UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

MQ-9A, T/N 08-4044

TWENTY-SEVENTH SPECIAL OPERATIONS WING
KANDAHAR INTERNATIONAL AIRPORT

LOCATION: AFGHANISTAN
DATE OF ACCIDENT: 18 NOVEMMBER 2015
BOARD PRESIDENT: LIEUTENANT COLONEL JOHN M. ROSS

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

ACTION OF THE CONVENING AUTHORITY

The report of the abbreviated accident investigation board, conducted under the provisions of AFI 51-503, that investigated the 15 November 2015 mishap near Kandahar International Airport, Afghanistan, involving MQ-9A, T/N 08-4044 assigned to the 27th Special Operations Wing, Cannon Air Force Base, New Mexico, complies with applicable regulatory and statutory guidance and on that basis is approved.

MORRIS E. HAASE
Major General, USAF
Vice Commander

20 Jan 17
Date

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION

MQ-9A, T/N 08-4044
AFGHANISTAN
18 November 2015

On 18 November 2015, at approximately 2338 Zulu (Z) an MQ-9A, tail number 08-4044, assigned to the 27th Special Operations Wing at Cannon Air Force Base (AFB), and deployed to Kandahar International Airport, crashed in an open field near the base after declaring an in-flight emergency (IFE) shortly after take-off. The Launch and Recovery Element mishap crew (MC), consisting of one mishap pilot (MP) and one mishap sensor operator (MSO), noticed high oil pressure, rising exhaust gas temperature, and fluctuating torque immediately upon take-off. The MC reported the IFE and attempted a recovery to the runway; however, complete engine failure occurred on the crosswind leg at approximately 500 feet above ground level. The mishap aircraft (MA) glided to a crash landing as the crew attempted to circle around to land. The impact destroyed MA, four missiles, and one bomb, resulting in a loss valued at $14,391,950. 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 a compressor bearing failure that led to engine loss. The Board President determined that the lack of an audible warning to indicate the high oil pressure associated with the bearing failure and the mishap crew's task saturation significantly contributed to the mishap.

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 08-4044
18 November 2015

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

1 LT	First Lieutenant
27 SOW	27th Special Operations Squadron
451 AEG	451st Air Expeditionary Group
62 ERS	62d Expeditionary Reconnaissance Squadron
89 ATKS	89th Attack Squadron
AAIB	Abbreviated Aircraft Accident Investigation Board
ACC	Air Combat Command
AF	Air Force
AFB	Air Force Base
AFE	Aircrew Flight Equipment
AFI	Air Force Instruction
AFSOC	Air Force Special Operations Command
AFTO	Air Force Technical Order
AGM	Air to Ground Missile
AMXS	Aircraft Maintenance Squadron
AO	Air Operation
ATC	Air Traffic Control
ATO	Air Tasking Order
CAPT	Captain
COMM	Communications
DL	Down Link
DO	Director of Operations
EGT	Exhaust Gas Temperature
EM	Emergency Mission
EP	Emergency Procedures
FL	Florida
GCS	Ground Control Station
GPS	Global Positioning System
HUD	Heads-Up Display
HQ	Headquarters
IFE	In-flight Emergency
IQT	Initial Qualification Training
IMDS	Integrated Maintenance Digital System
IR	Infrared
LRE	Launch and Recovery Element
Lt Col	Lieutenant Colonel
MA	Mishap Aircraft
Maj	Major
MAJCOM	Major Command
MC	Mishap Crew
MCE	Mission Control Element
MP	Mishap Pilot
MQT	Mission Qualification Training
MSgt	Master Sergeant
MSL	Mean Sea Level
MSN	Mission
MSO	Mishap Sensor Operator
NM	New Mexico
NOTAMs	Notices to Airmen
NV	Nevada
ORM	Operational Risk Management
RPA	Remotely Piloted Aircraft
SAR	Search and Recovery
SIB	Safety Investigation Board
SME	Subject Matter Expert
SOF	Special Operations Forces
SQ/CC	Squadron Commander
TBA	Training Business Area
TCTO	Time Compliance Technical Order
TDY	Temporary Duty
T/N	Tail Number
T/O	Take-off
TSgt	Technical Sergeant
Z	Zulu

