

UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT
INVESTIGATION BOARD REPORT



MQ-9A, T/N 12-4177

3RD SPECIAL OPERATIONS SQUADRON
27TH SPECIAL OPERATIONS WING
CANNON AIR FORCE BASE, NEW MEXICO



LOCATION: UNDISCLOSED LOCATION
DATE OF ACCIDENT: 5 JULY 2016

BOARD PRESIDENT: LIEUTENANT COLONEL RICHARD H. WAGGONER

Conducted Pursuant to Chapter 11 of Air Force Instruction 51-503

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

**MQ-9A, T/N 12-4177
UNDISCLOSED LOCATION
5 JULY 2016**

On 5 July 2016, at 0408 Zulu (Z) time, an MQ-9A, tail number 12-4177, assigned to the 27th Special Operations Wing at Cannon Air Force Base (AFB), New Mexico, and deployed to an undisclosed location, crashed in an open area. While flying with the autopilot engaged, the aircraft experienced an uncommanded loss of thrust followed by an uncommanded descent. The Mishap Crew (MC), which consisted of two mishap pilots (MP1 & MP2) and one mishap sensor operator (MSO), were unable to regain normal engine control, but were able to guide the aircraft to a controlled crash, away from any persons, animals, cultivated plants, or manmade objects. The impact destroyed the MA with modifications, resulting in a loss valued at \$15,922,806. There were no fatalities or damage to private property.

The Abbreviated Accident Investigation Board President found by a preponderance of the evidence the cause of the mishap to be an unrecoverable failure of the on-engine fuel control unit which resulted in insufficient thrust to maintain flight under any circumstance. Further, the board was able to rule out other malfunctions, anomalies, or defects of the command/control datalink, fuel, aircraft, or ground control station and any encounter with adverse weather, foreign object, or hostile fire.

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

SUMMARY OF FACTS AND STATEMENT OF OPINION
MQ-9A, T/N 12-4177
5 July 2016

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ACRONYMS AND ABBREVIATIONS

3 SOS	3rd Special Operations Squadron	MAJCOM	Major Command
27 SOW	27th Special Operations Wing	MC	Mishap Crew
AAIB	Abbreviated Aircraft Investigation Board	MCE	Mission Control Element
AF	Air Force	MGCS	Mishap Ground Control Station
AFB	Air Force Base	MP	Mishap Pilot
AFE	Aircrew Flight Equipment	MSO	Mishap Sensor Operator
AFI	Air Force Instruction	NM	New Mexico
AFSOC	Air Force Special Operations Command	NSTR	Nothing Significant to Report
AFTO	Air Force Technical Order	ORM	Operational Risk Management
AGM	Air-to-Ground	RPA	Remotely Piloted Aircraft
FCU	Fuel Control Unit	SAR	Search and Rescue
GMT	Greenwich Mean Time	SOW	Special Operations Wing
IMDS	Integrated Maintenance Digital System	TCTO	Time Compliance Technical Order
KIAS	Knots Indicated Air Speed	T/N	Tail Number
Lt Col	Lieutenant Colonel	U.S.C.	United States Code
MA	Mishap Aircraft	Z	Zulu

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

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 29 December 2016, Major General Morris E. Haase, Vice Commander, Air Force Special Operations Command (AFSOC), appointed Lieutenant Colonel Richard H. Waggoner to conduct an Abbreviated Aircraft Accident Investigation Board (AAIB) of a mishap that occurred on 5 July 2016 involving an MQ-9A aircraft at an undisclosed overseas location (Tab Y-3). The AAIB was conducted in accordance with Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*, Chapter 11, at Cannon AFB, New Mexico, and Hurlburt Field, Florida, from 11 October 2016 through 17 March 2017. Board members included a Captain (Legal Advisor), a Senior Master Sergeant (Maintenance Member), and a Staff Sergeant (Recorder) (Tab Y-3).

