for potential lightning within 15 miles of the airfield (Tab F-2). Forecast visibility was 7 statute miles with scattered clouds at 12,000 ft MSL and broken clouds at 20,000 ft MSL (Tab F-2).

The MF planned to be on the NTTR from 19:00L to 21:00L (Tab AA-6). The forecast weather for Range 65C during this time was for winds to be from the southwest at 20 knots gusting up to 30 knots (Tab F-2). The forecast visibility was 6 statute miles with broken clouds at 11,000 - 18,000 ft MSL and another layer of broken clouds from 20,000 - 30,000 ft MSL (Tab F-2). The Mission Execution Forecast predicted light thunderstorms to be in the area during MF range time (Tab F-2). The forecast illumination was high throughout the MF range time (Tab F-2).

b. Observed Weather

The weather observation at Nellis AFB at MF takeoff time was winds out of the west at 3 knots with clear skies and unlimited visibility (Tab F-5). The weather observation from Creech AFB (located 13 miles southeast of the midair collision) 46 minutes prior to the midair collision was winds out of the east at 6 knots with clear skies and unlimited visibility (Tab F-6). 14 minutes after the midair collision, Creech AFB put out a new weather observation of calm winds with a broken layer of clouds at 11,000 ft above ground level (AGL), which is 14,100 ft MSL (Tab F-6). The observation at Desert Rock Airport (located 11 miles southwest of the midair collision) 49 minutes prior to the time of the midair collision was winds out of the west at 5 knots with broken clouds at 12,000 ft AGL, which is 15,300 MSL and unlimited visibility (Tab F-8). Upon entering the AO, MP1 observed clouds between 16,000 - 17,000 ft MSL and requested approval from the JTAC to descend to a lower altitude (Tab V-1.11). MP 1 stated there were no clouds below 12,000 ft MSL (Tab V-1.24).

c. Space Environment

Not applicable.

d. Operations

Based upon the forecast and prevailing conditions, the weather was within pilot limits (Tab G-2 and G-9). Operations were conducted IAW AFI 11-202, Volume 3, *General Flight Rules*, dated 10 August 2016.

8. CREW QUALIFICATIONS

a. Mishap Pilot 1

MP1 was a current and qualified A-10C pilot (Tabs G-2 to G3, and K-3). MP1 completed Undergraduate Pilot Training (UPT), Introduction to Fighter Fundamentals, and initial A-10C qualification training (Tab T-4). After completing initial qualification training, MP1 completed the multi-ship flight lead upgrade and the instructor pilot (IP) upgrade (Tab T-5 to T-6). MP1 began the Weapons Instructor Course (WIC) in July 2017 (Tab T-7 to T-8). The most recent mission checkride for MP1 was 19 June 2017 and the most recent instrument checkride was 21 June 2017 (Tab G-16). At the time of the accident, the total flight time for MP1 was 886.7 hours, with 67.6 of those hours as an instructor (Tab G-8). On the day of the accident, flight time for MP1 was as follows (Tab T-7 to T-8):

MP1	Hours	Sorties
Last 30 Days	15.6	8
Last 60 Days	30.5	16
Last 90 Days	38.9	22

c. Mishap Pilot 2

MP2 was a current and qualified A-10C pilot (Tab G-9 to G-10). MP2 completed UPT, Introduction to Fighter Fundamentals, and initial A-10C qualification training (Tab T-9 to T-11).

MP2 also completed the multi-ship upgrade and the IP upgrade (Tab T-13). Following graduation from the WIC, MP2 was a squadron weapons officer and later returned to become a WIC instructor (Tab T-12 to T-13). The most recent mission and instrument checkride for MP2 was 31 October 2016 (Tab G-39). At the time of the accident, the total flight time for MP2 was 1,780.8 hours, 609.1 of those hours as an instructor (Tab G-15). On the day of the accident, flight time for MP2 was as follows (Tab G-10):

MP2	Hours	Sorties
Last 30 Days	15.2	8
Last 60 Days	26.9	14
Last 90 Days	33.4	17

9. MEDICAL

a. Qualifications

MP1 and MP2 were fully medically qualified without restrictions for appropriate flight duty at the time of the accident (Tab X-2).

b. Health

While each pilot reported no apparent injuries at the time of pickup, MP1 and MP2 both suffered injuries from the accident, although they were minor and superficial, and both pilots recovered within one week (Tabs DD-29 and X-2 to X-3).

c. Pathology/Toxicology

This accident did not result in death or dismemberment, and no autopsy was conducted (Tab X-3). Toxicology testing was normal for all tested personnel including MP1 and MP2 (Tab X-3).

d. Lifestyle

There is no evidence to suggest lifestyle factors were a factor in the accident (Tabs T-15 to T-22, T-24 to T-33, V-1.3 to V-1.4, V-2.4 to V-2.5, and X-3).

e. Crew Rest and Crew Duty Time

AFI 11-202, Volume 3, *General Flight Rules*, dated 10 August 2016, prescribes mandatory crew rest and maximum flight duty periods for all personnel who operate Air Force aircraft (Tab BB-5 to BB-6). Based upon the information provided in their 72-hour and 7-day histories as well as interviews with MP1 and MP2, crew rest and flight duty periods were adequate and IAW published guidance (Tabs T-15 to T-17, T-24 to T-28, V-1.3 to V-1.4, V-2.4 to V-2.5, and X-3).