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

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 25 July 2016, Major General Morris E. Haase, Vice Commander, Air Force Special Operations Command (AFSOC), appointed Lieutenant Colonel John Ross to conduct an Abbreviated Aircraft Accident Investigation Board (AAIB) of a mishap that occurred on 18 November 2015 involving an MQ-9A aircraft in Afghanistan (Tab Y-2). The AAIB was conducted in accordance with Air Force Instruction (AFI) 51-503, *Aerospace and Ground Accident Investigations*, Chapter 11, at Hurlburt Field, Florida, from 15 August 2016 through 12 September 2016. Initial board members included a Captain Legal Advisor, a Master Sergeant Maintainer and a Master Sergeant Recorder (Tab Y-2). A Subject Matter Expert, a Captain Pilot, was also appointed to assist the board. (Tab Y-4). On 12 August 2016, the Convening Authority replaced the Captain Legal Advisor with a Major Legal Advisor. (Tab Y-5)

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 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 18 November 2015, at approximately 2338 Zulu (Z) time (19 November 2015, 0408 local time), an MQ-9A, tail number 08-4044, assigned to the 27th Special Operations Wing at Cannon Air Force Base (AFB), New Mexico, and deployed to Kandahar International Airport, crashed in an open field near the base after declaring an in-flight emergency (IFE) shortly after take-off. (Tab V-11, Tab DD-4) The Launch and Recovery Element (LRE) mishap crew (MC), consisting of one mishap pilot (MP) and one mishap sensor operator (MSO), noticed high oil pressure immediately upon take-off, declared an IFE, and attempted a left-traffic pattern return to the active runway. (Tab N-4, Tab V-4 and Tab V-6) The mishap aircraft (MA) crashed on left crosswind north of the airfield, destroying the aircraft, four missiles and one bomb. (Tab N-4 to N-5, Tab P-2) The estimated value of the loss was $14,391,950. (Tab P-2) There were no fatalities or damage to private property. (Tab P-2)

3. BACKGROUND

MP and MSO are assigned to the 89th Attack Squadron at Ellsworth Air Force Base AFB, South Dakota, previously the 432d Attack Squadron. (Tab G-6, Tab G-15, Tab CC-14) MP and MSO were deployed to the 62d Expeditionary Reconnaissance Squadron at the time of the mishap, part

of the 451st Expeditionary Operations Group at Kandahar International Airport, Afghanistan. (Tab G-2 to G-3 and Tab G-11 to G-12) MA belonged to the 27th Special Operations Wing, Cannon AFB, but was on loan to Air Combat Command and forward deployed to Kandahar International Airport. (Tab DD-3)

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-2). AFSOC is one of ten Air Force major commands (MAJCOM) and is the Air Force component of United States Special Operations Command (Tab CC-2). 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-3 to 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-2).

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. 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-8)

c. 451st Air Expeditionary Group (451 AEG)

The 451 AEG provides a persistent and powerful airpower presence in the Afghanistan area of operations. The 451 AEG Airmen provide world-class close air support, intelligence, surveillance and reconnaissance, command and control, and airborne datalink capabilities whenever and wherever needed. The group operates the E-11, MQ-1B Predator, and MQ-9 Reaper at Kandahar and Jalalabad airfields. (Tab CC-12)

d. 89th Attack Squadron (89 ATKS)

The 89 ATKS mission is to remotely employ MQ-9 Reaper aircraft from ground control facilities located at Ellsworth AFB, providing combatant commanders with actionable precision reconnaissance capabilities for time critical targets, air interdiction, close air support, and strike coordination. (Tab CC-14)

e. 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-16). 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-16). 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-16). The MQ-9 can also employ up to four Air-to-Ground (AGM)-114 Hellfire missiles (Tab CC-16).

