UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

F-16CM, T/N 90-0714

80TH FIGHTER SQUADRON
8TH FIGHTER WING
KUNSAN AIR BASE, SOUTH KOREA

LOCATION: KUNSAN AIR BASE, SOUTH KOREA

DATE OF ACCIDENT: 2 DECEMBER 2019

BOARD PRESIDENT: COLONEL JARED J. HUTCHINSON

Conducted IAW Air Force Instruction 51-307

United States Air Force Accident Investigation Board Report

Class A, Kunsan AB

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION

F-16CM, T/N 90-0714
KUNSAN AB, SOUTH KOREA
2 DECEMBER 2019

At 1537 hours local time on 2 December 2019, an F-16CM Block 40, tail number 90-0714, crashed in between Runway 36 and Taxiway P on Kunsan Air Base (AB), South Korea. The Mishap Pilot (MP) was an instructor-pilot assigned to the 80th Fighter Squadron. The MP was returning to Kunsan AB for landing after completing a local continuation training sortie. Upon initial contact with the runway, the mishap aircraft's (MA) right main landing gear (RMLG) collapsed. The MA departed the runway and the MP successfully ejected. There were no casualties and no loss of civilian property. The MA, valued at $19.4 million, was completely destroyed. The MA was assigned to the 8th Fighter Wing, Kunsan AB, South Korea.

When the MA initially touched down on the runway, the RMLG collapsed and the MA yawed to the right. The MP attempted to keep the MA on the runway and take the MA airborne again, but was unsuccessful. The MP safely ejected from the MA suffering only minor injuries. The MA remained upright and skipped across the infield intermittently becoming airborne and settling back onto the field. The MA eventually stopped approximately 2,200 feet from the initial touchdown point, and the MA rotated 150 degrees from the initial runway heading.

The Accident Investigation Board President found, by a preponderance of evidence, this mishap was caused by a failure of the RMLG downlock actuator, causing the RMLG to collapse, making the aircraft uncontrollable during the landing phase of flight. Specifically, the tension on the main landing gear was great enough to overcome the force of the downlock actuator, resulting in a collapse of the RMLG. This is a known issue for F-16C/D blocks 40/42/50/52 and is addressed by Time Compliance Technical Order 1F-16-2855.

United States Air Force Accident Investigation Board Report

Class A, Kunsan AB

SUMMARY OF FACTS AND STATEMENT OF OPINION
F-16CM, T/N 90-0714
2 DECEMBER 2019

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

8 FW	8th Fighter Wing
80 FS	80th Fighter Squadron
AB	Air Base
ACMI	Air Combat Maneuvering Instrumentation
AF	Air Force
AFB	Air Force Base
AFE	Air Flight Equipment
AFI	Air Force Instruction
AFIP	Air Force Institute of Pathology
AFLCMC	Air Force Life Cycle Management Center
AFPAM	Air Force Pamphlet
AFPET	Air Force Petroleum Office
AFTO	Air Force Technical Order
AFTTP	Air Force Tactics, Techniques, and Procedures
AGL	Above Ground Level
AI	Air Interdiction
AIB	Accident Investigation Board
AOA	Angle of Attack
ASIMS	Aerospace Information Management System
ATAGS	Advanced Tactical Anti-G System
BRAG	Breathing Regulator/Anti-G
Capt	Captain
CG	Center of Gravity
CIP	Core Integrated Processor
Col	Colonel
CSFDR	Crash Survivable Flight Data Recorder
CSMU	Crash Survivable Memory Unit
DAF	Department of the Air Force
DoD	Department of Defense
DVR	Digital Video Recorder
FL	Flight Lead
FLCS	Flight Control System
FPM	Feet Per Minute
ft	Feet
g	Gravitational Force
HPT	High Pressure Turbine
HUD	Heads-Up Display
IAW	In Accordance With
IP	Instructor Pilot
K	Thousand
KIAS	Knots Indicated Airspeed
KCAS	Knots Calibrated Airspeed
kts	Knots
L	Local Time
LG	Landing Gear
LMLG	Left Main Landing Gear
LM-Aero	Lockheed Martin Aeronautics Company
Lt Col	Lieutenant Colonel
M	Mach
MA	Mishap Aircraft
MFL	Maintenance Fault List
MLG	Main Landing Gear
MLP	Mishap Lead Pilot
Maj	Major
MAJCOM	Major Command
MFL	Mishap Flight Lead
MP	Mishap Pilot
MS	Mishap Sortie
MSL	Mean Sea Level
MLG	Main Landing Gear
NLG	Nose Landing Gear
NM	Nautical Miles
NOTAMs	Notices to Airmen
OBOGS	On-board Oxygen Generating System
OG	Operations Group
OPR	Officer Performance Report
Ops Tempo	Operations Tempo
ORM	Operational Risk Management
OSS	Operation Support Squadron
PACAF	Pacific Air Forces
PHA	Physical Health Assessment
PSE	Product Support Engineering
PSI	Pounds Per Square Inch
RMLG	Right Main Landing Gear
RTB	Return-To-Base
RWD	Right Wing Down
SAR	Search and Rescue
SOF	Supervisor of Flying
TC	Time Change
TCTO	Time Compliance Technical Order
T/N	Tail Number
TOD	Tech Order Data
TO	Technical Order
VFR	Visual Flight Rules
WOW	Weight on Wheels
Z	Zulu

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

United States Air Force Accident Investigation Board Report

Class A, Kunsan AB

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 13 December 2019, Major General Brian M. Killough, Pacific Air Forces (PACAF) Deputy Commander, appointed Colonel Jared J. Hutchinson as president of this Accident Investigation Board (AIB) to investigate the subject mishap under the provisions of AFI 51-307 (Tab Y-2 to Y-3). On 13 December 2019, other members were appointed to this AIB, including a Captain Legal Advisor and a Technical Sergeant Recorder (Tab Y-2 to Y-5). On 15 January 2020, the Captain Legal Advisor was relieved and substituted with a Major Legal Advisor (Tab Y-6 to Y-7). Additionally, on 15 January 2020, a Captain Pilot Member and a Master Sergeant Maintenance Member were appointed as other members to this AIB (Tab Y-6 to Y-7). They conducted this investigation at Kunsan Air Base (AB), South Korea from 22 January 2020 through 6 February 2020 (Tab Y-2 to Y-7).

b. Purpose

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

2. ACCIDENT SUMMARY

On 2 December 2019, at 1537 hours local time, an F-16CM Block 40, tail number 90-0714, crashed on Kunsan AB, between Runway 36 and Taxiway P (Tabs K-5, L-2). Both the Mishap Pilot (MP) and Mishap Aircraft (MA) were assigned to the 80th Fighter Squadron (FS), 8th Fighter Wing (FW), Kunsan AB, South Korea (Tab K-5). The MP was number three of a four-ship, returning to Kunsan AB for landing after completing a local continuation training sortie (Tab K-5). Upon initial contact with the runway, the MA yawed to the right and departed the runway's prepared surface (Tab L-2). The MP successfully ejected and the MA slid across the grassy infield before coming to a stop approximately 2,200 feet from the point of initial touchdown (Tabs L-2, S-2 to S-3, S-5 to S-9). The MA, valued at $19.4 million, was completely destroyed (Tabs O-2, EE-15). There were no casualties and no loss of civilian property (Tab O-2).

3. BACKGROUND

a. Pacific Air Forces (PACAF)

PACAF's primary mission is to deliver rapid and precise air, space, and cyberspace capabilities to protect and defend the United States, its territories and our allies and partners; provide integrated air and missile warning and defense; promote interoperability throughout the Pacific area of responsibility; maintain strategic access and freedom of movement across all domains; and posture to respond across the full spectrum of military contingencies in order to restore regional security (Tab CC-2 to CC-4).