10. OPERATIONS AND SUPERVISION

a. Operations

The operations tempo for both students and instructors during the WIC is very high (Tab V-1.19, V-2.5, and V-2.22). Students expect to fly two to four times per week and work 12 to 16 hours on non-flying days (Tab V-1.19 and V-2.23). However, 66 WPS personnel were very clear that violation of flight duty periods or crew rest were not tolerated (Tab V-3.1). The day of the accident was the first duty day following a four-day break over the Labor Day holiday (Tab V-1.3).

b. Supervision

MP2 was the IOR for the sortie (Tab V-3.1). The flight lead of Shark 41 was a former USAFWS IP (Tabs G-9 and V-4.1). MP2 and the JTAC instructor coordinated before the flight to mitigate the risks associated with having multiple aircraft operating in the same AO (Tab V-2.3). Deconfliction measures were briefed to participants multiple times, and included required radio calls and actions if an aircraft was to fly outside an assigned altitude block (Tabs BB-2, V-1.5, V-2.4, and V-2.6). There was a supervisor of flying (SOF) in the Nellis tower at the time of the accident (Tab DD-5 to DD-6).

11. HUMAN FACTORS ANALYSIS

a. Introduction

AFI 91-204, *Safety Investigations and Reports*, dated 12 February 2014, Attachment 6, describes the DoD Human Factors Analysis and Classification System (HFACS) and lists potential human factors that can play a role in aircraft mishaps (Tab BB-9 to BB-10). Human factors describe how interactions with tools, tasks, and working environments systemically influence human performance (Tab BB-9 to BB-10). It is used by an investigation board to accurately record all aspects of human performance associated with an individual and the mishap event (Tab BB-9 to BB-10). The DoD HFACS helps investigators perform a more thorough investigation as well as classify particular actions (or inactions) that sustained the mishap sequence (Tab BB-9 to BB-10). The DoD HFACS has been updated from its initial description in Attachment 6, and version 7.0 is the current version used below, followed by the classification code (Tab BB-9 to BB-10).

The AIB identified four human factors relevant to this accident: (1) Task Over-saturation; (2) Misperception of Changing Environment; (3) Breakdown in Visual Scan; and (4) Environmental Conditions Affecting Vision.

b. Task Over-saturation

Task Over-Saturation is a factor when the quantity of information an individual must process exceeds their mental resources in the amount of time available to process the information (PC103) (Tab BB-14).

At the time of the accident MP1 was planning multi-flight attacks in close proximity to friendly forces, receiving and sending frequent radio communications, recalculating weapons delivery

parameters, and flying an upgrade mission (Tabs V-1.15 to V-1.16, V-2.4, V-2.7, and V-2.14 to V-2.17). MP1 did not recall hearing an audible notification when MA1 climbed above 10,000 ft MSL (Tab V-1.24 to V-1.25). Task over-saturation is evident based upon not perceiving the aircraft altitude information available within the cockpit, missing an audible notification when exceeding the directed altitude, as well as pauses in communication and lags in replying to radio calls (Tabs V-5.1, BB-13, and DD-20 to D-21).

c. Misperception of Changing Environment

Misperception of Changing Environment is a factor when an individual misperceives or misjudges altitude, separation, speed, closure rate, road/sea conditions, aircraft/vehicle location within the performance envelope or other operational conditions (PC504) (Tab BB-13).
MP1 stated he was flying between 8,000 – 10,000 ft MSL (Tab V-1.24). MP1 never gave a radio call or took corrective actions required by pilots who fly outside of an assigned altitude block (Tabs V-1.5, V-1.26, V-2.6, V-2.14, V-2.18, BB-2, and FF-4 to FF-5). There is no evidence that MP1 was aware MA1 had climbed above the directed 10,000 ft MSL altitude ceiling for MA1 and then continued to climb to 11,400 ft MSL (Tabs V-1.16, V-2.18, and FF-4 to FF-5,). MP2 did not detect the reducing altitude separation between MA1 and MA2 that would have been displayed on the TAD (Tabs V-2.18, Z-5, and FF-4 to FF-5).

d. Breakdown in Visual Scan

Breakdown in Visual Scan is a factor when the individual fails to effectively execute visual scan patterns (AE105) (Tab BB-11).