4. SEQUENCE OF EVENTS

a. Mission

The scheduled mission for the MC was launch the MA and perform a hand over to a mission coordination element (MCE) crew (Tab V-2 and Tab V-8).

b. Planning

The MC received the mission tasking from squadron leadership at the 62d Expeditionary Reconnaissance Squadron at Kandahar. (Tab K-2 to K-3) The MC, per standard operating procedures, planned to execute the preflight, taxi, takeoff and handover of the MA to the MCE. (Tab V-2 and Tab V-8)

c. Preflight

Prior to the scheduled 2330Z take-off, the MC reviewed currencies, Notices to Airmen (NOTAMs), and weather reports (Tab V-9).

d. Summary of Accident

At 2325Z, MC called for taxi to runway 5 at Kandahar airfield. (Tab N-3) During taxi, MP noted that the aircraft's speed was difficult to control due to a sensitive throttle, with power fluctuating between 1% and 18%. (Tab N-2, Tab V-4) Approaching the runway via Golf 5 taxiway, MC called ready for takeoff and Kandahar tower cleared MA for takeoff at 2333Z. (Tab N-3 to N-4) After noticing that applying full brakes did not hold the aircraft, MP initiated the takeoff roll, observing no aircraft generated warnings prior to takeoff. (Tab N-2, Tab V-10 to V-11) Reaching rotate speed, MSO called "rotate", MP echoed "rotating", and MA lifted off the runway. (Tab N-2) MSO subsequently called out "oil pressure high: abort abort abort"; however, MA did not have sufficient runway available to immediately land. (Tab N-2, Tab V-5, Tab V-11) MA continued the climb while oil pressure and exhaust gas temperature continued rising. (Tab N-2, Tab V-11) MC declared in IFE and requested a left turn to join the left downwind at 2336Z with the intention of joining the traffic pattern and landing MA on Runway 5. (Tab N-4, Tab V-6, Tab V-11) Kandahar Tower approved the request, and MA commenced a 90-degree turn to the left. (Tab N-4, Tab J-19, Tab V-11) MA climbed to approximately 500 feet above ground level, at which time the engine torque dropped to 0%, the engine briefly restarted, and then again went to 0% torque, at which time MP feathered the propeller per regulation. (Tab J-3, Tab J-4, Tab V-6, Tab V-11) MA glided to a crash landing northeast of the airfield approximately 30 seconds after engine failure. (Tab J-4)

e. Impact

MA impacted the ground north of Kandahar Airfield. (Tab N-4)

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 U-2 to U-6 and Tab U-8 to U-13) 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 U-2 to U-6 and Tab U-8 to U-13)

b. Inspections

All scheduled inspections were current and satisfactorily completed at the time of the mishap. (Tab U-2 to U-6 and Tab U-8 to U-13) MA had 11,137.2 flight hours on the day of the mishap. (Tab D-2, Tab U-3) The last scheduled inspections completed on MA were a 200 hour airframe and a 200 hour engine inspection. (Tab D-2, Tab D-10) Maintenance completed the inspections at 11,042.2 flight hours with no discrepancies noted. (Tab D-2, Tab D-10)

c. Maintenance Procedures

Maintenance procedures and practices were in accordance with applicable technical orders.

d. Maintenance Personnel and Supervision

All maintenance personnel had the appropriate supervision and the preflight inspection and servicing of MA was in accordance with applicable technical orders. The only point of interest is a discrepancy in the Training Business Area as to dates and member initials. (Tab T-3 to T-4) There is no indication that this is relevant to the mishap.

e. Fuel, Hydraulic, and Oil Inspection Analyses

Response teams collected post-mishap fuel and oil samples from MA, along with a sample from the fuel vehicle that serviced MA. (Tab J-13 to J-14). All sample results were within limits (Tab J-13 to J-14).

f. Unscheduled Maintenance

There were no unscheduled maintenance issues relevant to the mishap (Tab U-2 to U-6 and Tab U-8 to U-13).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

