AIRCRAFT ACCIDENT INVESTIGATION REPORT

CRASH SHORTLY AFTER TAKE-OFF

CARIBBEAN AVIATION TRAINING CENTER

TRAINING FLIGHT

TEXTRON AVIATION INC. (FORMERLY CESSNA) 172N

UNITED STATES REGISTRATION N101KA

11 SEAVIEW AVENUE & ADJOINING PREMISES, GREENWICH FARM, KINGSTON 13, JAMAICA

10 NOVEMBER 2016

REPORT NUMBER JA-2016-01

Investigation conducted by the Jamaica Civil Aviation Authority.

Accredited Representative: The National Transportation Safety Board of the United States of America (NTSB).

In accordance with Annex 13 to the *Convention on International Civil Aviation*, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the prevention of accidents and incidents.

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ABBREVIATIONS

AAJ	Airports Authority of Jamaica
ABN	Aerodrome Beacon
AD	Airworthiness Directive
AFFF	Aqueous Film-forming Foam
AIP	Aeronautical Information Publication
AMO	Approved Maintenance Organization
ARFFS	Airport Rescue and Fire Fighting Services
ATC	Air Traffic Control
ATO	Approved Training Organization
ATS	Air Traffic Services
AVGAS	Aviation Gasoline
AWOS	Automated Weather Observation System
CASORTS	Civil Aviation Safety Oversight Reporting and Tracking System
CATC	Caribbean Aviation Training Center
CFR	Code of Federal Regulations
ICAO	International Civil Aviation Organization
JCAA	Jamaica Civil Aviation Authority
FAA	Federal Aviation Administration
FSAM	Flight Safety Administration Manual
FSD	Flight Safety Division
FTU	Flight Training Unit
IT	Information Technology
L/H	Left Hand
MANOPS	Manual of Operations
MAS	Manual of Aerodrome Standards
MCM	Maintenance Control Manual
MCTOW	Maximum Certificated Take-off Weight
MEL	Minimum Equipment List
MKTP	Tinson Pen Aerodrome (ICAO Designator)
NMIAL	Norman Manley International Airport Limited
NTSB	National Transportation Safety Board
OPSPEC	Operations Specification
R/H	Right Hand
RWY	Runway
SARPS	Standards and Recommended Practices
UAV	Unmanned Aerial Vehicle
UHF	Ultra High Frequency
VHF	Very High Frequency

1.0 Factual Information

1.1 History of the flight

N101KA History of the Flight

On November 10, 2016, about 1:35pm local time, a Textron Aviation Inc. (formerly Cessna) aircraft, model 172N, registration N101KA operated by Caribbean Aviation Training Center, impacted terrain after loss of control following takeoff from runway 14 at the Tinson Pen Aerodrome. The student pilot, flight instructor and rear passenger (also a student pilot) were fatally injured. Visual Meteorological Conditions existed at the time, and a VFR[1] flight plan had been filed. The flight was operated under the provision of the Civil Aviation Regulations, the Ninth Schedule – Approved Training Organizations.

At approximately 1:27pm, Air Traffic Control (ATC) received flight plan details from the aircraft, there were three (3) persons on board, three (3) hours of fuel, destined for the Old Harbour Bay training area with a total estimated flight time of one (1) hour.

Prior to takeoff, ATC passed information to the airplane regarding aerodrome traffic, surface winds, altimeter setting and also information regarding drone[2] operation observed on the premises in the vicinity of runway 14 and taxiway Alpha.

At approximately 1:31pm the aircraft departed the runway 14, there was no further communication between the aircraft and ATC after takeoff.

The Flight Instructor occupied the right front seat and one of the Student Pilot's occupied the left front seat, while the other Student Pilot was in the rear passenger seat.

Ground witnesses observed the airplane take off from the aerodrome via runway 14. The witnesses, one of whom was a licensed pilot, stated that they saw the aircraft rotate abeam the Sandals hangar, shortly after take-off, a noticeable change in the sound of the engine was heard, which sounded like a partial power loss, after pitching up, it was observed that the nose of the aircraft was pitched downward as if trying to gain airspeed down the runway. It then pitched back up and started to climb slowly above the tree line, the aircraft began to turn to the left, that is toward the North, at approximately 200 feet above ground level, the airplane was observed to spin[3] and descend to the ground in a near vertical flight path. The impact occurred approximately 1,870 feet from the hard surface at departure end of runway 14 in a residential neighborhood. The absence of damage to the house on the property where the aircraft came to rest, the orientation of the aircraft, as well as the absence of any horizontal drag markings at the area of impact

[1] Visual Flight Rules
[2] Unmanned Aerial Vehicle
[33] A spin is a special category of stall resulting in autorotation about the vertical axis and a shallow, rotating downward path.

support eyewitness reports that the final flight path of the aircraft prior to impact was near vertical.

