DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR COMBAT COMMAND

OFFICE OF THE DEPUTY COMMANDER
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18 JUL 2025

ACTION OF THE CONVENING AUTHORITY

The report of the abbreviated accident investigation board conducted under the provisions of Air Force Instruction 51-307, *Aerospace and Ground Accident Investigations*, that investigated the 16 December 2024 mishap in the Mediterranean Sea, involving an MQ-9A, T/N 13-4225, and operated by the 20th Attack Squadron, complies with applicable regulatory and statutory guidance, and is hereby approved.

MICHAEL G. KOSCHESKI
Lieutenant General, USAF
Deputy Commander

UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

MQ-9A, T/N 13-4225

20th ATTACK SQUADRON
432d WING
CREECH AFB, NEVADA

LOCATION: MEDITERRANEAN SEA

DATE OF ACCIDENT: 16 DECEMBER 2024

BOARD PRESIDENT: COLONEL RICK G. SCHUESSLER

Abbreviated Accident Investigation Board, conducted pursuant to Chapter 12 of Air Force Instruction 51-307

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION

MQ-9A, T/N 13-4225
MEDITERRANEAN SEA
16 DECEMBER 2024

On 16 December 2024, at approximately 17:00:00 Zulu time (Z), an MQ-9A Reaper, tail number 13-4225, the Mishap Aircraft (MA), descended from an assigned cruising altitude and impacted the water in the Mediterranean Sea. The MA was launched by a launch and recovery element (LRE) crew from a location in the EUCOM Area of Responsibility (AOR) and shortly after takeoff, control of the aircraft was transferred to a mission control element (MCE) located at Whiteman Air Force Base, Missouri. At the time of the mishap, the aircraft was operated by members of the 20th Attack Squadron and the Mishap Crew (MC) was comprised of a Mishap Pilot (MP) and Mishap Sensor Operator (MSO). The mishap resulted in no reported injuries, no damage to civilian property and no fatalities. The MA was not recovered, and the loss of government property is valued at $13,154,585.00.

At 17:00:18 (Z), at cruising air speed and altitude, the MA's engine torque display decreased from a normal torque operating range to a loss of torque within one second. The MA experienced a loss of air speed and began an uncommanded descent. At 17:00:46 Z, throttle input was rapidly increased to full power, but the engine torque did not change. Over the next 16 minutes, as the aircraft descended, the MC executed multiple checklists to maintain control and restore thrust to the aircraft. At 17:16:00 Z, metal debris was detected in the engine oil. With indications of engine internal damage, the MP shutdown the engine and the MC executed a forced landing into the water. At 17:23:02 Z, without torque or thrust, the datalink was lost with the aircraft and the last received data indicated aircraft altitude was near impact with the water. The MA was not recovered.

The Accident Investigation Board President (BP) found, by a preponderance of the evidence, the cause of the mishap was a failure within the Splined Coupling Assembly which led to a sudden and permanent mechanical decoupling of the propeller from the engine resulting in an unrecoverable loss of thrust. Data logs showed that immediately following the decoupling, the Digital Electronic Engine Controller (DEEC) and the Engine Fuel Interface Unit (EFIU) indicated different but accurate speeds, which can occur only if the propeller is decoupled from the engine. The BP found the cause of the decoupling was a failure within the Splined Coupling Assembly during flight. Therefore, but for the decoupling, the MA would not have experienced a sudden loss of torque, and the MC would not have had to perform the emergency procedures to attempt to restore thrust or to force land the aircraft into the water. General Atomics Aeronautical Systems Incorporated (GA-ASI) reported the Spiral Retaining Ring as the most likely cause of the Splined Coupling Assembly failure, but the definitive cause could not be discerned by a preponderance of the evidence because the wreckage was unrecoverable.