The Interim Safety Board recovered MA for post-mishap analysis of its components. The Safety Investigation Board submitted the first stage turbine blades, second stage compressor blades, oil pressure regulator, prop pitch control aft cover port, deswirl vane, chip detector housing, fuel oil heater cooler, gear box scavenger pump housing, and compressor bearings for spectral and micro level analysis. (Tab J-23 to J-24) Additionally, the manufacturer of MA, General Atomics, analyzed data from 34 minutes of flight up to the moment of impact at 2338Z. (Tabs J-1 to J-6) The data showed low engine performance throughout the flight and erratic torque prior to takeoff. (Tab J-4) Data showed increasing oil pressure at 30 minutes into the data log, approximately three minutes 20 seconds prior to takeoff, reaching the yellow caution zone and then the red warning zone prior to engine shutdown. (Tab J-4) Approximately one minute 30 seconds after takeoff, the torque spiked and then went to zero, at which time automatic restart activated. (Tab J-3) Torque increased, automatic restart ceased, and four seconds later torque once again went to zero. (Tab J-3) Data logs continued during the remaining 30 seconds until MA impacted the ground. (Tab J-4)

b. Evaluation and Analysis

(1) Previous Similar Mishaps

Not applicable.

(2) Flight Simulation

The AAIB Board President performed an MQ-9A flight simulation at Hurlburt Field, FL, in the 2d Special Operations Squadron Predator Mission Aircrew Training System to replicate the high oil pressure malfunction. (Tab DD-2) The MQ-9A did not have an audible alert associated with either the caution or the warning. (Tab V-4, Tab DD-2) Additionally, the location of the gauges was not conducive to easily recognizing the caution or warning. (Tab DD-2)

7. WEATHER

a. Forecast Weather

The forecasted weather for 18 November 2015, 2300-2359Z, was few clouds at 280, temperature 50 degrees Fahrenheit, winds 050 at 10 knots. (Tab F-2)

b. Observed Weather

On the day of the mishap, the observed weather was clear, temperature 52 degrees, winds 070 at 9 knots. (Tab F-8)

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-21, Tab G-37).

a. Mishap Pilot

MP was a current and qualified pilot in the MQ-9A. (Tab G-4) She had 629.6 total flight hours, which includes 541.2 hours in the MQ-9. (Tab G-4) MP showed several ground events overdue however, there is no evidence to indicate crew qualifications were a factor in the mishap. (Tab G-32)

Recent flight time is as follows (Tab G-5, G-8):

	Hours	Sorties
Last 30 Days	47.0	64
Last 60 Days	56.4	84
Last 90 Days	56.4	84

b. Mishap Sensor Operator

MSO was a current and qualified Sensor Operator in the MQ-9A. (Tab G-37) He had 1004.3 total Remotely Piloted Aircraft flight hours. (Tab G-13) MSO showed several ground events overdue however, there is no evidence to indicate crew qualifications were a factor in the mishap. (Tab G-49) Recent flight time is as follows (Tab G-14):

	Hours	Sorties
Last 30 Days	18.2	45
Last 60 Days	53.1	100
Last 90 Days	63.5	145

9. MEDICAL

a. Qualifications

(1) Mishap Pilot

MP was medically qualified for flying duties at the time of the mishap. (Tab G-6) There is no evidence to suggest physical or medical qualifications of MP were factors in this mishap. (Tab G-6)

(2) Mishap Sensor Operator

MSO was medically qualified for flying duties at the time of the mishap. (Tab G-15) There is no evidence to suggest physical or medical qualifications of MSO were factors in this mishap. (Tab G-15)

b. Health

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

c. Pathology

Not applicable.

d. Lifestyle

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

e. Crew Rest and Crew Duty Time

MP and MSO had adequate crew rest at the time of the mishap. (Tab V-3, Tab V-5, Tab V-8, Tab V-9, Tab V-10 to V-11). While they were at the end of their duty day, there is no evidence to suggest crew rest or crew duty time were factors in this mishap. Additionally, MP's comment that "We're both out of it. Probably weren't the good choice for the last crew to takeoff today" once explained by MP and MSO did not indicate that any major problems existed with the crew. (Tab V-5, Tab V-11)

10. OPERATIONS AND SUPERVISION

a. Operations

There is no evidence to suggest that the operations tempo or experience level of MC were factors in the mishap.

b. Supervision

There is no evidence to suggest supervision was a factor in the mishap.