1.2 Injuries to Persons

Table 1. Injury Chart.

Injuries	Flight Crew	Flight Attendants	Passengers	Other	Total
Fatal	2		1		3
Serious					
Minor/None					
Total	2		1		3

1.3 Damage to Aircraft

The aircraft was destroyed by impact with the ground, the airplane interior and some external skin and flight control surfaces were extensively damaged by fire.

1.4 Other Damage

The airplane damaged a section of zinc fencing which separated the housing lots where the aircraft came to rest, the fence and a previously burnt out structure were also damaged by the fire.

The R/H wing leading edge and lower wing skin made contact with an outside kitchen on the premises of the property where the airplane came to rest.

There was fire damage to the bonnet, roof and forward section of a small black and white motor vehicle parked in the adjoining property where the aircraft came to rest, the windscreen was also cracked.

1.5 Personnel Information

The Instructor's last Jamaica Civil Aviation Authority (JCAA) Medical Records contained the following:

- Last Medical: March 3, 2016
- First Class
- Weight: 165 1bs ; Height: 72 inches
- No limitations
- No medications
- Vision: 6/6
- Color vision and hearing tests: passed

The instructor held a valid Commercial Pilot Licence. His Instrument Rating was valid until June 1, 2018; his Flight Instructor Rating was valid until February 1, 2017, his Class 1 Medical was valid until March 21, 2017 and he had approximately 220 total instruction hours.
The Student Pilot's last Jamaica Civil Aviation Authority (JCAA) Medical Records contained the following:

- Last Medical: August 29, 2015
- Second Class
- Weight: 134 lbs; Height: 68 inches
- No limitations
- No medications
- Vision: 6/6
- Color vision and hearing test: passed

The Student Pilot held a valid Student Pilot Licence which was valid until May 24, 2018; his Class 2 Medical was valid until August 31, 2020.

The passenger's (who was also a Student Pilot), last Jamaica Civil Aviation Authority (JCAA) Medical Records contained the following:

- Last Medical: August 31, 2015
- Second Class
- Weight: 112 lbs; Height: 68 inches
- No limitations
- Medication: Ventolin as needed
- Vision: 6/6
- Color vision and hearing test: passed

The passenger held a valid Student Pilot licence which was valid until February 1, 2018; his Class 2 Medical was valid until August 31, 2020.

Both Flight Information Officers (FIO's) had less than one year of service with the Jamaica Civil Aviation Authority and had current Flight Information Officer Permits provided in accordance with the requirements of the Civil Aviation Regulations 2012, Regulation 206. During their Abbreviated Aerodrome Control Course conducted at the Jamaica Civil Aviation Authority Training Institute, the FIO's had been exposed to the Phases of Emergency and Search and Rescue.

The maintenance personnel who certified the 200 hour/annual, 100 hour and 50 hour inspection were appropriately certified by the Federal Aviation Administration (FAA).

1.6 Aircraft Information

The Aircraft was manufactured by Cessna Aircraft Company (now Textron Aviation Inc.) in 1979, under Production Certificate No. 4. It was a Model 172N, with Serial No. 17272754. The Type Certificate Data Sheet Number is 3A12.

The Certificate of Registration was issued on February 13, 2014, with an expiration date of February 29, 2020 to MUSTANG SALLY AVIATION LLC with registration markings N101KA.

The Certificate of Airworthiness was issued on May 23, 1979 in the Normal & Utility Categories.

The last scheduled inspection conducted on the aircraft was a 50 hour inspection which was accomplished on September 26, 2016 at a stated Aircraft Total Time of 11216.2 hours. The aircraft was operated for approximately 36.6 hours since the last inspection.

The last 100 hour inspection conducted on the aircraft was accomplished on June 24, 2016 at a stated Aircraft Total Time of 11169.1 hours

The last 200 hour/ Annual inspection conducted on the aircraft was accomplished on January 12, 2016 at a stated Aircraft Total Time of 11084.0 hours

On November 10, 2016 some of the maintenance records were collected from the operator's facility at Tinson Pen Aerodrome, these included the current airframe, engine and propeller logbooks. Additional maintenance records were provided by the operator on December 1, 2016, however to date not all the maintenance records for the aircraft have been provided.