The command's vision is to provide combat-ready American Airmen who are the foundation of Pacific stability and security (Tab CC-2 to CC-4). PACAF's area of responsibility is home to 60 percent of the world's population in 36 nations spread across 53 percent of the Earth's surface and 16 time zones, with more than 1,000 languages spoken (Tab CC-2 to CC-4). The unique location of the Strategic Triangle (Hawaii-Guam-Alaska) gives our nation persistent presence and options to project U.S. airpower from sovereign territory (Tab CC-2 to CC-4).

b. 7th Air Force (7 AF)

The men and women of 7 AF and Air Component Command are privileged to serve in Korea as a key part of a proud and powerful joint/combined team (Tab CC-5 to CC-7). The mission of 7 AF is to employ airpower to Deter aggression and maintain the Armistice, Defend South Korea, and Defeat any attack against the Alliance (Tab CC-5 to CC-7). 7 AF provides "ready to fight tonight" air power - precise, intense, and overwhelming; whenever and wherever needed (Tab CC-5 to CC-7).

c. 8th Fighter Wing (8 FW)

The 8 FW is responsible for conducting air-to-ground and air-to-air missions in the 45 F-16s assigned to the wing (Tab CC-8 to CC-9). Its mission includes air interdiction, close air support, counter air, air superiority, and suppression of enemy air defenses (Tab CC-8 to CC-9).

Kunsan AB, South Korea, is home to the 8 FW, known as the "Wolf Pack" (Tab CC-8 to CC-9). Located seven miles west of Gunsan City, the base is on the west coast of the peninsula near the Kum River estuary (Tab CC-8 to CC-9).

Kunsan AB has approximately 2,800 Air Force members, 110 Army soldiers and 20 U.S. civilians assigned (Tab CC-8 to CC-9). In addition, the base employs more than 420 local national appropriated and non-appropriated employees (Tab CC-8 to CC-9).

The base is known as one of the Air Force's last "warrior bases," and an assignment to the installation is typically a one-year unaccompanied tour (Tab CC-8 to CC-9). This means

members are assigned to the base without their families. All military members live on base in dormitories (Tab CC-8 to CC-9).

d. 80th Fighter Squadron (80 FS)

The 80 FS flies the F-16 Fighting Falcon out of Kunsan AB, South Korea, and is one of two fighter squadrons assigned to the 8 FW, the Wolf Pack (Tab CC-10 to CC-12).

The 80 FS stands ready to conduct counter-air, air interdiction, close air support, and forward air controllers missions in both day and night conditions (Tab CC-10 to CC-12).

The 80 FS is prepared to execute immediate air combat operations in support of COCOM theater wide taskings to dominate any aggressors threatening U.S. or South Korean interests (Tab CC-10 to CC-12).

e. F-16CM Fighting Falcon

The F-16 Fighting Falcon is a compact, multi-role fighter aircraft (Tab CC-13 to CC-15). It is highly maneuverable and has proven itself in air-to-air combat and air-to-surface attack (Tab CC-13 to CC-15). It provides a relatively low-cost, high-performance weapon system for the United States and allied nations (Tab CC-13 to CC-15).

In an air combat role, the F-16's maneuverability and combat radius (distance it can fly to enter air combat, stay, fight, and return) exceed that of all potential threat fighter aircraft (Tab CC-13 to CC-15). It can locate targets in all weather conditions and detect low flying aircraft in radar ground clutter (Tab CC-13 to CC-15). In an air-to-surface role, the F-16 can fly more than 500 miles (860 kilometers), deliver its weapons with superior accuracy, defend itself against enemy aircraft, and return to its starting point (Tab CC-13 to CC-15). An all-weather capability allows it to accurately deliver ordnance during non-visual bombing conditions (Tab CC-13 to CC-15).

4. SEQUENCE OF EVENTS

a. Mission

The mishap sortie (MS) was planned and briefed without incident and had a valid flight authorization (Tabs K-5, R-637 to R-638). The MS involved six F-16CM aircraft, four of which were to be conducting Air Interdiction (AI) in one formation; the other two would act as adversary training aids (also known as Red Air) in a second formation. (Tab AA-3)

b. Planning

Flight products for the MS were provided to the MP on the day of the mishap (Tab K-2, K-6). Prior to the MS, all flight members attended a mass briefing conducted by the squadron operations supervisor (Tab R-637). The mass briefing adequately covered forecasted weather conditions, notices to airmen (NOTAMs), and other routine items (Tab AA-5 to AA-12). The mishap lead pilot (MLP), the pilot in charge of the formation, also conducted a coordination brief and a tactical brief for the MS (Tabs K-2, R-637 to R-638). An Operational Risk Management (ORM) worksheet was also completed prior to the MS (Tab K-7).

c. Preflight

After the flight briefings, the personnel involved in the MS assembled at the 80 FS operations desk and received an update from the operations supervisor prior to proceeding to their assigned aircraft (Tab R-638). During this brief, the operations supervisor provided updated information on items pertinent to flying that day and assigned them their aircraft (Tab AA-13 to AA-24). The MP noted no discrepancies upon inspection of the aircrew flight equipment (Tab R-638). The MP's preflight inspection, engine start procedures, and ground operations were uneventful (Tab R-638).

d. Summary of Accident

The MP reported no issues with taxi or takeoff (Tab R-638). No significant events took place during the departure, recovery, or tactical portion of the sortie, and the MP operated the MA in accordance with all governing directives and publications (Tab R-638).

At approximately 15:35:40 hours local time (L), the MP called "SALT 3 Gear" on Tower frequency and began the base turn (Image 1) (Tab L-2). The MP saw positive indications that the MA's landing gear were down and locked (Tab R-639). In the F-16CM, a positive gear indication includes having three green wheels-down lights, no light in the landing gear handle, and the appearance of the angle of attack (AOA) staple in the head-up display (HUD) (Tab BB-54). The MP had checked the landing gear lights both before the turn to base and after the MP had rolled out on final approach (Tab R-634).

Image 1. MP's "SALT 3, Gear" Radio Call Prior to Base Turn (Tabs L-2, Z-2)

At 15:36:32L the MP rolled out on final runway heading and continued flying the approach at approximately 170 knots calibrated airspeed (KCAS) and an appropriate AOA (Image 2), in accordance with (IAW) approved techniques and procedures (Tab R-638).

Image 2. MA Final Approach (Tabs L-2, Z-2)

At 15:36:59.12L, 5.31 seconds prior to touchdown, the MA vertical velocity was recorded at -4 feet per second (Image 3) (Tab J-23). For the F-16 heavyweight landing gear, the limit sink rate is established at -10 feet per second for aircraft gross weights up to 31,000 pounds (Tab J-23). The gross weight of the MA at the time of initial touchdown was approximately 25,000 lbs (Tab J-23).

Image 3. MA's Flight Parameters Prior to Touchdown (Tabs L-2, Z-3)

At 15:37:04.43L initial touchdown on the runway occurred (Image 4) (Tab L-2). The MA touched down at approximately 146 KCAS, approximately 130 feet before the approach end arrestment cable (Tabs J-23, L-2). After the MA initially touched down on the runway, the RMLG collapsed causing the MA to display WARN in the HUD and produce the landing gear warning horn (Image 4) (Tab L-2). The WARN displayed in the HUD and the landing gear warning horn cycled intermittently for the next 6 seconds, from initial touchdown to ejection (Tab L-2). The landing gear warning horn is an intermittent fixed volume signal which sounds in the headset when the nose landing gear (NLG) or main landing gear (MLG) is not down and locked and the aircraft is preparing to land (Tab BB -54). This will also cause WARN to display in the HUD (Tab BB -54). After initial touchdown, the MA bounced slightly and became airborne again (Tabs J-21, L-2).

Image 4. MA's Initial Touchdown (Tabs L-2, Z-3)

Due to the heavy rubber deposits in the runway touchdown zone, initial touchdown witness marks were not visible; however, the width of the first visible set of tire witness marks on the runway were measured at approximately 84 inches with a "skipping/wobbling" effect of the right tire witness marks (Image 5) (Tab J-21). Since the F-16 main gear "footprint" is 93 inches (outside left tire to outside right tire), this reduced landing gear width indicates the MA had a collapsed condition of the right main landing gear after touchdown (Tab J-21).

Image 5. Skipping Ground Track - RMLG (Looking North) (Tab Z-6)

At 15:37:05.78L, when the MA settled back to the runway, the MA immediately began to yaw to the right towards the edge of the runway's prepared surface (Image 6) (Tabs L-2, R-639). The MP increased power and input left flaperon and left rudder in an attempt to control the aircraft and take the MA airborne again (Tabs L-2, R-639).