SUMMARY OF FACTS AND STATEMENT OF OPINION
MQ-9A, T/N 13-4225
MEDITERRANEAN SEA
16 DECEMBER 2024

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ACRONYMS AND ABBREVIATIONS

20 ATKS	20th Attack Squadron
31 FW	31st Fighter Wing
31 WG	31st Wing
432 WG	432d Wing
49 AMXS	49th Aircraft Maintenance Squadron
AAIB	Abbreviated Accident Investigation Board
AB	Air Base
ACC	Air Combat Command
AFB	Air Force Base
AFE	Air Flight Equipment
AFI	Air Force Instruction
AFMAN	Air Force Manual
AIB	Accident Investigation Board
AOC	Air Operations Center
AOR	Area of Responsibility
BP	Board President
BPO	Basic Post-flight Operation
C	Celsius
CAOC	Combined Air Operations Center
CAP	Critical Action Plan
Capt	Captain
CCB	Configuration Control Board
CCO	Contingency Contracting Officer
Col	Colonel
DEEC	Digital Electronic Engine Controller
DO	Director of Operations
DoD	Department of Defense
EFIU	Engine Fuel Interface Unit
EGT	Exhaust Gas Temperature
EP(s)	Emergency Procedures
FCIF	Flight Crew Information Files
FCU	Fuel Control Unit
ft	Feet
fpm	Feet per Minute
GA-ASI	General Atomics Aeronautical Systems Incorporated
GCS	Ground Control Station
GSU	Geographically Separated Unit
HDD	Heads Down Display
HFACS	Human Factor Analysis and Classification System
HUD	Heads-Up Display
HSI	Hot Section Inspection
HSP	High Speed Pinion
IA	International Airspace
ID	Identification
IFR	Instrument Flight Rules
IMDS	Integrated Maintenance Data System
K	Thousand
KIAS	Knots Indicated Airspeed
L	Local Time
LNO	Liaison Officer
LR	Launch and Recovery
LRE	Launch and Recovery Element
MA	Mishap Aircraft
Maj	Major
MAJCOM	Major Command
MC	Mishap Crew
MCD	Magnetic Chip Detector
MCE	Mission Control Element
ME	Mishap Engine
MP	Mishap Pilot
MSO	Mishap Sensor Operator
MSgt	Master Sergeant
MSL	Mean Sea Level
MTS	Multi-spectrum Targeting System
NAVEUR	United States Naval Forces Europe
NATO	North Atlantic Treaty Organization
NOTAMs	Notices to Airmen
OIC	Officer in Charge
OPR	Officer Performance Report
Ops	Operations
Ops Sup	Operations Supervisor
ORM	Operational Risk Management
PEX	Patriot Excalibur
PG	Propeller Governor
PMA	Permanent Magnet Alternator
pph	Pounds per Hour
PSO1	Pilot/Sensor Operator One
PST	Pacific Standard Time
RPM	Revolutions Per Minute
RTB	Return-To-Base
SAR	Search and Rescue
SARM	Squadron Aviation Resource Management

SIB	Safety Investigation Board
SIM	Simulator
SLR	Satellite Launch and Recovery
SrA	Senior Airman
SRL EGT	Single Red Line Exhaust Gas Temperature
SSgt	Staff Sergeant
TCTO	Time Compliance Technical Order
T/N	Tail Number
TO	Technical Order
TSgt	Technical Sergeant
TTP	Tactics, Techniques, and Procedures
V	Volts
VSI	Vertical Speed Indicator
Z	Zulu Time

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 7 March 2025, the Air Combat Command (ACC) Deputy Commander appointed Colonel (Col) Rick Schuessler as President of the Abbreviated Accident Investigation Board (AAIB) for the mishap that occurred on 16 December 2024 involving an MQ-9 crash in the Mediterranean Sea. (Tab Y-2 and Y-3). Other board members included a Captain (Capt) Legal Advisor, a Capt MQ-9 Pilot Member, a Master Sergeant (MSgt) Maintenance Member, and a Technical Sergeant (TSgt) Recorder (Tab Y-2). The AAIB conducted its investigation in accordance with Air Force Instruction (AFI) 51-307, *Aerospace and Ground Accident Investigations,* Chapter 12, from 18 March 2025 to 7 May 2025 (Tab Y-2). The AAIB initially assembled at Creech Air Force Base (AFB), Nevada to conduct the investigation and then continued the investigation remotely (TAB Y-3).

b. Purpose

In accordance with AFI 51-307, *Aerospace and Ground Accident Investigations,* Chapter 12*,* the AAIB conducted a legal investigation into all the relevant facts and circumstances surrounding this Air Force aerospace accident, prepared a publicly releasable report, and obtained and preserved all available evidence for use in litigation, claims, disciplinary action, and adverse administrative action. (Tab Y-2).

2. ACCIDENT SUMMARY

On 16 December 2024, an MQ-9A Reaper with tail number 13-4225, the Mishap Aircraft (MA), crashed into the Mediterranean Sea (Tab Y-2). The MA initially took off from a location in the EUCOM Area of Responsibility (AOR) before it experienced a sudden loss of thrust, a deterioration of air speed, and a gradual descent (Tab H-3). The MA belonged to the 432 Wing, Creech AFB, Nevada and was operated by the Mishap Pilot (MP) and Mishap Sensor Operator (MSO) (Tab K-75 and K-84). Both Mishap Crew (MC) members were assigned to the 20th Attack Squadron at Whiteman Air Force Base, Missouri, and were physically located there at the time of the mishap (Tab CC-2 to CC-3 and K-84). The mishap resulted in no reported injuries, no damage to civilian property and no fatalities (Tab P-2). The MA was not recovered, and the loss of government property is valued at $13,154,585.00. (Tab H-3, H-16, and P-2).