1.6.1 Engine

The engine fitted to the aircraft was manufactured by Lycoming under Production Certificate 3 as a Model O-320-H2AD and certified under Type Certificate E-274. Engine Serial Number L-3872-76 was manufactured as new on March 31, 1978. The engine records indicate that it was installed on Cessna 172N aircraft with registration markings N737NG on April 6, 1978. An entry dated February 23, 1993 (engine total time: 972.3) in the engine records reflects that the camshaft, main bearings, all lifters, No. 2 engine cylinder push rods and rocker arms were replaced; it also stated that the No. 2 cylinder was repaired by J & J Air Parts Inc. (Repair Station No. JE2R921K). A FAA Form 337 (Major Repair & Alteration) on file in Oklahoma City (FAA Aircraft Registration Branch) for N737NG indicates that the engine (S/N L-3872-76) was removed from that aircraft on May 18, 2015. There was no entry seen in the engine logbook for the removal of the engine from that aircraft. A maintenance entry in the current engine logbook states that the engine was overhauled on June 17, 2014 by One Stop Aviation (Repair Station No. XR3R981L) under Work Order 25624 with an engine total time recorded as 1580.3 hours as seen in Exhibit No. 1, however no Authorised Release Certificate nor a copy of the work order has been produced to date despite numerous requests made to the operator. The Repair Station was contacted in order to obtain a copy of the work order; in their response it was reported that the maintenance entry was forged and that they did not have any information regarding this engine. The aircraft records state that the engine was fitted to the aircraft on October 16, 2015 at Airframe Total Time 11084 hours (aircraft tach time 1084.0). The engine time run since installation on the aircraft was approximately 168.8 hours. The engine total time could

not be ascertained from the records provided. The engine manufacturer's recommended time between overhaul (TBO) is 2000 hours or 12 years.

1.6.2 Propeller

The propeller fitted to the aircraft was manufactured by McCauley Propeller Systems under Production Certificate No. 3 as Model 1C160/DTM7557M1 and certified under Type Certificate P-910. Propeller Serial Number 725953 was fitted to the aircraft, no Authorized Release Certificate had been provided by the operator for this propeller. The Propeller records reflect that the propeller was fitted to the aircraft on October 26, 2015 at a stated Propeller Total Time of 751.3 hours. The time since last propeller overhaul or calendar time since last propeller overhaul could not be ascertained from the records provided. The propeller manufacturer's recommended time between overhaul (TBO) is 2000 hours or 72 calendar months whichever comes first.

1.6.3 Fuel

The fuel type onboard the aircraft was 100LL/100 minimum grade aviation gasoline which is the fuel authorized by the aircraft manufacturer. The amount of fuel onboard the aircraft prior to take-off was 33 gallons, the fuel distribution was 15 gallons in the left wing tank and 18 gallons in the right wing tank.

1.6.4 Maintenance Program

The aircraft was being maintained under a maintenance program approved by the Jamaica Civil Aviation Authority for a similar Textron Aviation Inc. aircraft, Model: 172N, Serial No. 17272213, Reg. No. 6Y-JCH which was on the Jamaican aircraft registry.

There were a number of Corrosion Prevention and Control Program Inspections introduced by Temporary Revision No. 7 of the Service Manual for the aircraft, dated December 1, 2011 which were itemized in the Special Inspection & Yearly Items Record in the ADLOG Aircraft Maintenance Records, however, there was no entry made in these records or "dirty finger print paperwork" provided by the operator for a number of these inspections to reflect that they were accomplished. Examples of these include Inspection Operation No. 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 19, 21, 22, 23, 24 & 26.

1.6.5 Airworthiness Directives

The Airworthiness Directive (AD) records presented for the aircraft were found to be incomplete. Compliance for a number of engine AD's could not be confirmed, some of them had a compliance date listed as September 1, 2007, however the engine records state that engine S/N L-3872-76 was installed on October 16, 2015, another AD record indicated compliance for a different engine serial number.

1.6.6 Special Inspection Items

The maintenance records presented reflect that the Pitot/Static Check and Transponder checks were last accomplished on August 18, 2014. In accordance with the United States Code of Federal Regulations 14 CFR Part 91. 411 & 91.413, these tasks are due every 24 calendar months.

A number of the Special Inspection sheets presented were not filled out properly, for example, the registration marking for the aircraft was missing, and items that had next due date and time requirements, the next due date was not entered on the sheets.

1.6.7 Defects

On April 26, 2016 a defect was written in the technical log book on T/L page No. 6099, which stated that the "the engine lacks power", this defect was cleared on April 28, 2016.