b. Purpose

In accordance with AFI 51-503, *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 ground 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 5 July 2016, at 0408 Zulu (Z) time, the Mishap Aircraft (MA), an MQ-9A, tail number 12-4177, assigned to the 27th Special Operations Wing at Cannon Air Force Base (AFB), New Mexico, and deployed to an undisclosed location, crashed in an open area (Tab DD-7, 11). While flying with the autopilot engaged, the aircraft experienced an uncommanded reduction in torque and fuel flow followed by an autopilot-commanded descent to sustain airspeed (Tab DD-12). The descent from the commanded altitude caused an audible and visual alert to the Mishap Crew (MC), which consisted of two mishap pilots (MP1 & MP2) and one mishap sensor operator (MSO) (Tab R-5, 74). MP2, as the pilot flying, disabled the autopilot and turned away from manmade structures and personnel (Tab R-5, Tab DD-7). MP1 took over as pilot flying and an instructor pilot (MP3) entered the control station (Tab R-74). MP1, MP3, and MSO made unsuccessful attempts to regain control of the engine while gliding to the ground away from personnel and structures (Tab DD-7, 13). MA crashed in an open area, destroying the aircraft, two missiles, and additional modifications (Tab P-2 to P-4, Tab DD-7). The estimated value of the loss was \$15,922,806.00 (Tab P-4). There were no injuries or damage to private property (Tab P-3, Tab DD-7).

3. BACKGROUND

a. Air Force Special Operations Command (AFSOC)

AFSOC's primary mission is to organize, train and equip Airmen to execute global special operations as America's Air Commandos (Tab CC-3). AFSOC is one of ten Air Force major commands (MAJCOM) and is the Air Force component of United States Special Operations Command (Tab CC-3). AFSOC has more than 19,500 active duty, Air Force Reserve, Air National Guard, and civilian personnel operating in several subordinate units, including the 27th Special Operations Wing (Tab CC-4). The core missions of AFSOC include, among others, battlefield air operations, combat support, precision strike, information operations, specialized air mobility and intelligence, surveillance and reconnaissance (Tab CC-3).



b. 27th Special Operations Wing (27 SOW)

The 27 SOW, located at Cannon AFB, NM, conducts infiltration/exfiltration, combat support, tilt-rotor operations, helicopter aerial refueling, close air support, unmanned aerial vehicle operations, non-standard aviation, and other special missions (Tab CC-7). It directs the deployment, employment, training, and planning for squadrons that operate the AC-130W, MC-130J, CV-22B, C-146A, U-28A, MQ-1, MQ-9 and provides operational support to flying operations (Tab CC-7).



c. 3rd Special Operations Squadron (3 SOS)

The 3 SOS mission is to remotely employ MQ-9 Reaper aircraft from ground control facilities located at Cannon AFB, NM (Tab CC-11).



d. MQ-9A Reaper

The MQ-9A Reaper is an armed, medium-altitude, long endurance aircraft that is employed primarily to strike dynamic execution targets and secondarily for intelligence collection (Tab CC-13). The MQ-9A provides unique capabilities for strike coordination and reconnaissance against high value, fleeting and time sensitive targets because of its significant loiter time, wide-range sensors, multi-mode communications suite and precision weapons (Tab CC-13). In addition to its primary uses, the MQ-9A also performs close air support, combat search and rescue, target development and terminal air guidance, among others, making it uniquely qualified for irregular warfare operations (Tab CC-13). The MQ-9 can also employ up to four Air-to-Ground (AGM)-114 Hellfire missiles (Tab CC-13).



4. SEQUENCE OF EVENTS

a. Mission

The mission was an operational mission at an undisclosed location (Tab DD-7).

b. Planning

Mission planning was conducted without incident (Tab DD-7).

c. Preflight

Mishap Aircraft and Control Station preflight were conducted without incident (Tab R-196, 36).

d. Summary of Accident

On 5 July 2016, T/N 12-4177 was conducting an operational mission with the autopilot preprogrammed mode engaged, in clear weather with no indication of command/control datalink malfunction or hostile fire toward the aircraft (Tab DD-4-5, 7, 11).

At 03:53:10 Greenwich Mean Time (GMT) (all times shown in GMT), torque decreased, uncommanded, to 0%, and the aircraft began to descend (Tab DD-4, 12).

At 03:53:40 the MC disabled the autopilot and stall protection in accordance with the Loss of Control Prevent procedure (Tab J-4, Tab R-74, Tab DD-12).

At approximately 03:53:44 the MC turned away from inhabited areas and set the Power Control Lever full forward. Torque remained at 0% (Tab J-4, Tab R-184, Tab DD-7, 12).

At approximately 04:00:04, the MC momentarily selected backup engine control mode and then reselected automatic mode, which failed to return the engine to normal operation (Tab DD-13).

At approximately 04:05:52, the MC set the Condition Lever to Stop & Feather in accordance with the Engine Failure procedure, which feathered the propeller and cut fuel to the engine (Tab DD-13, Tab R-184).