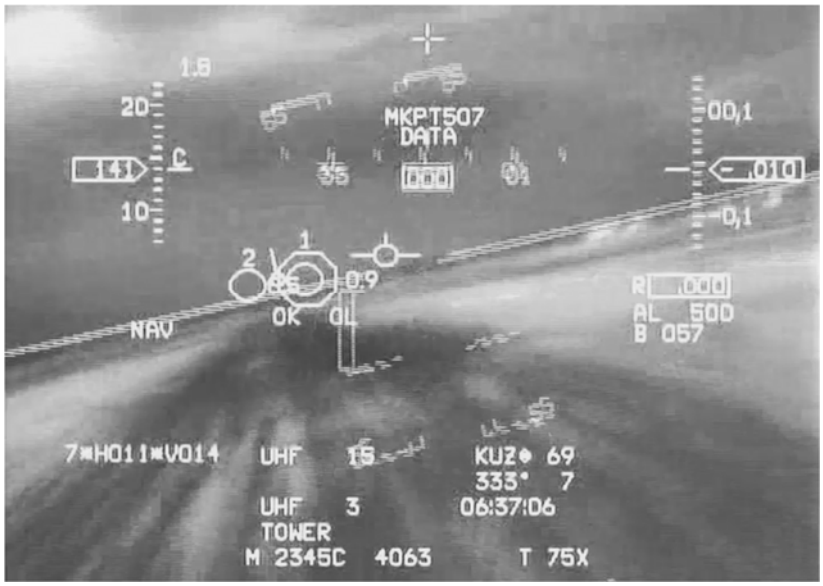

Image 6. MA Right Yaw After Second Touchdown (Tabs L-2, Z-4)

The MP was unable to control the MA and continued to approach the edge of the runway's prepared surface at approximately 143 KCAS (Image 7) (Tabs L-2, R-639).

Image 7. MA Approaching Edge of Runway's Prepared Surface (Tabs L-2, Z-4)

Prior to departing the runway's prepared surface, the MP made an aft stick input and the MA reached a sufficient AOA to cause the low speed warning tone to sound (Tab L-2). The MP's aft stick inputs and resultant AOA reduced the weight on the RMLG enough for the RMLG to fully extend and lock as the MA departed the runway's prepared surface (Tab J-18). At 15:37:09.99L, the crash survivable flight data recorder (CSFDR) measured a maximum AOA of 17.05 degrees prior to ejection (Image 8) (Table 1) (Tab L-2).

CSFDR Time h:mm:ss.fs	Zulu (HUD) Time h:mm:ss.fs	Local Time h:mm:ss.fs	Event
01:47:08.31	06:37:04.43	15:37:04.43	Initial touchdown
01:47:08.61	06:37:04.73	15:37:04.73	WARN displayed
01:47:08.62	06:37:04.74	15:37:04.74	RMLG WOW = In Air
01:47:09.48	06:37:05.48	15:37:05.48	Peak of bounce after initial touchdown
01:47:09.66	06:37:05.78	15:37:05.78	Positive yaw rate begins
01:47:09.74	06:37:05.86	15:37:05.86	Max roll stick left
01:47:09.99	06:37:06.11	15:37:06.11	Max bank angle right
01:47:11.00	06:37:07.12	15:37:07.12	Vertical velocity after firm touchdown
01:47:13.49	06:37:09.61	15:37:09.61	Maximum pitch (before ejection)
01:47:13.87	06:37:09.99	15:37:09.99	Maximum AOA (before ejection)
01:47:14.18	06:37:10.30	15:37:10.30	Canopy opened
01:47:14.37	06:37:10.49	15:37:10.49	Seat departs aircraft (Normal accel reduces to 0.5)
01:47:14.87	06:37:10.99	15:37:10.99	MLG tires make second trail in grass area
01:47:15.12	06:37:11.24	15:37:11.24	MA contacts berm of dirt
01:47:23.87	06:37:19.99	15:37:19.99	MA comes to a stop (Normal accel G = 0.94 with no further changes)
01:47:45.00	06:37:41.12	15:37:41.12	Last recorded data for mishap

Table 1. CSFDR and DVR Event Summary (Tab J-25)

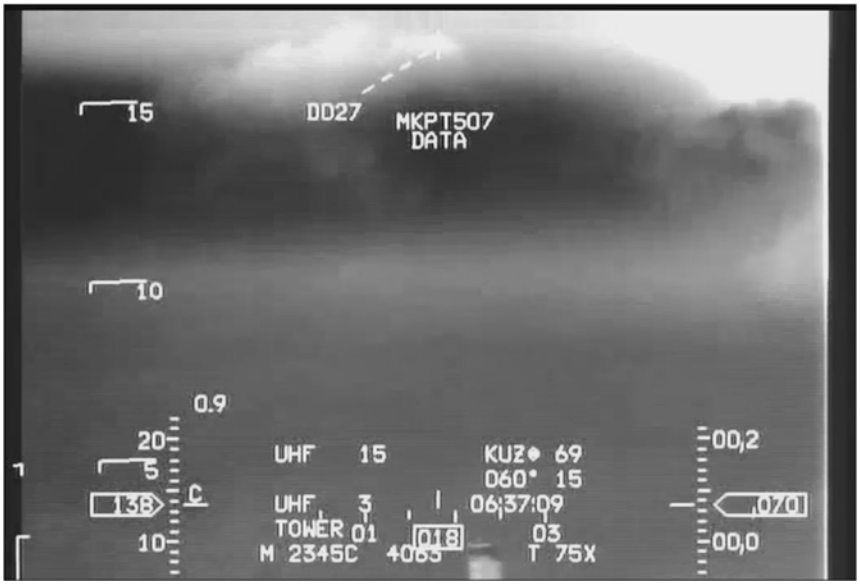

Image 8. MA's AOA Prior to Ejection (Tabs L-2, Z-5)

Just prior to departing the runway's prepared surface, the MP followed emergency action procedures and initiated the ejection sequence before departing a prepared surface above a normal taxi speed (Tabs R-629 to R-630, BB-1). At 15:37:10.30L the canopy opened, and at 15:37:10.49L the ejection seat departed the aircraft approximately 1,320 feet from the initial touchdown point

(Image 9) (Table 1) (Tabs J-23, L-2). The ejection sequence was successful, and the MP sustained only minor injuries (Tab X-2 to X-3). The MP was transported to Wonkwang Medical Center and was released later that day (Tabs N-5, R-556).

Image 9. MA's Canopy Opens from Ejection (Tabs L-2, Z-5)

After the MA departed the runway's prepared surface, there was a brief period where the MA bounced and did not leave any tire witness marks (Image 10) (Tab J-18). The first set of tire witness marks in the grass were measured at 93 inches indicating the RMLG was no longer in a collapsed condition (Tab J-22).

Image 10. Mishap Site Looking North; Runway Witness Marks Leading Into the Grass (Tab Z-7)

The MA continued across the infield with the RMLG now down and locked, and the engine running, until it came to rest approximately 2,200 feet from initial touchdown, having rotated approximately 150 degrees from runway heading (Tab J-20 to J-22).

The engine continued to run for approximately 74 minutes until being shut down by the crash recovery crew (Tab N-13).