One of the person's interviewed reported that about a month and a half prior he attempted to conduct a flight with the accident aircraft, he did not get full static rpm and as a consequence, cancelled the flight. The defect was not recorded in the technical log book; however the defect was verbally reported to mechanics employed by CATC.

1.6.8 Technical Logbook

None of the duplicate technical log pages (pink and yellow) were removed from the technical log books for the aircraft as required.

There were a number of instances in the technical log book where service checks were recorded as being accomplished; however, Certificates of Release to Service were not executed as required, instances of these were seen on the log book sheets listed below:

1. Technical Logbook page No. 6163, dated June 17, 2016
2. Technical Logbook page 6165, dated June 29, 2016
3. Technical Logbook page No. 6175, dated August 7, 2016

The "Next Inspection" information box on the technical log page was not filled out in most instances, also, the "Closing – Total Times" was not being carried forward.to the next technical logbook page.

There was no fuel uplift entry made in the technical logbook for the 29.3 US Gallons of AVGAS fuel which was purchased from Jamaica Aircraft Refueling Services for the aircraft on November 9, 2016.

There was no entry made in the Technical Logbook for the accident flight on November 10, 2016.

1.6.9 Aircraft Load

The Maximum weight as listed in the aircraft type certificate data sheet for Normal category is 2300 lbs.

The C. G Range per the aircraft type certificate data sheet is:
(+38.5) to (+ 47.3) at 2300 lbs
(+ 35.0) to (+ 47.3) at 1950 lbs or less

The weight of the aircraft at the time of take-off was 2179 1bs. The Center of Gravity of the aircraft at take-off was 42.6 in the Normal category as seen in Exhibit No. 2.

1.7 Meteorological information

The Meteorological Service, Jamaica provided a report on the meteorological (MET) conditions around the time of the accident. Due to the close proximity (approximately 4 Nautical Miles) of the Tinson Pen Aerodrome to the Norman Manley International Airport, the same MET report is used in Air Traffic Service operations. There is no MET Service certified Automatic Weather Observation Station (AWOS) at Tinson Pen.

The Meteorological Aerodrome Report (METAR) issued at 18:00 Universal Coordinated Time (UTC), 1pm Local time by the Meteorological Watch Office (MWO) located at the NMIA, reported Visual Meteorological Conditions (VMC) at the NMIA at the time of the accident. The METAR read as follows:

> *"METAR MKJP 101800Z WIND 18005KT VIS 9999 CLDS FEW020 32/23 Q1012="*

The METAR indicated that the wind at the NMIA was from the South, 180 degrees true, at five (5) knots. The prevailing visibility was 10 kilometers. Few clouds were observed at 2,000 Feet (FT)[4]. Air temperature was 32 degrees Celsius (˚C) and the Dew Point was 23˚C. The air pressure was 1012 Hectopascals (HPA).

A Special Met Observation at 18:50 UTC, 1:50pm Local time read:

> *MKJP 101850Z 20008KT 9999 FEW020 SCT080 31/22 Q1012=*

The special observation indicated that the wind at the NMIA was from the South, 200 degrees true, at eight (8) knots. The prevailing visibility was 10 kilometers. Few clouds were observed at 2,000 Feet (FT)[5]. Air temperature was 31 degrees Celsius (˚C) and the Dew Point was 22˚C. The air pressure was 1012 Hectopascals (HPA).

A Special Radar Observation at 18:45 UTC 1:45pm Local and revealed no significant rainfall or clouds over the Kingston and St Andrew Area.

The Flight Information Officer in charge of the watch reported that the flight crew received information on the surface winds and the altimeter setting before take-off.

1.8 Aids to Navigation

The Aerodrome has no form of Visual Approach Slope Indicator System in place, end-of-runway lights were absent on Runway 14; other lighting and markings were deficient and aerodrome maintenance was generally lacking.

[4] Above aerodrome elevation
[5] Above aerodrome elevation

1.9 Communications

On the day of the accident, there was no reported unserviceability of any aeronautical mobile or aeronautical fixed service communications systems. There was no recording of the radio transmissions in the Tower. The absence of the recording equipment was noted during an earlier regulatory inspection; however the matter had not been rectified despite it forming part of a Corrective Action Plan submitted by Air Traffic Services.

The Aerodrome Operator did not have a working set of VHF or UHF radios. Personnel, including Airport Rescue & Fire-fighting Service (ARFFS), were reliant upon mobile telephone communications. This, in the outdoor and tumultuous-environment circumstances, created some communication challenges during the rescue operation.