The aircrew pitched down to increase airspeed in order to maximize aircraft damage on impact (Tab R-184).

At 04:08:12, the aircraft transmitted its last report as it impacted the ground and was destroyed (Tab DD-7, 14).

e. Impact

At approximately 04:08:12, the aircraft impacted the ground at 19.5° nose down, 1.2° left roll, 184 knots indicated air speed (KIAS), 3,646 feet per minute descent with the propeller feathered (Tab DD-14).

f. Egress and Aircrew Flight Equipment (AFE)

Not applicable.

g. Search and Rescue (SAR)

Not applicable.

h. Recovery of Remains

Not applicable.

5. MAINTENANCE

a. Forms Documentation

Review of Air Force Technical Order (AFTO) 781 series forms, which document maintenance actions and inspections, revealed MA's maintenance complied with applicable guidance and regulations (Tab D-2 to D-49). The use of time compliance technical orders (TCTOs) is the process for aircraft system changes, such as part and software upgrades. The Integrated Maintenance Digital System (IMDS), which tracks TCTO implementation, showed MA as current on all TCTOs as of the date of the mishap (Tab D-27).

No deficiencies were found in the MA or Mishap Ground Control Station (MGCS) forms documentation.

b. Inspections

All scheduled inspections for the MA were current and satisfactorily completed at the time of the mishap (Tab D-3 to D-4). The aircraft had 2668.0 flight hours and 740.5 engine hours on the day of the mishap (Tab D-2, 25). The last scheduled inspections completed on MA were a 28 day battery reconditioning completed on 29 June 2016 and 200 hour engine inspection completed at 563.9 engine hours on 6 June 2016 (Tab D-26, 25). The preflight inspection was completed at 2668.0 flight hours/731.5 engine hours with no discrepancies noted (Tab D-3).

All scheduled inspections for the MGCS were current and satisfactorily completed at the time of the mishap (Tab U-20). Preflight inspection was conducted 5 July 2016 (Tab U-6).

c. Maintenance Procedures

Maintenance procedures and practices for the MA and MGCS were in accordance with applicable technical orders.

d. Maintenance Personnel and Supervision

All maintenance personnel had appropriate training, qualification, and supervision

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

Samples analyzed from the fuel vehicle that serviced MA prior to flight were within limits (Tab D-76 to D-79). Fuel samples could not be obtained from MA due to its impact location.

f. Unscheduled Maintenance

There were no unscheduled maintenance issues on the MA or the MGCS relevant to the mishap.

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

MA was destroyed on impact and not recovered for structural analysis (Tab DD-11).

b. Evaluation and Analysis

(1) Analysis from General Atomics

Data log analysis indicated the airframe fuel system was operating normally throughout the mishap sequence. Analysis from engine vendor, Honeywell Aerospace, indicated a failure within the fuel control unit (FCU) most likely caused reduced fuel flow to the engine, causing the loss of engine torque. Honeywell reported this is the first known FCU failure of this type. This is the first MQ-9A loss attributed to an FCU failure (Tab DD-11).

(2) Analysis from Flight Simulation

Flight simulation showed the reduced fuel flow observed in the mishap, was equivalent to a zero thrust condition of a normally operating aircraft (Torque 0% and Engine Speed minimum). Therefore, the observed fuel flow in the mishap was insufficient to sustain flight under any circumstance (Tab DD-9).

7. WEATHER

a. Forecast Weather

Weather forecast at operating altitude was briefed to the aircrew by the 27th Special Operations Wing (SOW) weather personnel as follows: (Tab F-2)

- a. Winds: 250 at 50-70 knots
- b. Visibility: Clear
- c. Significant Weather: Nothing Significant to Report (NSTR)

b. Observed Weather

Weather observed at the initiation of the mishap sequence: (Tab F-3)

- a. Winds: 240 at 20 knots
- b. Visibility: Clear
- c. Significant Weather: NSTR
- d. Outside Air Temperature: -5 Celsius

c. Space Environment

Not applicable.

d. Operations

Not applicable.