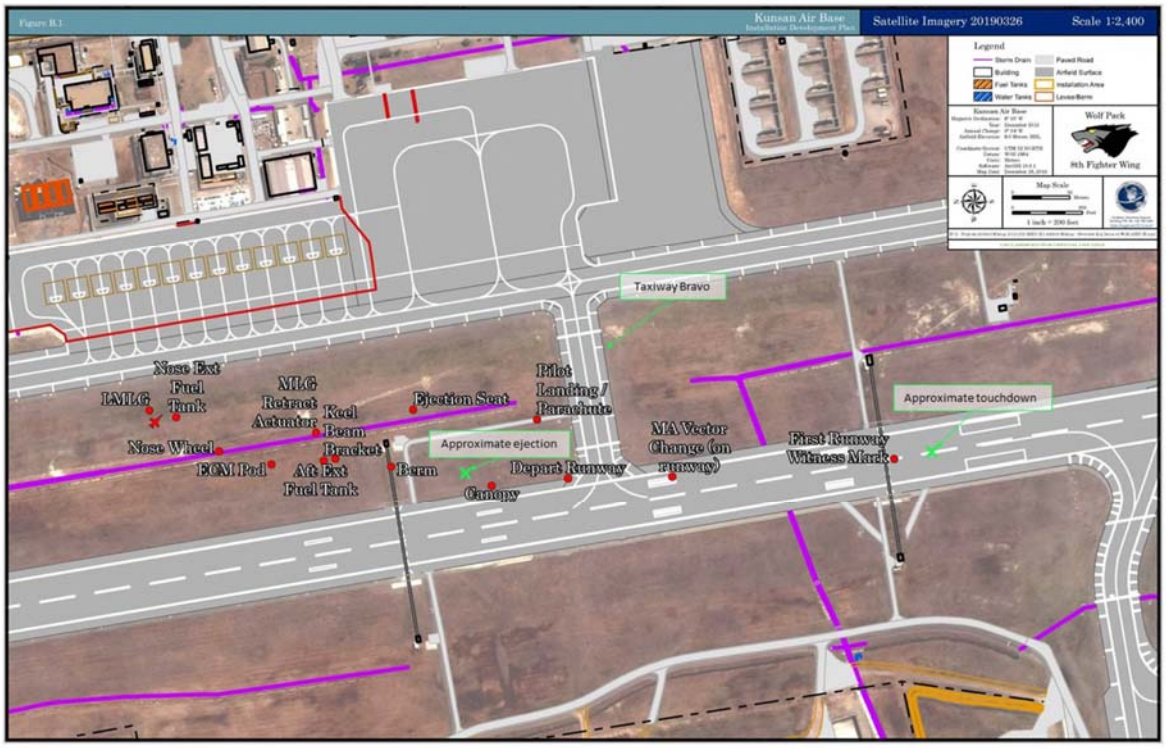

Figure 1. Mishap Site Overview (Tab Z-8)

e. Impact

Post ejection, the unmanned MA traversed the grassy infield between Runway 36 and Taxiway P (Tabs J-20, Z-8). The MA left various tire tracks and heavy ground scarring on the grassy infield (Tab J-21). The MA eventually came to a rest after rotating approximately 150 degrees from runway heading (Tab J-20). The MA's radome, electronic counter measures pod, air combat maneuvering instrumentation pod, and captive training missiles were detached, and the engine remained running for approximately 74 minutes after touchdown (Tabs N-2 to N-13, S-5). The distance from initial touchdown to the main wreckage was approximately 2,200 feet (Tab J-20). All crash site debris remained within the runway environment (Tab J -20).

f. Egress and Aircrew Flight Equipment (AFE)

(1) Egress

The MP ejected safely, sustaining minor injuries (Tab X-2 to X-3). The ejection sequence was initiated within the performance envelope of the ACES II Ejection Seat (Tab J-26). The MA, MP, ejection seat, and parachute were all found within close proximity of each other and were successfully recovered (Tab J-20).

(2) AFE

All flight and survival equipment had current inspections and performed as designed (Tab DD-2 to DD-32). The survival vest and seat kit records indicated that non-rechargeable batteries and the beacon batteries were expired; however, this was a scrivener's error on documenting the date the batteries had been replaced (Tab DD-33). The 8 OSS AFE Non-Commissioned Officer in Charge confirmed the batteries had been replaced in accordance with technical standards, and nothing was expired (Tab DD-33).

g. Search and Rescue (SAR)

At 1537L on 2 December 2019, the MA crashed in between Runway 36 and Taxiway P on Kunsan AB (Tab N-16).

Search and Rescue operations consisted of 8 FW Emergency Response personnel. (Tab N-16 to N-21). At 1537L Tower announced the mishap over the tower's shout line, a system used to communicate between airfield agencies (Tab N-16). At 1538L the Fire Department announced on the Fire Dispatch Net that all units were to respond to an aircraft crash on the runway near the Tower (Tab N-18). At 1540L Fire and Medical response personnel made contact with the pilot at the post ejection location (Tab N-20 to N-21).

The MP was transported to the Wonkwang Medical Center at approximately 1557L (Tab N-29).

h. Recovery of Remains

Not applicable.

5. MAINTENANCE

The AIB analyzed and reviewed all pertinent maintenance records, as detailed below, and there is no evidence to suggest maintenance was a factor in this mishap (Tabs D-2 to D-23, U-159 to U-168).

a. Forms Documentation

(1) Summary

At 1537L on 2 December 2019, an F-16CM Block 40, tail number 90-0714, crashed in between Runway 36 and Taxiway P on Kunsan AB (Tab R-625 to R-646). The MP was returning to Kunsan AB for landing after completing a local continuation training sortie (Tab R-625 to R-646). Upon initial contact with the runway, the MA's RMLG collapsed (Tab R-625 to R-646). The MA departed the runway and the MP successfully ejected. The MP observed no flight-control, avionics, or engine-related malfunctions (Tab R-625 to R-646).

Active Air Force Technical Orders (AFTO) Form 781K series and historical record AFTO Form 781K for the period of 30 days prior to the MS indicate the MA was current on all inspections and

Time Changes (TC) (Tabs D-2 to D-23, U-159 to U-168). Time Compliance Technical Order (TCTO) 1F-16-2855 (Replacement of Main Landing Gear Downlock Actuator and Support Bracket and Hardware) had not yet been accomplished at the time of the mishap (Tabs D-22, U-169).

(2) 30-Day Discrepancies

On 21 November 2019, during a seat not arm light switch operational check, the not armed light switch was found in-op (Tab U-2 to U-19). The MA was returned to service after corrective maintenance action (Tab U-2 to U-19).

(3) 60-Day Discrepancies

Panel 3409 Thumb Latch was found faulty on 30 October 2019 (Tab U-2 to U-19). The Thumb Latch was replaced and the MA returned to service (Tab U-2 to U-19).

The ejection seat was required to be raised and tilt on 29 October 2019, to facilitate other maintenance (Tab U-2 to U-19). The MA was returned to service after corrective actions were accomplished (Tab U-2 to U-19).

On 23 October 2019, multiple Heli-Coils were found unserviceable on the antenna (Tab U-2 to U-19). The antenna was replaced and the MA was returned to service (Tab U-2 to U-19).

On 16 October 2019, the MA Left Horizontal Stab required installation of leading edge (LE) tape (Tab U-2 to U-19). The MA was returned to service after corrective maintenance actions were complied with (Tab U-2 to U-19).

(4) 90-Day Discrepancies

From 9 September 2019 to 2 October 2019, the MA underwent a depot level repair of the Radar Absorbent Material (Tab U-2 to U-19). All corrective actions were completed in accordance with applicable guidance and directives (Tab U-2 to U-19).

There is no evidence to suggest any maintenance discrepancies or events were a factor in this mishap (Tabs D-2 to D-23, U-2 to U-19).

b. Inspections

Inspection records and transcripts indicate maintenance personnel completed the Basic Post-Flight Operations/Pre-flight IAW technical data (Tab D-2, D-16 to D-21). The crew chief's preflight inspection did not reveal mechanical issues with the MA, and the aircrew did not relay any concerns with the MA after their pre-flight walk-around inspection (Tabs D-2, R-625 to R-646). Maintenance personnel completed TCTO's, TC's, and Phase inspection items with no discrepancies (Tabs D-2 to D-22, U-170 to U-171).

c. Maintenance Procedures

According to active and historical records, maintenance personnel followed procedures IAW official technical data processes (Tab D-2 to D-24). There is no evidence to suggest that maintenance procedures were a factor in this mishap (Tabs D-2 to D-24, U-159 to U-168).

d. Maintenance Personnel and Supervision

Training records confirm all maintenance supervision and personnel had adequate training and were current and qualified to complete assigned tasks (Tab T-1 to T-14). There is no evidence to suggest maintenance personnel were a factor in this mishap (Tab T-1 to T-14).

e. Fuel, Hydraulic, Oil, Inspection Analyses

The Air Force Petroleum Office (AFPET/PTPLG) tested the JP-8 aviation turbine fuel Kerosene (Tab D-25 to D-28). The MA had refueled at Kunsan AB (Tab D-13). AFPET/PTPLG concluded that the samples were within limits, did not contain contaminants, and passed laboratory tests (Tab D-25 to D-28).