3. BACKGROUND

a. Air Combat Command (ACC)

ACC, headquartered at Joint Base Langley-Eustis, Virginia, is one of nine major commands (MAJCOMs) in the United States Air Force (Tab CC-7). For more than seven decades, ACC has served as the primary provider of air combat forces to America's warfighting commanders (Tab CC-7). ACC organizes, trains, and equips Airmen who fight in and from multiple domains to control the air, space, and cyberspace (Tab CC-7). As the lead command for fighter, command and control, intelligence, surveillance and reconnaissance, personnel recovery, persistent attack and reconnaissance, electronic warfare, and cyber operations, ACC is responsible for providing combat air, space, and cyber power and combat support that assures mission success to America's warfighting commands (Tab CC-7).

b. 432d Wing (432 WG)

The 432 WG is located at Creech AFB, Nevada (Tab CC-5 to CC-6). The 432 WG was returned to active service in May 2007 as the U.S. Air Force's first unmanned (and later remotely piloted) aircraft systems wing (Tab CC-5 to CC-6). The wing's mission is to conduct unmanned precision attacks and intelligence, surveillance, and reconnaissance combat missions in support of overseas contingency operations (Tab CC-5 to CC-6). The 432d is focused on a sudden call to duty—preparing Airmen for combat and other roles in service to the nation (Tab CC-5 to CC-6).

c. 31st Fighter Wing (31 FW)

The 31 FW is located at Aviano AFB Italy (Tab CC-8). The 31 FW maintains two F-16 fighter squadrons, the 555th Fighter Squadron and the 510th Fighter Squadron, capable of conducting offensive and defensive air combat operations (Tab CC-8). The 31 FW also hosts the 56th Rescue Squadron providing a rapidly deployable, worldwide combat rescue and reaction force response (Tab CC-8). In peacetime, the 31 FW prepares for its combat role by maintaining aircraft and personnel in a high state of readiness (Tab CC-8). The 31 FW is the only U.S. fighter wing south of the Alps, a strategic location that makes the wing critical to operations in NATO's southern region. (Tab CC-8).

d. 20th Attack Squadron (20 ATKS)

The 20 ATKS, a geographically separated unit (GSU) of the 432d Wing/432nd Air Expeditionary Wing, is located at Whiteman Air Force Base, Missouri (Tab CC-2 to CC-3). The 20 ATKS, known as the Hellhounds, fly the MQ-9A Reaper and provide close air support for friendly forces and coalition troops on the ground (Tab CC-2 to CC-3).

e. MQ-9 Reaper

The MQ-9A Reaper is employed primarily as an intelligence-collection asset and secondarily against dynamic execution targets (Tabs CC-10 to CC-16). Given its significant loiter time, wide-range sensors, multi-mode communications suite, and precision weapons, it provides a unique capability to perform strike, coordination, and reconnaissance against high-value, fleeting, and time sensitive targets (Tab CC-10 to CC-16). Reapers can also perform the following missions and tasks: intelligence, surveillance and reconnaissance, close air support, combat search and rescue, precision strike, buddy-lase, convoy and raid overwatch, route clearance, target development, and terminal air guidance (Tab CC-10 to CC-16). The MQ-9A's capabilities make it uniquely qualified to conduct irregular warfare operations in support of combatant commander objectives (Tab CC-10 to CC-16).

4. SEQUENCE OF EVENTS

a. Mission

On 16 December 2024, the MA was scheduled to conduct an operational mission at an undisclosed location within or around the Mediterranean Sea (Tab K-60 and V 8.7). The MA was launched by a Launch and Recovery Element (LRE) aircrew at the scheduled launch time of 13:00:00 Zulu (Z), was transferred to a Mission Control Element (MCE) aircrew, and flew through international airspace under an approved flight plan (Tab K-75 and K-77). The MP conducted a changeover (where a crewmember receives a formal brief of the aircraft's status from the crewmember currently in the seat and then relieves them of flying) and then took control of the MA at approximately 14:50Z (Tab K-60). The MSO also conducted a changeover and took control of the aircraft's sensor at approximately 16:00:00 Z (Tab K-60 and Tab V-8.4). The MP and MSO were the second MCE members to operate the MA in their respective stations. The MA continued to fly without incident for another hour (Tab R-5). At 17:00:00 Z, and immediately before the first indication of a malfunction, the MP was conducting a changeover brief with his scheduled relief pilot while still enroute to the mission airspace (Tabs K-60 and R-5). No evidence indicates the mission profile was a factor in this mishap.

b. Planning

As part of the MCE mission planning, the MC attended a mass briefing to discuss the current mission status and operations tempo for the day (Tab R-4). The MP was not originally scheduled to pilot the aircraft that day but was asked by the Operations Supervisor (Ops Sup) if he could fly to provide a break for a pilot scheduled to fly for 8 hours, and the MP agreed (Tab R-5). The MC properly filled out the Operational Risk Management worksheet and the MP checked currencies prior to taking control of the MA, along with verification from the Ops Sup (Tabs G-147, G-149, G-151, G-155, G-157, R-4, and V-7.3). All members of the MC were current to fly on the day of the mishap (Tabs G-147, G-149, G-155, G-157). No evidence indicates that mission planning was a factor in this mishap.

c. Preflight

Prior to taking control of the MA, the MC accomplished all preflight procedures, signed the flight orders, and received a brief from the shift Ops Sup (Tabs R-5, G-139, and V-7.3). A Department of Defense Form 1801 flight plan was filed with air traffic control prior to the launch of the MA (Tab G-138). No evidence indicates that preflight was a factor in this mishap.