Aircraft altitude is displayed in multiple locations in the cockpit in addition to the Altimeter (Heads Up Display, TAD, and Attitude Reference System) (Tab V-1.26 to V-1.27, and V-2.10). A proper visual scan of instruments is required to accurately assess aircraft parameters and identify deviations (Tab BB-24). However, MP1 flew for an extended period of time above the directed altitude block (Tabs FF-4 to FF-5, and Z-5).

e. Environmental Conditions Affecting Vision

Environmental Conditions Affecting Vision is a factor that includes obscured windows; weather, fog, haze, darkness, smoke, etc.; brownout/whiteout (dust, snow, water, ash or other particulates); or when exposure to windblast affects the individual's ability to perform required duties (PE101) (Tab BB-12).

MP1 and MP2 stated they were unable to effectively use visual observation as an additional method to maintain aircraft separation because the accident occurred at night and external lights were off (Tabs F-2 and V-1.13). NVG use was negatively impacted by environmental conditions, in particular light interference made it difficult to distinguish detail when looking west (Tab V-2.11).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

(1) AFI 11-202, Volume 3, *General Flight Rules*, dated 10 August 2016
(2) AFI 11-214, *Air Operations Rules and Procedures*, dated 14 August 2012, incorporating Change 1, dated 23 March 2016, paragraph 5.8.4.1.1.
(3) AFMAN 11-217, Volume 1, *Instrument Flight Procedures*, dated 22 October 2010, paragraphs 1.2.4.1. to 1.2.4.3.
(4) AFI 21-101, Aircraft and Equipment Maintenance Management, dated 21 May 2015, incorporating Air Force Guidance Memorandum, dated 2 June 2017
(5) AFI 51-503, *Aerospace and Ground Accident Investigations*, dated 14 April 2015
(6) AFI 51-503, ACC Supplement, *Aerospace and Ground Accident Investigations*, dated 28 January 2016
(7) AFI 91-204, *Safety Investigations and Reports*, Attachment 6, dated 12 February 2014, incorporating Air Force Guidance Memorandum, dated 19 January 2017

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

b. Other Directives and Publications Relevant to the Mishap

(1) 66 WPS *A-10 Weapons Instructor Course Syllabus*, dated May 2016
(2) A-10 CAF *Standards*, dated 31 July 2015
(3) A-10C *Warrior Guide*, Volume 2, Change 2, dated 1 October 2012
(4) AFTTP 3-3.A10, *Combat Aircraft Fundamentals – A-10*, dated 15 September 2015
(5) T.O. 1A-10C-1, *A-10C Flight Manual*, Change 3, dated 1 May 2017
(6) Department of Defense Human Factors Analysis and Classification System (DoD HFACS) Version 7.0

c. Known or Suspected Deviations from Directives or Publications

None.

//Signed//

12 March 2018

BRUCE E. MUNGER, Colonel, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

A-10C, T/N 79-0204, AND A-10C, T/N 78-0657
NEVADA TEST AND TRAINING RANGE 65C
6 SEPTEMBER 2017

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 6 September 2017, at 19:44:09 local time (L), two A-10C aircraft, tail number 79-0204 (Mishap Aircraft 1 [MA1]) and tail number 78-0657 (Mishap Aircraft 2 [MA2]), assigned to the 66th Weapons Squadron, 57th Wing, Nellis Air Force Base (AFB), Nevada, collided over Range 65C on the Nevada Test and Training Range (NTTR), 55 miles northwest of Nellis AFB. The midair collision rendered both MA1 and MA2 uncontrollable and both pilots (Mishap Pilot 1 [MP1] and Mishap Pilot 2 [MP2]) ejected. Military search and rescue forces rapidly located MP1 and MP2. MP1 and MP2 suffered minor injuries during the ejection or parachute landing. Both MA1 and MA2 were destroyed when they crashed on the NTTR. This resulted in the loss of $30,661,412.84 in aircraft and an environmental clean-up cost of $108,000.

I found by a preponderance of the evidence the cause of the accident was an unintentional failure to adhere to directed altitude deconfliction procedures.

I developed my opinion by interviewing both mishap pilots (in-person, video teleconference, and telephone) as well as other relevant aircrew and ground personnel. Additionally, I reviewed applicable Air Force directives and the information provided by technical experts. I also analyzed the crash sites as well as available radar data, recorded audio and a simulation of the recorded parametric flight data.