A hydraulic fluid sample was taken from the MA servicing cart as well as from the servicing oil carts and engine (Tab Q-12). The SIB sent these samples out for analysis (Tab Q-12). No results have been received for these samples, but there is no evidence to suggest that contamination of the MA fluids was a factor in this mishap.

f. Unscheduled Maintenance

Unscheduled maintenance is typically a result of a Pilot Reported Discrepancy during flight operations or maintenance-personnel discovered discrepancy during ground operations (Tab U-2 to U-19).

In the 90 days prior to mishap, the MA experienced 16 unscheduled maintenance actions (Tab U-2 to U-19). These unscheduled maintenance actions included a seat arm switch with broken wires, two system case drain delta-p's popped indicating the filter needed to be changed, an anti-ice probe, a waveguide, a heat shrink not installed on throttle, as well as several avionic instrumentation failures (Tab U-2 to U-19). There is no evidence to suggest that minor mechanical issues contributed to the mishap (Tab U-2 to U-19).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

(1) Flight Controls

The flight controls operated normally during the mishap (Tab L-2).

(2) Aircraft Configuration

A Weight and Balance calculation for the MA was conducted and found that the aircraft configuration and fuel balance was within acceptable limits during the mishap (Tab J-26).

(3) Hydraulic System

Post-mishap, the hydraulic system B gauge was reading 0 psi (see Image 11 below) (Tab J-26). After reviewing the CSFDR, it was concluded that the loss of the hydraulic system B pressure occurred post-ejection during the mishap and did not affect the normal operation of the landing gear during the MA landing (Tab J-26).

Image 11. Post-mishap Hydraulic System Pressure Gauges (Tab Z-9)

(4) Landing Gear System

There are three general causes of landing gear collapses (Tab EE-15 to EE-16):

1. The main landing gear was not fully down and locked at touchdown (Tab EE-15 to EE-16).
2. Structural failure of the drag brace component of the main landing gear (Tab EE-15 to EE-16).
3. Drag brace failure to remain in the overlock position causing a specific landing gear to collapse (Tab EE-15 to EE-16).

The first category is not applicable (Tab EE-15 to EE-16). The photographs of the MA cockpit and MP interview corroborate that the landing gear handle was in the down position (see Image 12 below) (Tabs R-638 to R-639, S-4). Examination of the HUD video showed pronounced roll and yaw to the right after touchdown (Tab L-2). The marks on the runway and in the grassy field show a constant Left Main Landing Gear (LMLG) track that indicates the LMLG was in the down and locked position (Tab J-21 to J-22).

Image 12. Landing Gear Handle (Tabs S-4, Z-9)

The second category is not applicable (Tab BB-8). Initial observations discovered that the drag brace failed at the keel beam attachment point (Tab BB-6 to BB-10). The MA showed a failure of the keel beam attachment point on the aircraft (see Image 13 below) (Tab BB-6 to BB-10).

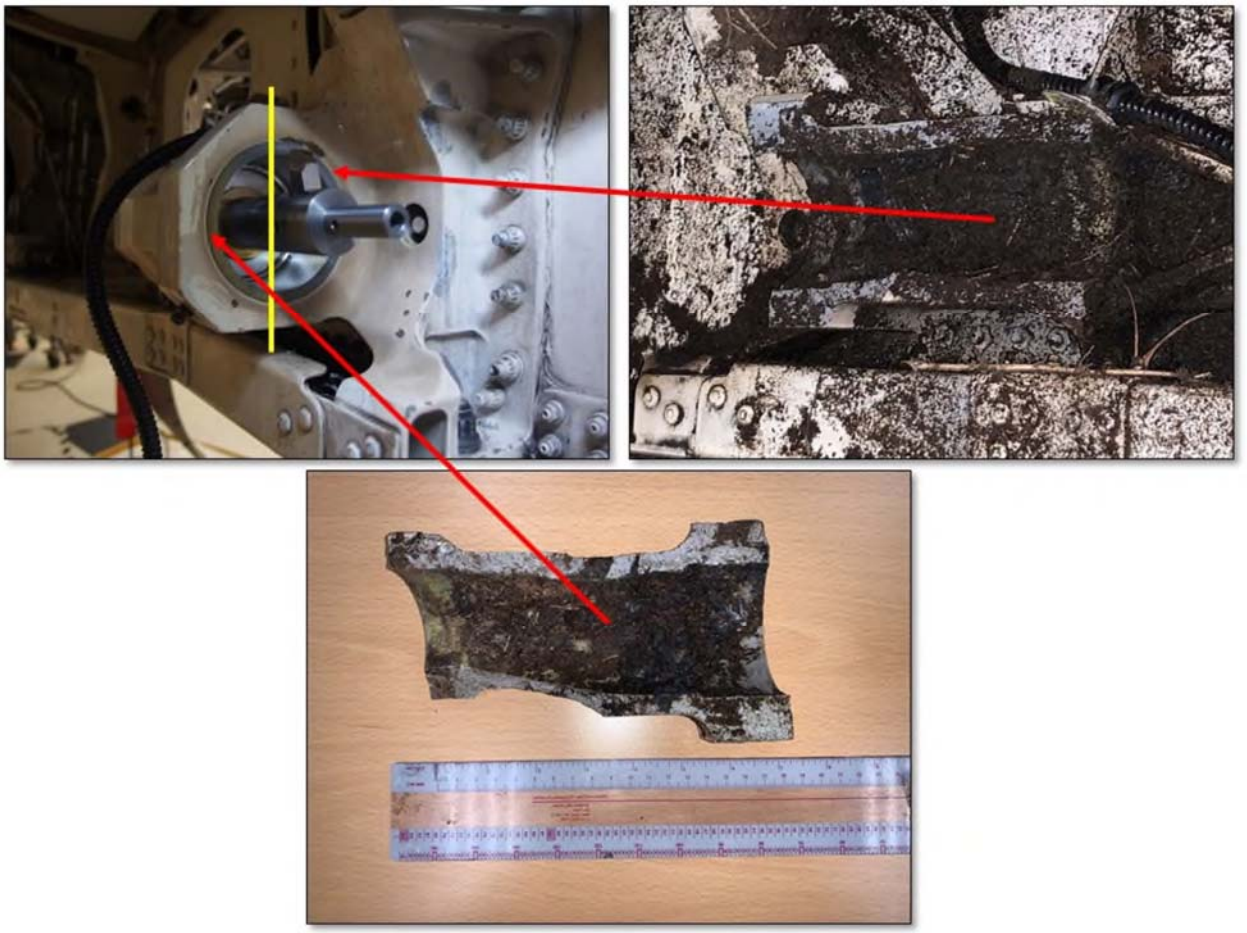

Image 13. RMLG Wheel Well Keel Beam Attachment Point (Tab Z-10)

The outboard portion of the fitting was found approximately 1,716 feet past the MA touchdown and 515 feet before the main wreckage (Tab EE-15 to EE-16). Since the broken piece of the fitting was found well past the touchdown location, it is likely the broken piece of the fitting attachment fell away from the MA near the point of failure (Tab EE-15 to EE-16). This indicates the failure of the keel beam attachment fitting occurred well after the initial touchdown point (Tab BB-6 to BB-10). Therefore, the drag brace did not fail at the keel beam fitting attachment during landing (Tab BB-6 to BB-10).

The third potential cause of the landing gear failure is that the drag brace failed to remain in the overlock position causing gear collapse (Tab EE-15 to EE-16). Normal distance between the MLG of an F-16 is 93 inches (Tab J-21). The measured width of the first visible MA tire marks on the runway were 84 inches with a "skipping/wobbling" effect of the right tire witness marks (Tab J-21). This indicates a collapsed condition of the RMLG after touchdown (Tab J-21 to J-22). The RMLG drag brace remained attached to the RMLG assembly and in the fully extended position (see Image 14 below) (Tab BB-6 to BB-10).