d. Summary of Accident

Immediately prior to the start of the mishap, the MP was conducting a changeover brief with his relief pilot, who was the same pilot the MP had relieved approximately two hours prior (Tab R-5). According to the MP, the MA "was flying safe and pretty much untouched" during the transit (Tab R-5). At 17:00:18 Z, with the MA operating at cruising air speed and altitude, engine torque decreased from a normal torque operating range to a complete loss of torque within one second (Tab H-17). Over the next few seconds, the engine speed reported by the Digital Electronic Engine Controller (DEEC) increased outside normal operating range and engine speed reported by the Engine Fuel Interface Unit (EFIU) also increased (Tab H-17). Fuel flow rate also indicated a significant decrease (Tab H-17). "DEEC health bad – Using Backup" was indicated in the Heads Down Display (HDD) after 5 seconds (Tab H-17). Single Red Line Exhaust Gas Temperature decreased substantially outside of normal operating range and then leveled off after a short amount of time (Tab H-17). At 17:00:46 Z, throttle input was increased to full power, but engine torque did not increase (Tab H-17 and R-5). The MA was initially able to maintain altitude until the air speed decreased and the MA began descending (Tab R-5). Shortly after beginning the descent, to maintain aircraft control, the MC executed the procedures for the Loss of Control Prevent checklist (Tab R-5). The MC also declared an emergency, transmitting that they were unable to maintain altitude, asking for a block altitude, and requesting a direct route back to the airport (Tab R-5). The MP turned the MA around toward the airport, adjusted the emergency mission accordingly, and selected an area clear of people and property for a potential forced landing (Tab R-5 and V-8.8).

In a controlled descent, outside of the glide-back range of a suitable airfield, and with a forced landing site selected, the MC executed the DEEC Failure checklist and the Torque Indication Failure checklist (Tab R-5 and R-6). The MC also scanned the aircraft for structural damage and tried a rack swap (Tab R-6 and R-51). A rack swap is where the pilot and sensor switch workstations in the GCS. Since either workstation can be configured to fly the aircraft, this procedure can be used to restore normal operation in the event of a malfunction with the current workstation configured to fly the aircraft (Tab V-4.4). In this case, no structural damage was found and thrust was not restored (Tab R-6).

At 17:16:00 Z, the data logs showed metal debris was detected in the engine oil (data log signal: Magnetic chip detector) followed by a DEEC health bad – Using Backup indicator (Tab H-17). The MP verified this warning in their HDD along with noting a decay of Revolutions Per Minute (RPM) (Tab V-8.6). The MC proceeded to execute the Engine Failure checklist (Tab R-6 and V-8.6). The MC opted to not try an engine restart due to the Engine – Metal Detected warning (Tab R-6 and V-8.6). At 17:18:16 Z, as the aircraft descended through lower altitude, the engine was shut down, and the propeller feathered by movement of the condition lever, indicated by feather servo feedback increasing to a feathered propellor status (Tab H-17). Shortly after, an Engine Out

Detected warning was indicated and as the aircraft continued to descend, the Air Force liaison officer and the Ops Sup directed the MC to force land the MA in the water. (Tab H-17 and R-7).

e. Impact

The MA impacted the water of the Mediterranean Sea, indicated by the loss of data at 17:23:02 Z (Tab H-18 and V-8.7).

f. Egress and Aircrew Flight Equipment (AFE)

The MA is a remotely piloted aircraft, egress and AFE are not applicable.

g. Search and Rescue (SAR)

Search and rescue are not applicable.

h. Recovery of Remains

Recovery of remains is not applicable.

5. MAINTENANCE

a. Forms Documentation

A review of the maintenance records for the MA leading up to the mishap revealed no relevant discrepancies, including no documented significant engine maintenance, overdue time compliance technical orders, time change items, or special inspections (Tabs D-9 to D-13, D-1246, D-1591, D-1602 to D-1603, D-1816 to D-1818, and D-1848 to D-1855). On the date of the mishap, the MA was released for flight and cleared all pre-flight inspections (Tab D-1588).

b. Inspections

All required maintenance inspections were current and conducted within the required time interval (Tab D-1246 and D-1602). The last 200-hour engine inspection was properly completed on 26 November 2024, and the subsequent engine run indicated no follow up maintenance was required (Tab D-9 to D-13 and D-1848 to D-1855). Between the 200-hour inspection and the mishap event, the MA flew three, long duration sorties. (Tab D-1503, D-1513, and D-1577 to D-1578). There were no relevant discrepancies with the MA inspections. (Tabs D-9 to D-13, D-1596 to D-1598, and D-1848 to D-1855).

c. Maintenance Procedures

In March 2024, a 6000-hour overhaul of the Mishap Engine (ME) was completed, and the ME was installed into the MA (Tabs D-1232, D-1239 to D-1246. D-1249, and D-196). In July 2024, an Engine Metal Detected discrepancy was documented. All subsequent required inspections were documented as completed and no further discrepancies were noted (D-73). In October

2024, a 200-hour inspection was accomplished with no additional discrepancies noted (D-39 to D-41). From August 2024 until December 2024, the MA flew 32 sorties and 618 hours without any Engine Metal Detected warnings reported (D-1503 and D-1574 to D-1577). All maintenance procedures were conducted in accordance with applicable guidance (BB-52 to BB-58). No evidence indicates the maintenance procedures were a factor in this mishap.

d. Maintenance Personnel and Supervision

Maintenance personnel documented all pre-flight servicing and maintenance (Tab D-1588 to D-1589 and D-1596 to D-1598). No evidence indicates that the training, qualifications, and supervision of the maintenance personnel were a factor in this mishap.