11. HUMAN FACTORS ANALYSIS

a. Preconditions are factors in a mishap if active and/or latent preconditions such as conditions of the operators, environmental or personnel factors affect practices, conditions or actions of individuals and result in human error or an unsafe situation. (Tab BB-11)

(1) Environmental Factors are factors in a mishap if physical or technological factors affect practices, conditions and actions of individual and result in human error or an unsafe situation. (Tab BB-11)

(2) Technological Environment is a factor in a mishap when cockpit/vehicle/control station/workspace design factors or automation affect the actions of individuals and result in human error or an unsafe situation. (Tab BB-12)

(3) Condition of Individuals is a factor in a mishap if cognitive, psycho-behavioral, adverse physical state, or physical/mental limitations affect practices, conditions or actions of individuals and result in human error or an unsafe situation. (Tab BB-13)

(4) Cognitive Factors are factors in a mishap if cognitive or attention management conditions affect the perception or performance of individuals and result in human error or an unsafe situation. (Tab BB-13)

b. Applicable Environmental Factors/Technological Environment Factors

(1) PE202 Instrumentation and Sensory Feedback Systems: Instrumentation and Sensory Feedback Systems is a factor when instrument factors such as design, reliability, lighting, location, symbology or size are inadequate and create an unsafe situation. This includes Night Vision Displays, Heads-Up Display, off-bore-site and helmet mounted display systems and inadequacies in auditory or tactile situational awareness or warning systems such as aural voice warnings or stick shakers. (Tab BB-12 to BB-13)

(2) Per a warning in the checklist, high oil pressure is associated with impending engine loss. (Tab V-5) The MQ-9A provides a visual signal for high oil pressure in both the Heads-Up Display and the Heads-Down Display; however, it does not provide an auditory or tactile warning. Accordingly, the pilot and sensor operator must look at the gauges in order to determine if the oil

pressure is too high and may not recognize the condition prior to engine failure. (Tab V-4, Tab DD-2)

c. Applicable Conditions of Individuals/Cognitive Factors

(1) PC103 Cognitive Task Oversaturation: Cognitive Task Oversaturation is a factor when the quantity of information an individual must process exceeds their cognitive or mental resources in the amount of time available to process the information. (Tab BB-14)

(2) Prior to the mishap, MP noticed that the brakes were not working effectively on MA. (Tab V-10) She chose to accomplish the final checklist steps while MA was taxiing. (Tab V-10) Concurrently, the tower provided a weather report differing from the pre-briefed weather. (Tab V-7, Tab V-10) While winds had not been a factor during the deployment, the tower reported significant gusts, requiring MC to recalculate some of the flight parameters. (Tab V-7, Tab V-10) The checklist and recalculations distracted MC and they did not notice the visual-only caution and warning of high oil pressure until takeoff. (Tab V-4) At that point, there was insufficient runway to put the aircraft back down and MA lost its engine prior to completing an emergency landing. (Tab V-11)

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*, 10 August 2016

(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. Known or Suspected Deviations from Directives or Publications

None.

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12 SEPTEMBER 2016

JOHN M. ROSS, Lt Col, USAF
President, Accident Investigation Board

United States Air Force Abbreviated Accident Investigation Board Report

STATEMENT OF OPINION

MQ-9A, T/N 08-4044
Afghanistan
18 November 2015

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. SUMMARY

I find, by a preponderance of the evidence, that the cause of the mishap was compressor bearing failure, which led to high oil pressure and ultimately engine failure. I did not have sufficient evidence to determine the precise cause of the bearing failure. I developed my opinion by analyzing factual data from historical records, Air Force directives and guidance, engineering analysis, witness testimony, flight data, and information provided by technical experts.