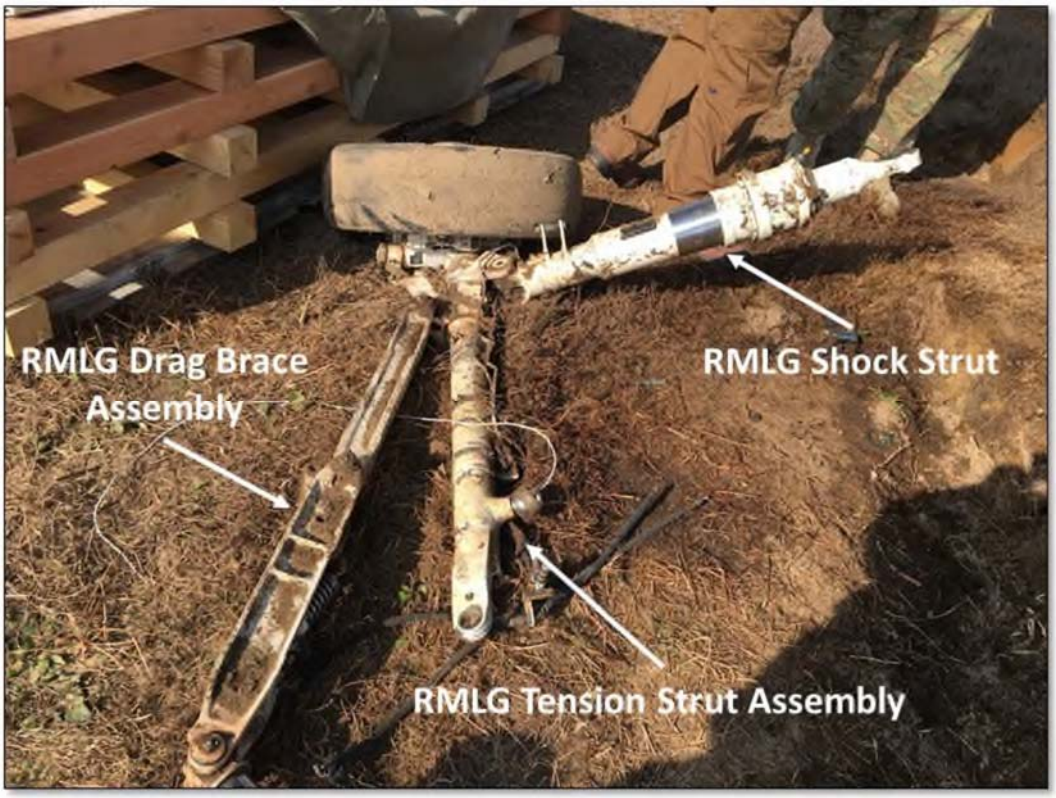

Image 14. RMLG Assembly (Tab Z-11)

The CSFDR data indicates that 1.5 seconds after touchdown, the MA reached a maximum bank angle of the right wing down (Tabs J-23, L-2). The left stick force increased, presumably to maintain a level attitude of the MA. Aft stick input then recorded a range of 1.5 pounds aft to a maximum of 30.5 pounds aft (Tab EE-15 to EE-16).

These inputs likely would have resulted in either a bounce or a removal of weight from the MLG (reduction of wing loads) while departing the runway's prepared surface which would allow the landing gear to re-extend (Tab EE-15 to EE-16). Physical evidence corroborates this with the absence of continuous tire witness marks from the runway edge into the grass (see Image 15 below) (Tab Z-7).

The MLG drag brace is a major structural load bearing member of the landing gear (Tabs BB-69 to BB-71, EE-15 to EE-16). The drag brace holds the landing gear locked in the extended position during takeoff, landing, and ground operations (Tabs BB-69 to BB-71, EE-15 to EE-16). The drag brace attaches to the fuselage in the main wheel well and to the tension strut assembly at the lower end (Tabs BB-69 to BB-71, EE-15 to EE-16).

The drag brace assembly is composed of five major components: The upper, lower, link, toggle, and downlock actuator (Tabs BB-69 to BB-71, EE-15 to EE-16). The upper and lower are the structural members, when extended, and the drag brace is locked into position by the link, toggle, and downlock actuator (Tabs BB-69 to BB-71, EE-15 to EE-16). The downlock actuator is a

spring-loaded hydraulic actuator that uses spring force to keep the link and toggle in an over center locked position, and hydraulic pressure to release the lock for retracting (Tabs BB-69 to BB-71, EE-15 to EE-16).

Image 15. Mishap Site Looking North; Runway Witness Marks Leading Into the Grass (Tab Z-7)

During the landing phase, the gear experiences a series of forces and resultant forces referred to as spin-up and spring-back (Tabs BB-69 to BB-71, EE-15 to EE-16). Initially the wheels, tires, and brakes are stationary; spin-up occurs when the wheel touches down on the runway and begins spinning to match the speed of the landing aircraft (Tabs BB-69 to BB-71, EE-15 to EE-16). When this happens the entire gear set is forced aft, then it springs back to its original position (Tabs BB-69 to BB-71, EE-15 to EE-16).

During this event, the link and toggle vibrate and "fight" against the forces of the springs in the downlock actuator (Tabs BB-69 to BB-71, EE-15 to EE-16). In this dynamic environment, the link and toggle can overcome the downlock actuator spring forces, break over center, and become unlocked (Tabs BB-69 to BB-71, EE-15 to EE-16). An application of compressive load to the drag brace can cause collapse (Tabs BB-69 to BB-71, EE-15 to EE-16). This is referred to as a "spin-up/spring-back" condition (Tabs BB-69 to BB-71, EE-15 to EE-16).

There are at least eight other known incidents attributed to the spin-up/spring-back phenomenon (Tabs BB-69 to BB-71, EE-15 to EE-16). Three of these eight incidents involved the landing gear re-extending after a go-around was initiated resulting in a successful second landing (Tabs BB-69 to BB-71, EE-15 to EE-16).

The MA experienced a RMLG collapse due to the spin-up/spring-back phenomenon and bounced slightly as it departed the runway, which allowed the RMLG drag brace to fully extend and lock (Tabs BB-69 to BB-71, EE-15 to EE-16).

The Department of the Air Force (DAF) began issuing Time Compliant Technical Orders (TCTO) to address different aspects of F-16C MLG collapses as early as 1997 (Tab BB-24 to BB-51). On 5 March 2019, the DAF issued its most recent TCTO to combat the spin-up/spring-back condition. TCTO 1F-16-2855, "Replacement of Main Landing Gear Downlock Actuators and Support Brackets and Hardware on all USAF F-16C/D Blocks 40/42/50/52 Aircraft," mandates the removal of the current Heavy-Weight MLG downlock actuator and the placement of a new actuator, bracket assembly, and attaching hardware. (Tab BB-23). The MA did not have the TCTO redesigned downlock actuator incorporated (Tab EE-17).

(5) Engine

Analysis of the MA's engine downloaded data and CSFDR Type 1 data did not record any engine Maintenance Fault List (MFL) codes (Tab L-2). This means the propulsion system was operating normally based on pilot commands and flight conditions (Tabs L-2, R-625 to R-646). Specifically, these systems were assessed as operating within normal limits during the entirety of the flight: engine temperature, fuel flow, engine oil pressure, and engine oil temperature (Tab U-22 to U-150). The data indicates the MA was attaining expected engine performance prior to and after the mishap (Tabs L-2, R-625 to R-646). The MA engine was last overhauled on 11 October 2017 (Tab U-152). Total Engine Operating Time was 9,531.4 hours (Tab U-151). Since overhaul, the engine logged 2,703.1 full cycles of the throttle from idle to military power (Tab U-151).