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

Fluid levels were properly inspected and met required parameters to conduct the mission (D-1588 to D-1589). The crew properly conducted a 200-hour oil filter change in November 2024, prior to the mishap (D-9 to D-10). The requirements for an oil analysis, in accordance with the Spectrometric Oil Analysis Program, were not triggered as they are only needed on a conditional basis. (D-2492 to D-2943 and J-7 to J-8).

f. Unscheduled Maintenance

No evidence indicates that unscheduled maintenance was a factor in this mishap.

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

TPE331-10YGD Engine: The MQ-9A Block 5 Extended Range is equipped with a Honeywell TPE331-10YGD engine controlled by a DEEC (Tab H-19). Reference to the engine assembly is commonly divided between the power group (turbine, combustor, and compressor) and the gearbox (Tab H-19). In the gearbox, the output from the power group drives two separate gear trains that drive the propeller (thrust) and the gearbox-mounted accessories (Tab H-19).

DEEC and EFIU: The DEEC receives commands and flight condition information from the aircraft and engine condition information from the engine (Tab H-20). The DEEC provides engine telemetry information to the aircraft and engine system status (Tab H-20). The DEEC can operate in two modes, Auto and Manual (Tab H-20). In DEEC mode (Auto), the DEEC electronically controls fuel flow via the Fuel Control Unit (FCU) torque motor and propeller blade angle via the Propeller Governor (PG) torque motor (Tab H-20). By manipulating the FCU torque motor and PG torque motor, the DEEC meets engine power and engine speed commands (Tab H-20). The DEEC also performs Exhaust Gas Temperature (EGT) limiting and torque limiting (Tab H-20). In normal operation, the EFIU works in conjunction with the DEEC to provide engine control. In Backup Mode (Manual), the DEEC does not control fuel flow or engine speed. EGT and torque limiting functions also cease (Tab H-20). Fuel flow is manually controlled by the throttle lever and engine speed is maintained at the propeller governor backup mode high setting of between 100.5% and 101.5% (Tab H-20). The EFIU provides engine feedback for manual engine management but does not provide any automatic control (Tab H-20).

Splined Coupling Assembly: The Splined Coupling Assembly connects the power group output to the High-Speed Pinion (HSP) (Tab H-20). This connection permits the HSP shaft to drive the bull/sun gear assembly and planetary gear carrier assembly, which rotates the propeller (H-20). Within the Splined Coupling Assembly, the internal-external splined coupling and the splined coupling transfer rotation of the power group output shaft to the HSP (H-20). The Spiral Retaining Ring, Compressor Bearing Nut Retainer, and Retainer keep the Splined Coupling axially constrained and engaged with the Internal-External Splined Coupling (H-20).

Duplex Compressor Bearing: The Duplex Compressor Bearing is part of the oil engine system and is located at the compressor end of the main power group shaft (Tab: DD-7). While not part of the Splined Coupling Assembly, the Internal-External Splined Coupling, Compressor Bearing Nut Retainer, Retainer, and Nut are all part of the hardware stack-up that secures the Duplex Compressor Bearing in place (Tab: DD-7).

Actual structures and systems analysis were not conducted since the MA was not recovered. (Tab H-16).

b. Evaluation and Analysis

Engine Decoupling: The MA data logs were analyzed by GA-ASI, which indicated the loss of engine torque was caused by a decoupling of the propeller from the engine (Tab H-16). After the decoupling occurred, the data logs confirm the DEEC and Engine and Fuel Interface Unit (EFIU) indicated different but accurate speeds, which is possible only if the propeller was decoupled from the engine (Tab H-16). Without an analysis of the hardware, GA-ASI could not confirm the cause of the decoupling, but it reported that the decoupling was most likely the result of a failed Spiral Retaining Ring (also known as the spiral lock ring) inside the gearbox (Tab H-16).

Spiral Retaining Ring: Failure of the Spiral Retaining Ring was considered most likely because of its history of excessive wear and failure (Tab H-23). If the Spiral Retaining Ring were to wear excessively, the Splined Coupling Assembly could move aft toward the HSP (Tab H-23). Engagement between the splined coupling and internal-external splined coupling would then be reduced, applying more stress to a smaller portion of the gear splines (Tab H-23). Eventually, the reduced engagement and subsequent higher stress would result in failure of the internal-external splined coupling teeth, resulting in loss of continuity between the splined coupling and internal-external splined coupling (Tab H-23).