2. BACKGROUND

At 2325 Zulu (Z), the Mishap Crew (MC) called for taxi to runway 5 at Kandahar airfield. During taxi, the Mishap Pilot (MP) noted that the aircraft's speed was difficult to control due to a sensitive throttle with power fluctuating between 1% and 18%. Approaching the runway via Golf 5 taxiway, the MC called ready for takeoff and Kandahar tower cleared the Mishap Aircraft (MA) for takeoff at 2333Z. After noting that full brakes did not hold the aircraft, MP initiated the takeoff roll, observing no warnings prior to takeoff. Reaching rotate speed, the Mission Sensor Operator (MSO) called "rotate," MP echoed, "rotating," and MA lifted off the runway. MSO subsequently called out, "oil pressure high: abort, abort, abort"; however, MA did not have sufficient runway available to immediately land. MA continued the climb while oil pressure and exhaust gas temperature continued rising. MC declared an IFE and requested a left turn to join the left downwind at 2336Z with the intention of joining the traffic pattern and landing MA on Runway 5. Kandahar Tower approved the request, and MA commenced a 90-degree turn to the left. MA climbed to approximately 500 feet above ground level, at which time the engine torque dropped to 0%, the engine briefly restarted, and then again went to 0% torque, at which time MP feathered the propeller per regulation. MA glided to a crash landing northeast of the airfield approximately 30 seconds after engine failure.

2. CAUSE

The cause of the MQ-9A, tail number 08-4044, mishap, by a preponderance of the evidence, was compressor bearing failure, leading to high oil pressure, and ultimately engine failure. The AAIB reviewed the expert analysis of compressor bearing breakdown, spectral scans of the recovered

engine parts and data log parameters of the engine systems from engine start through impact with the ground. Data provided from the stuck oil pressure regulator, turbine, and compressor blades showed metal residue indicative of bearing failure, and the bearings themselves showed flat spots and heat stress from metal on metal contact. Additionally, the MQ-9 expanded checklist has a warning regarding high oil pressure being indicative of a failed compressor bearing. The experts were unable to determine if heat related bearing wear occurred prior to or during the engine failure event on 18 November 2015.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

The crew failed to notice a high oil pressure warning during taxi and takeoff. Data logs show that the oil pressure began to climb for approximately 3 minutes and 20 seconds prior to takeoff, remaining in the red for 30 seconds prior to brake release, hence the MC had at least 30 seconds prior to brake release to notice the high oil pressure.

An audible tone does not accompany the warning indication for high oil pressure. The oil pressure gage turns yellow and then red at set parameters; and the oil pressure in the "head's down display" is highlighted yellow and red to correspond with the parameters. However, during a re-creation of the malfunction in the simulator, I found both of these locations easy to miss, especially when task saturated running checklists, taxiing, and preparing for departure.

Task saturation. Both the MP and MSO commented during interviews that they, "got a weird wind call" because they received a report of gusty winds from the tower even though forecast and observed weather prior to flight showed 10 and 9 knot winds, respectively. Additionally, MC noted that MA was challenging to taxi based on several factors, including weight, throttle response, and fluctuating torque. MC noted that each aircraft taxis differently, but this aircraft on that night was noticeably more challenging.

4. CONCLUSION

Overall, MC actions from engine start through MA impact were not causal. If MC had immediately recognized the high oil pressure during taxi or prior to takeoff, the mishap would not have occurred. However, based on my experience as an aviator, the contributing factors listed above, and the simulator scenario I conducted, it is highly plausible that MC simply did not see either the high oil pressure caution or the warning prior to takeoff, and there was no audible tone to alert the MC of the issue. Therefore, I found, by a preponderance of the evidence, that the cause of the mishap was compressor bearing failure, which led to high oil pressure and ultimately engine failure.

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12 SEPTEMBER 2016

JOHN M. ROSS, Lt Col, USAF
President, Accident Investigation Board

United States Air Force Abbreviated Accident Investigation Board Report

INDEX OF TABS

United States Air Force Abbreviated Accident Investigation Board Report