2. CAUSE

The cause of the accident was an unintentional failure to adhere to directed altitude deconfliction procedures.

a. Failing to Adhere to Established Altitude Deconfliction

MP1 was the flight lead and briefed 1,000-foot (ft) altitude separation as the method to procedurally deconflict the MF, both within the formation and from other aircraft. This separation is in accordance with Air Force guidance for night operations. MP1 and MP2 both acknowledged the correct altimeter setting for the area of operations (AO). Both MP1 and MP2 flew at their assigned altitudes from takeoff until 19:28L. Once established in the AO, with mission tasks and

environmental conditions which did not allow use of visual deconfliction procedures, MP1 directed an altitude deconfliction plan for the MF with a 1,000-ft buffer zone between directed altitude blocks. MP1 directed MA1 must maintain below 10,000 ft Mean Sea Level (MSL) and MA2 must maintain 11,000 - 12,000 ft MSL. At 19:28L MP1 did not identify that MA1 flew above 10,000 ft MSL. Between 19:28L and 19:43L, MP1 unknowingly and progressively climbed 1,400 ft above the 10,000 ft MSL ceiling. At 19:43:30L MA1 and MA2 were co-altitude at approximately 11,400 ft MSL. At 19:44:09L, while making final preparations to attack a Range 65C target, MA1 and MA2 collided.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

Substantially contributing factors to this accident include task over-saturation, misperception of changing environment, breakdown in visual scan, and environmental conditions affecting vision.

a. Task Over-saturation

MP1 was an upgrading pilot in the Weapons Instructor Course. The sortie was a night Close Air Support mission, which required MP1 to coordinate target attacks with other aircraft and ground parties. MP1 likely set altitude alerts to cause an audible notification if MA1 climbed above 10,000 ft MSL. However, because of communications on multiple radios and the number of tasks being conducted, MP1 did not hear or comprehend this one-time audible notification. Over the next 15 minutes, the training scenario further intensified. Just prior to the midair collision, MP1 was developing a coordinated attack plan for the two flights of aircraft, communicating with the Joint Terminal Attack Controller as well as the instructor pilot, and calculating revised weapons delivery parameters. MP1 task over-saturation was evident based upon a failure to identify or correct the large altitude deviation, not hearing the audible alert, and lengthy pauses and lags in radio communication.

b. Misperception of Changing Environment

The primary means of determining altitude and ensuring deconfliction from other aircraft at night is by use of the cockpit altimeter. The pilot must check the altimeter against a known elevation while on the ground, set the local atmospheric pressure correction using the baroset knob on the face of the altimeter, and verify the altimeter does not have a warning flag displayed. A pilot can also read aircraft altitude from other displays within the cockpit. Pilots can set the Heads Up Display (HUD) to depict the same altitude source as the cockpit altimeter or a True Altitude/Global Positioning System altitude. The Attitude Reference System (ARS) located at the bottom of the Multi-Function Color Display depicts altitude in three digits, representing ten thousands, thousands, and hundreds of feet. Additionally, the Tactical Awareness Display (TAD) provides pilots with awareness of altitudes (rounded to the nearest thousand feet) for aircraft operating on the datalink. The evidence collected by the AIB suggests each of these systems was working for MA1 and MA2.

c. Breakdown in Visual Scan

MP1 most likely experienced a breakdown in visual scan inside the cockpit due to high task loading during the sortie. After climbing above 10,000 ft MSL, MP1 continued to climb without noticing MA1 was above the directed altitude block. The amount of time or attention spent performing a visual scan of aircraft instruments was not sufficient and did not allow MP1 to identify that an altitude deviation had occurred. Overreliance on an audible notification, as well as high task loading during the training scenario, likely resulted in MP1 decreasing the amount of time or attention spent on a visual scan of aircraft instruments in order to devote time and attention to mission tasks. Because of this, MP1 did not note the higher than planned altimeter display. MP1 flew at or near 10,800 ft MSL from 19:35L to 19:43L, which was approximately 800 ft above the assigned MSL altitude for MA1. MP1 experienced a breakdown of visual scan inside the cockpit and as a result did not process the altitude displayed on the cockpit altimeter and other displays such as the HUD, TAD, and ARS was higher than directed for MA1.

d. Environmental Conditions Affecting Vision

MP1 and MP2 were unable to effectively use unaided visual observation as a method to maintain aircraft separation because the accident occurred at night. Although MP1 and MP2 did use night vision goggles (NVG), they flew with external lights off while on Range 65C. Additionally, environmental conditions negatively impacted NVG use as the setting sun made it difficult to visually distinguish details when looking west. Due to environmental viewing conditions reported at the time of the collision, it is unlikely that MP1 or MP2 could have visually identified they were co-altitude and on converging flightpaths.

4. CONCLUSION

I found by a preponderance of the evidence the cause of the accident was an unintentional failure to adhere to established altitude deconfliction procedures. Substantially contributing factors include task over-saturation, misperception of changing environment, breakdown in visual scan, and environmental conditions affecting vision.

//Signed//

12 March 2018

BRUCE E. MUNGER, Colonel, USAF
President, Accident Investigation Board

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