History of excessive wear and failure: Due to a history of excessive wear and failure of the Spiral Retaining Ring and because accessing the Spiral Retaining Ring requires engine disassembly, Honeywell began replacing the Spiral Retaining Ring at the 3,000-hour Hot Section Inspection (HSI) in addition to the 6,000-hour engine overhaul (Tab DD-4 to DD-7 and H-19). For almost four years, a reduction in suspected Spiral Retaining Ring failures was realized (Tab DD-4 to DD-7 and H-23). The mishap engine was about halfway until its next overhaul, which would include replacement of the Spiral Retaining Ring (Tab H-23). Normally the Spiral Retaining Ring is replaced every 3,000 hours (Tab DD-4 to DD-7 and H-19). There are multiple possible causes for early Spiral Retaining Ring wear but, without recovery of the physical evidence, none could be verified (Tab H-23).

Compressor Bearing Nut Retainer and Retainer: In addition to the Spiral Retaining Ring, the Compressor Bearing Nut Retainer and Retainer also keep the Splined Coupling axially constrained and engaged with the Internal-External Splined Coupling (Tab H-20). The Compressor Bearing Nut Retainer typically wears with the Spiral Retaining Ring because it is the contact between these two components that keeps the Splined Coupling Assembly in place (Tab DD-7). They cause wear against each other, but with the Spiral Retaining Ring being the smaller, weaker component, the Spiral Retaining Ring would be expected to fail first (Tab DD-10). The Retainer does not have a wear or failure history, and the Retainer has not typically affected Spiral Retaining Ring wear or failure (Tab DD-7).

Duplex Compressor Bearing: Due to a history of wear and failure, GA-ASI considered the Duplex Compressor Bearing, but ruled it out as a likely cause, due to past failures being isolated to a suspect lot which were identified for replacement in 2017 (Tab H-12 to H-14). Also, known Duplex Compressor Bearing failures have been associated with high oil pressure indications and engine metal detected warning prior to engine failure and without a near-instantaneous and permanent decoupling of the propeller (Tab H-12 and DD-10).

Material Defect: The possibility of a material failure of one or more of the splined coupling components was also considered; however, no evidence has been obtained to suggest such a defect of any of these components at the time of this report (H-23).

Other Potential Failures in Power Extraction Group: Four other components within the power extraction gear train were considered potential failure points that could result in decoupling and producing the same data log indications: the HSP shaft, the HSP gear, the bull gear, and the sun gear shaft (H-23). None of these parts are life limited and failure of any of these components was considered unlikely because of lack of failure history (H-23).

In a separate analysis, GA-ASI looked at the MA GCS data logs, finding that the GCS was operating normally at the time of the mishap (Tabs H-3 and H-10 to H-11).

7. WEATHER

a. Forecast Weather

The enroute Flight Weather Briefing for 16 December 2024 predicted winds from the southwest at 70 knots at 26,000 ft Mean Sea Level (MSL) and clouds at flight level being "in and out" (Tab F-2). Minimum ceiling over the Eastern Mediterranean was broken at 4,000 ft MSL while maximum cloud tops were broken at 34,000 ft MSL (Tab F-2 and F-19). From 06:00:00 Z on the 16th to 12:00:00 Z on the 17th, isolated thunderstorms (1-2%) were predicted in the area (Tab F-2). No obscurations at flight level restricting visibility were predicted and freezing level was at 8,000 ft

MSL (Tab F-2). There is no evidence to indicate that the forecasted weather was a factor in this mishap.

b. Observed Weather

Leading up to the MA's mishap, the aircrew saw no significant weather factors along their route of flight (Tab R-8). Winds at the MA's flight level were prevailing out of the west ranging anywhere from roughly 82 to 110 knots with temperatures ranging from –32° Celsius (C) to –27°C (Tab AA-2). There is no evidence to indicate that the observed weather was a factor in the mishap.

c. Space Environment

The space environment is not applicable.

d. Operations

There is no evidence that the MA was operated outside of prescribed operational weather limitations.

8. CREW QUALIFICATIONS

The MC was fully qualified to fly in accordance with 20th Attack Squadron standards (Tabs G-224 to G-226, and K-61 to K-69). The training records and Letter of X (a form that displays what areas aircrew members are qualified in) show that the MC had received all the required training (Tabs G-18, G-159, G-224 to G-226). Training records also indicate that the MC was fully qualified in handling emergency procedures (Tabs G-18 and G-159).

a. Mishap Pilot (MP)

The MP was an MQ-9A instructor pilot, qualified to conduct close air support and air operations as well as maritime service warfare in accordance with 20 ATKS standards (Tabs G-23, G-225, and K-61 to K-69). The MP had 535.1 hours of MQ-9A flight time and 259.0 hours of MQ-9A simulator time around the time of the mishap (Tab G-23). The total flying hours/sorties for the previous increments of 30, 60, and 90 days are set forth below (Tab G-23).