Due to a suspected foreign object ingestion, on 5 November 2019, the mishap engine received a full borescope inspection (Tab U-2 to U-19). The maintenance crew inspected the 4th, 5th, 8th, and 9th stages of the core (Tab U-2 to U-19). The Low Pressure Turbine, High Pressure Turbine (HPT), HPT nozzles, and exhaust were also inspected (Tab U-2 to U-19). No defects were noted and the MA was returned to service (Tab U-20 to U21). The MP did not notice engine performance deficiencies prior to the mishap (Tab R-625 to R-646). There is no evidence to suggest engine discrepancies were a factor in this mishap (Tab R-625 to R-646).

b. Evaluation and Analysis

Prior to mishap, maintenance personnel performed all actions IAW applicable technical data and regulations (Tabs D-2 to D-22, R-625 to R-646). The center of gravity weight and balance was within tolerance limits (Tab J-26). The hydraulic system and the engine operated as designed (Tabs J-26, L-2). The RMLG collapsed after touchdown due to the spin-up/spring-back condition (Tab J-26). The AIB analyzed and reviewed all pertinent maintenance records, as detailed below, and there is no evidence to suggest maintenance was a factor in this mishap (Tabs D-2 to D-23, U-159 to U-168).

7. WEATHER

a. Forecast Weather

The Kunsan AB forecasted weather for the MA's initial takeoff at 1430L was winds out of the north-west (320°) at 20 knots gusting to 25 knots, 9 kilometers visibility, light showers and rain with broken ceilings at 3,000 feet above ground level (AGL) (Tab F-7).

There was a weather advisory for observed wind chill less than or equal to 40°F (4°C), observed at 35°F (2°C), issued at 1923L on 27 November 2019; an advisory for East Sea wave heights observed greater than or equal to 3 meters and/or winds greater than 25 knots sustained, issued at 1026L on 2 December 2019; and an advisory for observed surface winds greater than or equal to 25 knots but less than 35 knots, observed at 27 knots, issued at 1050L on 2 December 2019 (Tab F-5).

There was also forecast light rime icing in the operating area from 3,000-12,000 feet AGL (Tab F-9).

b. Observed Weather

At approximately 1519L, when the MA was preparing to enter the visual flight rules (VFR) pattern at Kunsan AB, Kunsan Tower reported winds out of the north-west (330°) at 19 knots gusting to 23 knots, 10 statute miles visibility, few clouds at 3,500 feet AGL, temperature 7°C (45°F), dew point 0°C (32°F), altimeter setting of 30.18 and that the VFR pattern was open (Tab N-14). Kunsan Tower also reported observed wind chill less than or equal to 40° F at 35° F (Tab N-14).

c. Space Environment

Not applicable.

d. Operations

Review of the applicable weather data did not disclose any weather phenomena that met or exceeded any operational limitation for the MA (Tabs F-2 to F-9, N-14).

8. CREW QUALIFICATIONS

a. Mishap Pilot

The MP had 1103.7 total military flying hours on the date of the mishap, including 874.8 hours in the F-16CM (Tab G-15). The MP logged 457.7 combat hours, 64.5 simulator hours, and 8.7 instructor hours, all in the F-16CM (Tab G-15).

The MP had a current instrument qualification AF Form 8, Certificate of Aircrew Qualification, flying evaluation dated 26 August 2019 (Tab G-12). The MP also had a current mission

qualification evaluation AF Form 8, Certificate of Aircrew Qualification, flying evaluation dated 22 August 2019, certifying the MP's mission and instructor qualification (Tab G-12).

The MP was qualified as a 4-ship flight lead and instructor pilot. The MP was also undergoing an Operations Supervisor upgrade on the date of the mishap (Tab R-628). The MP recently PCS'ed (moved) from Aviano AB, Italy (Tab V-2). He attended Squadron Officer School (a 6.5 week professional military education course for company grade officers) en route to Kunsan AB (Tab V-2). He had only been stationed at Kunsan AB for approximately one month prior to the mishap (Tab V-2).

	Hours	Sorties
30 days	12.8	10
60 days	12.8	10
90 days	12.8	10

Table 2. MP's Recent Flying Hours (30/60/90 Day Look Back) (Tab T-6)

9. MEDICAL

a. Qualifications

At the time of mishap, the MP was medically qualified for flight duty (Tab X-2). A review of the MP's medical records, Aerospace Information Management System (ASIMS), and Aeromedical Information Management Waiver Tracking System did not show any discrepancies in the MP's health qualifications (Tab X-2). The MP was up-to-date on all required medical examinations and had current DD Form 2992s, *Medical Recommendation for Flying or Special Operational Duty*, valid through 26 August 2020 (Tab X-2). There is no evidence that medical factors contributed to the mishap (Tab G-3 to G-10, G-18).

b. Health

A review of the MP's medical records, dental records, 72-hour and 14-day History forms, personal testimonies, ASIMS, and RM worksheet did not reveal duty-limiting conditions that contributed to the mishap (Tabs G-3 to G-10, X-2 to X-3, and AA-2).

Post-mishap, the MP was transported to the Wonkwang Medical Center and received comprehensive evaluations with minor injuries noted (Tabs N-29, X-2 to X-3). The MP was released from medical care the same day with a duty limiting condition (Tab X-2 to X-3). Flight medicine medically cleared the MP back to flying status on 16 December 2019 (Tab X-2 to X-3).

c. Pathology

Not applicable (Tab G-18).

d. Lifestyle

The medical records, toxicology reports, personal and witness testimonies, 72-hour and 14-day History forms, and RM worksheet for the MP do not reveal mishap-contributing lifestyle factors, to include unusual habits, behaviors, or stress (Tabs G-3 to G-10, G-18, K-7, R-637 to R-646, and X-2 to X-3) There is no evidence to suggest lifestyle factors were a factor in the mishap.

e. Crew Rest and Crew Duty Time

U.S. Air Force pilots are required to have proper crew rest, as defined by AFI 11-202v3, paragraph 2.1, prior to performing in-flight duties (Tab BB-61 to BB-68). Crew rest consists of a minimum 12-hour non-duty period before the designated flight duty period begins (Tab BB-61 to BB-68). During this time, aircrew may participate in meals, transportation, or rest as long as there is an opportunity for at least eight hours of uninterrupted sleep (Tab BB-61 to BB-68). The MP complied with crew rest and duty time requirements (Tab G-3 to G-6).

10. OPERATIONS AND SUPERVISION

a. Operations

On the day of the mishap, the squadron had 34 assigned and attached pilots (Tab G-17). Of those 34 pilots, 19 were experienced and 15 were inexperienced (Tab G-17). Overall, the operations tempo at Kunsan AB is relatively high, but typical for the Kunsan AB F-16CM squadrons (Tab G-2). There is no evidence that the operations tempo contributed to this mishap.

b. Supervision

The MS was led by the MLP, an experienced 4-ship flight lead (Tab G-17).

The 80 FS Operations Supervisor, a qualified and experienced F-16CM instructor pilot, oversaw flying operations for the 80 FS on the day of the mishap (Tabs G-17, R-556). The Operations Supervisor also completed an Accident/Aircraft Mishap Response checklist after being notified of the mishap (Tab R-556 to R-558).

The Supervisor of Flying (SOF) was qualified in that duty position (Tab V-30). At the time of the mishap, the SOF directed an airfield status of VFR, with Osan AB as the primary divert airfield (Tab R-527). At the time of the mishap, Osan AB also had an airfield status of VFR (Tab R-527). There is no evidence that operations supervision contributed to this mishap.