8. CREW QUALIFICATIONS

Each crewmember was current and qualified to accomplish the specific tasks related to the mission (Tab G-6, 14, 16, 26, 35).

a. Mishap Pilot 1 (MP1) (Tab G 28-29)

	Hours	Sorties
30 days	64.7	17
60 days	100.9	29
90 days	144.0	43
RPA	783.3	
Total	832.7	

b. Mishap Pilot 2 (MP2) (Tab G 37-38)

	Hours	Sorties
30 days	105.3	17
60 days	162.0	27
90 days	198.5	40
RPA	306.8	
Total	395.0	

c. Mishap Pilot 3 (MP3) (Tab G 9-10)

	Hours	Sorties
30 days	16.9	12
60 days	25.0	18
90 days	35.3	29
RPA	1117.7	
Total	2836.9	

d. Mishap Senior Operator (MSO) (Tab G 19-20)

	Hours	Sorties
30 days	19.8	10
60 days	39.2	18
90 days	65.2	28
RPA	2897.9	
Total	2292.8	

9. MEDICAL

a. Qualifications

MP1, MP2, MP3, and MSO were medically qualified for flying duties at the time of the mishap. (Tab G-11, 21, 30, 39). There is no evidence to suggest physical or medical qualifications of the aircrew were factors in this mishap.

b. Health

There is no evidence to suggest the health of the aircrew was a factor in this mishap.

c. Pathology

Not applicable.

d. Lifestyle

There is no evidence to suggest patterns or behaviors for the aircrew were factors in the mishap.

e. Crew Rest and Crew Duty Time

There is no evidence to suggest crew rest or duty time of the aircrew were factors in the mishap.

10. OPERATIONS AND SUPERVISION

There is no evidence to suggest operations and supervision were a factor in this mishap.

11. HUMAN FACTORS ANALYSIS

Not applicable.

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

(1) AFI 11-2MQ-1&9, Volume 3, MQ-1 and MQ-9 Operating Procedures, 1 November 2012

(2) AFI 51-503, Aerospace and Ground Accident Investigations, 14 April 2015

(3) AFI 11-202, Volume 3, General Flight Rules, 07 November 2014

(4) AFI 91-204, Safety Investigations and Reports, 10 April 2014

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

None.

c. Known or Suspected Deviations from Directives or Publications

None.

17 MARCH 2017

RICHARD H. WAGGONER, Lt Col, USAF
President, Abbreviated Accident Investigation Board

STATEMENT OF OPINION

MQ-9A, T/N 12-4177 UNDISCLOSED LOCATION 5 JULY 2016

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

I find, by a preponderance of the evidence, that the cause of the mishap was on-engine fuel control unit failure which caused low fuel flow and thus insufficient thrust to maintain flight. Specifically, the most likely cause was the failure of the main metering valve to the minimum stop position due to failure of the bellows assembly or main metering valve. As the aircraft was not recovered, I developed my opinion by review of engineering analysis of flight data logs and through analysis of raw flight data, pre/post-flight control station records, aircraft records, and witness testimony.

2. CAUSE

The cause of the MQ-9 mishap on 5 July 2016 involving tail number 12-4177 was mechanical failure of the on-engine fuel control unit which resulted in low fuel flow and thus insufficient thrust to maintain flight. The AAIB reviewed engineering analysis and data logs recovered from the control station, aircraft/control station records, and witness testimony. The fuel source sample indicated no defects. Data logs and witness testimony gave no indication of encounter with adverse weather, foreign object, or hostile fire. Post flight inspection of the Control Station gave no indication of Control Station malfunction. Engineering analysis of data logs indicated no malfunction, anomaly, or defect of the command/control datalink, propeller system, aircraft fuel system, aircraft software, or Ground Control Station. Engineering analysis of data logs indicated that the on-engine fuel control unit experienced an uncommanded, irreversible restriction to fuel flow. As a result, the propeller governor appropriately reduced torque (thrust) to sustain the commanded engine speed. The flight manual does not address this malfunction, but the aircrew attempted, unsuccessfully, to restore engine operation. Fuel flow and torque after the malfunction were equivalent to a zero thrust condition on a normally operating aircraft. Thus, the post-malfunction thrust was insufficient to sustain flight under any circumstance.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

There were no substantially contributing factors in this mishap.

4. CONCLUSION

Engineering analysis of the data logs in this mishap provide convincing evidence that this mishap was caused by an unrecoverable failure of on-engine fuel control unit. There was no other malfunction, anomaly, or defect of the command/control datalink, fuel, aircraft, or Ground Control Station and no encounter with adverse weather, foreign object, or hostile fire. The post-failure thrust was insufficient to sustain flight under any circumstance.

17 MARCH 2017

RICHARD H. WAGGONER, Lt Col, USAF
President, Abbreviated Accident Investigation Board

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