Table 1. Mishap Pilot Hours and Sorties (G-23)

	Hours	Sorties
30 days	4.6	3
60 days	6	6
90 days	11.5	11

b. Mishap Sensor Operator (MSO)

The MSO was an experienced MQ-9A sensor operator, qualified to conduct close air support, air operations and maritime service warfare, strike coordination and reconnaissance, and combat search and rescue in accordance with 20 ATKS standards (Tabs G-226, G-228, and K-61 to K-69). The MSO had 684.1 hours of MQ-9A flight time and 225.7 hours of MQ-9A simulator time around the time of the mishap (Tab G-228). The total flying hours/sorties for the previous 30, 60, and 90 days are set forth below (Tab G-228).

Table 2. Mishap Sensor Hours and Sorties (G-228)

	Hours	Sorties
30 days	8.1	5
60 days	12.1	7
90 days	19.4	11

9. MEDICAL

a. Qualifications

All crew members were medically qualified for their specific duties at the time of the mishap (Tabs G-147 and G-157).

b. Health

No evidence indicates that any members' health contributed to the mishap (Tabs G-985, G-1000, G-1022, G-1058 to G-1060, G-1072, G-1076 to G-1078, V-3.3, and V-8.3).

c. Pathology

Toxicology test samples were collected from crew members after the mishap (Tab G-1130 and G-1134). The reports indicate that toxicology was not a factor in the mishap (Tab G-1130 and G-1134).

d. Lifestyle

No evidence indicates that lifestyle was a factor in the mishap (Tabs G-1058 to G-1069 and G-1076 to G-1087).

e. Crew Rest and Crew Duty Time

At the time of the mishap, AFMAN 11-202, Volume (V) 3, Flight Operations, 10 January 2022, required aircrew members to have proper crew rest prior to performing any duties involving aircraft operations (Tabs BB-2 to BB-3). Paragraph 3.1 of the applicable version of AFMAN 11-202 V3 defined crew rest periods as a minimum 12-hour non-duty period before the flight duty period begins (Tabs BB-2 to BB-3). Its purpose is to ensure the aircrew members adequately rest before performing duties or flight-related duties (Tabs BB-2 to B-3). Crew rest is defined as "free time and includes time for meals, transportation, and an opportunity for at least 8 hours of uninterrupted sleep" (Tabs BB-2 to BB-3). The MC verified they received adequate crew rest before the mishap on the required Operational Risk Management form (Tab G-151).

10. OPERATIONS AND SUPERVISION

a. Operations

There is no indication that the operations tempo or any other operational issues were a factor in this mishap (G-151).

b. Supervision

According to the Ops Sup on shift on the day of the mishap, the MC was current and qualified and followed the appropriate stepping procedures to fly on 16 December 2024 (Tabs V-7.3 to V-7.4). There is no evidence to indicate operations supervision was a factor in this mishap (G-151).

11. HUMAN FACTORS analysis

The AAIB considered all human factors as prescribed in the Department of Defense Human Factors Analysis and Classification System (DOD HFACS), Version 8.0, to determine whether any human factors were directly related to the mishap (Tabs BB-4 to BB-35). It was determined that human factors were not a factor in this mishap.

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publicly Available Directives and Publications Relevant to the Mishap

(1) AFI 51-307, Aerospace and Ground Accident Investigations, 18 March 2019, available at https://www.e-publishing.af.mil.

(2) AFI 51-307, Air Combat Command Supplement, Aerospace and Ground Accident Investigations, 3 December 2019, available at https://www.e-publishing.af.mil.

(3) AFMAN 11-2MQ-9 Volume 3, MQ-9-Operations Procedures, 12 Jan 2023, available at https://www.e-publishing.af.mil.

(3) Department of the Air Force Instruction (DAFI) 91-204, Safety Investigations and Reports, 10 March 2021, available at https://www.e-publishing.af.mil.

(4) AFMAN 11-202, Volume (V) 3, Flight Operations, 10 January 2022, available at https://www.e-publishing.af.mil.

(5) Human Factors Analysis and Classification System, Version 8.0, available at https://www.safety.af.mil/Divisions/Human-Factors-Divisions/HFACS/

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

b. Other Directives and Publications Relevant to the Mishap

(1) TO 1Q-9(M)A-1, Flight Manual, 22 February 2024.

c. Known or Suspected Deviations from Directives or Publications

There is no evidence to suggest that any directive or publication deviations occurred during this mishap.

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10 JULY 2025

RICK G. SCHUESSLER, Colonel, USAF
President, Abbreviated Accident Investigation Board

STATEMENT OF OPINION

MQ-9A, T/N 13-4225
MEDITERRANEAN SEA
16 December 2024

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.

On 16 December 2024, at approximately 17:00:00 Zulu time (Z), an MQ-9A Reaper, tail number 13-4225, descended from an assigned cruising altitude and impacted the water in the Mediterranean Sea. The Mishap Aircraft (MA) was launched from a location in the EUCOM Area of Responsibility (AOR) by a collocated Launch and Recovery Element (LRE) crew and after takeoff, control of the aircraft was transferred to a Mission Control Element (MCE) crew located at Whiteman Air Force Base, Missouri. At the time of the mishap, the aircraft was operated by members of the 20th Attack Squadron and the Mishap Crew (MC) comprised of Mishap Pilot (MP) and Mishap Sensor Operator (MSO). The mishap resulted in no reported injuries, no damage to civilian property and no fatalities. The MA was not recovered, and the loss of government property is valued at $13,154,585.00.