11. HUMAN FACTORS ANALYSIS

In accordance with AFI 91-204_AFGM2019-01, *Safety Investigation and Hazard Reporting*, the AIB evaluated human factors relevant to the mishap using the analysis and classification system model established by the Department of Defense Human Factors Analysis and Classification System guide, and no defined human factors were found to be contributory in this mishap (Tab BB-72 to BB-97).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publicly Available Directives and Publications Relevant to the Mishap

(1) AFMAN 11-2F-16, Volume 1, F-16 *Pilot Training*, dated 17 June 2019
(2) AFMAN 11-2F-16, Volume 2, F-16 *Aircrew Evaluation Criteria*, dated 8 October 2019
(3) AFI 11-2F-16, Volume 3, F-16 *Operations Procedure*s, dated 13 July 2016, Incorporating Change 1, dated 26 May 2017
(4) AFMAN 11-202, Volume 1, *Aircrew Training*, dated 27 September 2019
(5) AFI 11-202, Volume 2, *Aircrew Standardization and Evaluation Program*, dated 6 December 2018
(6) AFI 11-202, Volume 2, *Pacific Air Forces Supplement, Aircrew Standardization and Evaluation Program*, dated 13 September 2019
(7) AFI 11-202, Volume 3, *General Flight Rules*, dated 3 October 2019
(8) AFI 11-202, Volume 3, *Pacific Air Forces Supplement, General Flight Rules*, dated 21 February 2019
(9) AFI 11-214, *Air Operations Rules and Procedures*, dated 14 August 2012, Incorporating Change 1, dated 23 March 2016
(10) AFI 11-301, Volume 1, *Aircrew Flight Equipment (AFE) Program*, dated 10 October 2017
(11) AFI 11-401, *Aviation Management*, dated 10 December 2010
(12) AFI 11-401, *Pacific Air Forces Supplement, Aviation Management*, dated 18 June 2013, certified current 12 February 2019
(13) AFI 11-418, *Operations Supervision*, dated 14 October 2015
(14) AFI 48-123, *Medical Examinations and Standards*, dated 5 November 2013
(15) AFI 51-307, *Aerospace and Ground Accident Investigations*, dated 18 March 2019
(16) AFI 91-204, *Safety Investigations and Hazard Reporting*, dated 27 April 2018
(17)AFMAN 11-217, *Flight Operations*, dated 10 June 2019
(18) Air Force Technical Order 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*, dated 1 April 2016
(19) Air Force Safety Center, *DoD Human Factors Analysis and Classification System (HFACS),* Version 7.0

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

b. Other Directives and Publications Relevant to the Mishap

(1) T.O. 1F-16CM-1
(2) T.O. 1F-16CM-1CL
(3) T.O. 1F-16CM-1-1
(4) T.O. 1F-16CM-1-2
(5) T.O. 1F-16-34-1-1
(6) T.O. 1F-16-34-1-1CL-1
(7) 8 FW Pilot Guide
(8) Air Force Tactics, Techniques, and Procedures 3-3.F.F-l6, *Combat Aircraft Fundamentals F-16*, dated 6 October 2017
(9) T.O. 1F-16CG-6WC-I, *Combined Preflight/Post-flight, End-of-Runway, Thru-flight, Launch and Recovery, Alert Inspections, Quick Turnaround, Basic Post-flight, and Walk around Before First Flight of Day Inspection Work cards*, dated 1 November 2013

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14 March 2020

JARED J. HUTCHINSON, Colonel, USAF
President, Accident Investigation Board

United States Air Force Accident Investigation Board Report

Class A, Kunsan AB

STATEMENT OF OPINION

F-16CM, T/N 90-0714
KUNSAN AB, SOUTH KOREA
2 DECEMBER 2019

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

1. OPINION SUMMARY

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

The mishap involving an F-16CM Block 40, tail number 90-0714, occurred at approximately 1537 local time on 2 December 2019. The mishap aircraft (MA) and mishap pilot (MP) were assigned to the 80th Fighter Squadron (FS), 8th Fighter Wing (FW), Kunsan Air Base (AB), South Korea. The MP was an instructor–pilot, and was number three of a four-ship that was flying an Air Interdiction continuation training sortie in the 8 FW's local airspace.

The mishap sortie was planned and briefed without incident and had a valid flight authorization. There were no reported issues with aircraft pre-flight, taxi, nor takeoff. No significant events took place during the departure, recovery, or tactical portion of the sortie, and the MP operated the MA in accordance with all governing directives and publications.

During the MP's return to base and preparation for landing, the MP lowered the MA's landing gear. The MP saw positive indications that the MA's landing gear were down and locked. The MP continued to fly the final approach and landing IAW approved techniques and mandated procedures.

When the MA initially touched down on the runway, the right main landing gear (RMLG) collapsed as indicated by the distance between the MA's tire witness marks on the runway. The MA also instantaneously displayed visual and audio warnings confirming the collapsed RMLG condition. Simultaneously, the MA began to yaw to the right towards the edge of the runway's prepared surface.

The MP increased power, and made flight control inputs in an attempt to keep the MA on the runway and take the MA back airborne. The MP was unable to go around and continued to approach the right edge of the runway's prepared surface.

Just prior to departing the runway's prepared surface, the MP initiated the ejection sequence. The MP successfully ejected and sustained minor injuries.

After the ejection, the MA continued to bounce across the grassy infield. Approximately six seconds after initial touchdown, the MA's RMLG re-locked back into place as indicated by the distance between the MA's tire witness marks in the grassy infield. The MA came to rest approximately 2,200 feet from the point of initial touchdown after rotating approximately 150 degrees from runway heading.

2. CAUSE

I find, by a preponderance of evidence, this mishap was caused by a failure of the RMLG downlock actuator, causing the RMLG to collapse, making the aircraft uncontrollable during the landing phase of flight.

There is historical evidence, as far back as 1993, of F-16C main landing gear (MLG) collapsing upon initial touchdown and subsequently re-locking into a safe condition. Air Force Material Command, the Air Force Sustainment Center, and Lockheed Martin Aero have all studied and published reports on F-16C MLG collapsing and sometimes re-locking into place. This F-16C MLG failure phenomena is commonly known as the spin-up/spring-back condition.

The F-16C MLG spin-up/spring-back condition occurs during the landing phase of flight due to several compounding factors. At landing, the MLG are initially stationary; spin-up occurs when the wheel touches down on the runway and begins spinning to match the speed of the landing aircraft. When this happens, the entire MLG set is forced aft, then it springs back to its original position. During this event, various MLG components vibrate and may overcome the forces of the springs in the downlock actuator and cause the MLG to become unlocked and collapse.

The Department of the Air Force (DAF) began issuing Time Compliant Technical Orders (TCTO) to address different aspects of F-16C MLG collapses as early as 1997. On 5 March 2019, the DAF issued its most recent TCTO to combat the spin-up/spring-back condition. TCTO 1F-16-2855, "Replacement of Main Landing Gear Downlock Actuators and Support Brackets and Hardware on all USAF F-16C/D Blocks 40/42/50/52 Aircraft," mandates the removal of the current Heavy-Weight MLG downlock actuator and the placement of a new actuator, bracket assembly, and attaching hardware.

Of note, initial evidence strongly suggests that a left MLG (LMLG) also collapsed during landing due to the spin-up/spring-back condition on 13 January 2020, on aircraft tail number 90-0736 in the 80 FS at Kunsan AB. The pilot of aircraft tail number 90-0736 received the same indications as the MP did on 02 December 2019. However, aircraft 90-0736 bounced after initial contact with the runway, and the LMLG immediately re-locked back into place. The pilot was able to keep the aircraft on the runway with the aircraft only sustaining minimal damage.

No F-16Cs that have undergone TCTO 1F-16-2855 have experienced MLG collapse due to the spin-up/spring-back condition.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

I find, by a preponderance of evidence, that the following factor substantially contributed to the mishap: DAF mandated time frame to implement TCTO 1F-16-2855, "Replacement of Main Landing Gear Downlock Actuators and Support Brackets and Hardware on all USAF F-16C/D Blocks 40/42/50/52 Aircraft."

TCTO 1F-16-2855 has a rescission date of 5 March 2022 allowing for up to 3 years for units that operate the F-16C to come into compliance and make the mandated MLG actuator changes. The DAF did a risk assessment in the "Systems Safety Evaluation for the F-16 MLG Downlock Actuator Redesign, SSE# 2014-F16-SSE01-V1" and accepted the risk of this MLG failure condition.

There were no other factors that substantially contributed to this accident.

4. CONCLUSION

I find, by a preponderance of evidence, this mishap was caused by a failure of the RMLG downlock actuator, causing the right main landing gear to collapse, making the aircraft uncontrollable during the landing phase of flight.

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

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14 March 2020

JARED J. HUTCHINSON, Colonel, USAF
President, Accident Investigation Board

United States Air Force Accident Investigation Board Report

Class A, Kunsan AB

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