The MC was responsible for mission control operations for the MA. The MA was transferred to the MP and MSO from a previous MCE crew who assumed control from the LRE crew that launched the MA. None of the crew members prior to the MC reported anything unusual with the aircraft's performance that day.

At 17:00:18 (Z), at cruising air speed and altitude, the MA's engine torque display decreased from a normal operating range to a loss of torque within one second. Within a few seconds, engine speed reported by the Digital Electric Engine Control (DEEC) and engine speed reported by the Engine Fuel Interface Unit (EFIU) increased. Fuel flow rate decreased and a DEEC Health Bad – using backup indication was displayed in the Heads Down Display (HDD) after 5 seconds. The DEEC switched to backup mode and the MA experienced a loss of air speed and a gradual descent. At 17:00:46 Z, throttle input rapidly increased to full power, but torque did not increase. Over the 22 minutes following the loss of torque and thrust, the aircraft lost altitude, metal debris was detected in the engine oil, and an Engine – Metal Detected warning was displayed. Also, over this time, the MC executed multiple checklists to maintain aircraft control in an attempt to restore thrust to the aircraft.

Ultimately, the MC correctly assessed the engine as unrecoverable and, being outside glide range of the LRE airfield, the MC selected a clear area of water to conduct a forced landing of the MA. At 17:23:02 (Z), and still without torque or thrust, datalink was lost with the aircraft and the last received data indicated the MA would impact the surface shortly. The MA impacted the water in a remote location and without recovery.

1. Opinion Summary

On 16 December 2024, an MQ-9A Reaper with the tail number 13-4225, the MA, crashed into the Mediterranean Sea. The MA initially took off from a location in the EUCOM AOR before it experienced a sudden and permanent loss of thrust and descent. At the first indication of a malfunction, the MA was outside of glide range of the airfield for an engine out recovery. The MA belonged to the 432 Wing, Creech Air Force Base, Nevada. The MA was being operated by the MP and MSO, both of whom were assigned to the 20th Attack Squadron, Whiteman Air Force Base, Missouri, where they were physically located at the time of the mishap. The mishap resulted in no reported injuries, no damage to civilian property and no fatalities. The MA was not recovered, and the loss of government property is valued at $13,154,585.00.

2. Cause

As the Abbreviated Accident Investigation Board President (BP), I find, by a preponderance of the evidence, that the cause of the mishap was a failure within the Splined Coupling Assembly which led to a sudden and permanent mechanical decoupling of the propeller from the engine resulting in an unrecoverable loss of thrust. Data logs showed that immediately following the decoupling, the Digital Electronic Engine Controller (DEEC) and the Engine Fuel Interface Unit (EFIU) indicated different but accurate speeds, which can occur only if the propeller is decoupled from the engine. I find the cause of the decoupling was a failure within the Splined Coupling Assembly during flight. Therefore, but for the decoupling, the MA would not have experienced a sudden loss of torque, and the MC would not have had to perform the emergency procedures to attempt to restore thrust or to force land the aircraft into the water. General Atomics Aeronautical Systems Incorporated (GA-ASI) reported the Spiral Retaining Ring as the most likely cause of the Splined Coupling Assembly failure, but the definitive cause could not be discerned by a preponderance of the evidence because the wreckage was unrecoverable.

GA-ASI considered failure of the Spiral Retaining Ring most likely because of its history of excessive wear and failure. If the Spiral Retaining Ring wears excessively, the Splined Coupling can move aft toward the high-speed pinion (HSP) and apply more stress to a smaller portion of the gear splines. Eventually, the reduced engagement gear splines and subsequent higher stress would result in the decoupling of the propeller from the engine. The MA had logged about half the flight hours until the mishap engine would undergo another overhaul, which would include replacement of the Spiral Retaining Ring. This is a low number of hours to expect a ring failure when compared to the prior failure history of the Spiral Retaining Ring. Normally the Spiral Retaining Ring is replaced every 3,000 hours. There are multiple possible causes for early Spiral Retaining Ring wear but, without recovery of the physical evidence, none could be verified. Therefore, I could not discern the definitive cause of the failure within the Splined Coupling Assembly by a preponderance of the evidence because the wreckage was unrecoverable.

3. Substantially Contributing Factors

I find there was insufficient evidence indicating any substantially contributing factors.

4. Conclusion

I find by a preponderance of the evidence the cause of the mishap was the decoupling of the propeller from the engine due to a failure inside of the Splined Coupling Assembly. The most likely cause of the Splined Coupling Assembly failure was Spiral Retaining Ring failure but, without recovery of the physical evidence, Spiral Retaining Ring failure could not be verified. There was insufficient evidence to conclude there were any substantially contributing factors.

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10 July 2025

RICK G. SCHUESSLER, Colonel, USAF
President, Accident Investigation Board

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