Communication channels were not clearly or properly defined, in that, in the extract provided to the Investigator from the draft Tinson Pen Aerodrome Emergency Plan – 'Off-Airport Crash Procedure', instruction and chain-of-command are not clear.

1.10 Aerodrome Information

The accident occurred in the vicinity of the Tinson Pen Aerodrome (ICAO: MKTP), in the Greenwich Farm community of Kingston. Tinson Pen, the aerodrome of departure is situated approximately 2.1 Nautical Miles (NM) from the Kingston city center with its aerodrome reference point located at N17° 59" 19' W076° 49" 26 ' (WGS 84)[6]. This aerodrome is used only in Visual Flight Rules (VFR) conditions – operators must always be able to determine their position with visual reference to the terrain, and to avoid other aircraft and obstructions.

1.10.1 Aerodrome Design and Reference Code

Tinson Pen Aerodrome is defined as an ICAO Code 3C field, with a paved runway length of 1319m (4,326'), oriented along designations 14/32 (runway alignment—140°/320° Magnetic), which accommodates general aviation aircraft, up to the size of a Bombardier Challenger aircraft (which requires a balanced field length 1,223m or 4,013').

1.10.2 Declared Distances

Current AIP Jamaica (AMDT 01/11 dated 31 AUG 11) data erroneously states that the strip is shorter than the runway: Strip dimensions -1218 x 80m vs runway – 1319 x 30m.

1.10.3 Visual Aids

1.10.3.1 There is no Visual Approach Slope Indicator System serving either runway (MAS Chapter 9: 9.4.5.1 refers).

1.10.3.2 AIP entry AMDT AD 01/14 dated 20 OCT 14: Approach & Runway Lighting advises:

a) Coloured Wingbar runway-end lights serving RWY 14 as well as RWY 32;

[6] Reference Datum: World Geodetic System - 1984

This was not consistent with the findings, wherein the light fixtures have been replaced by surface-mounted road reflectors (plastic). The Flight Safety Division (JCAA) has no record of having authorised this variation.

b) Aerodrome Beacon (ABN)
The steady white light atop the tower was not in conformance with the characteristics of an Aerodrome Beacon as defined in the JCAA Manual of Aerodrome Standards (MAS) Chapter 9: 9.2.3.3.6

1.10.4 Airport Rescue and Fire-fighting - Facilities:
The Aerodrome had one foam tender, 'Fire #11', with a capacity of some 6820L mobile Water + 560L Aqueous Film-Forming Foam (AFFF) Type B, manned by a crew of three, sunrise to sunset, or on request. One 20 lbs CO2 portable fire extinguisher and one 20 lbs Purple K Cartridge portable fire extinguisher was also carried aboard 'Fire 11', in addition to crash axe and other ancillary equipment.

1.10.5 Airport Rescue and Fire-fighting - Guidance Material
The draft Tinson Pen Aerodrome Operator Manual extract Section dealing with '*Off-Airport Accident'* states, in part:

"3.2.1.2 Action by Airport Rescue & Fire-fighting Services (ARFFS)

i) The ARFFS will respond to off-airport accidents as advised by the Senior ARFF Officer present, or his designated representative.

ii) Confirm with JCAA Air Traffic Services that they are aware of the report.

iii) Will await clearance from the Air Traffic Services and or Operations Officer or his designate to dispatch appliances."

iv) Deploy pre-determined attendance on instruction from Operations Officer only.

These instructions are not consistent with the Air Traffic Services Manual of Operations (ManOps) which, in fact, states in part:

"*828.5.1 Where the emergency response services are called upon to perform extraneous duties, these duties must not interfere with the prime function of the aerodrome fire service.*

1.10.6 Aerodrome Perimeter
The eastern perimeter of the aerodrome was practically open to intruders, with large gaps in the perimeter fencing.

1.10.7 Aerodrome Condition Reporting
Aerodrome Condition Reports were not generated or disseminated on a regular basis, nor were records kept in a file. Deficiencies are said to be reported to the Engineering/

Maintenance unit at NMIA by e-mail occasionally, when they become apparent. Bushing/cutting maintenance was generally unsatisfactory.

1.11 Flight Recorders

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder. Neither recorder was required by the relevant aviation regulations.

1.12 Wreckage and Impact Information

The aircraft came to rest in a near upright position as seen in Figure 1; all four corners of the aircraft were observed at the crash site. The engine was still attached to the airplane.

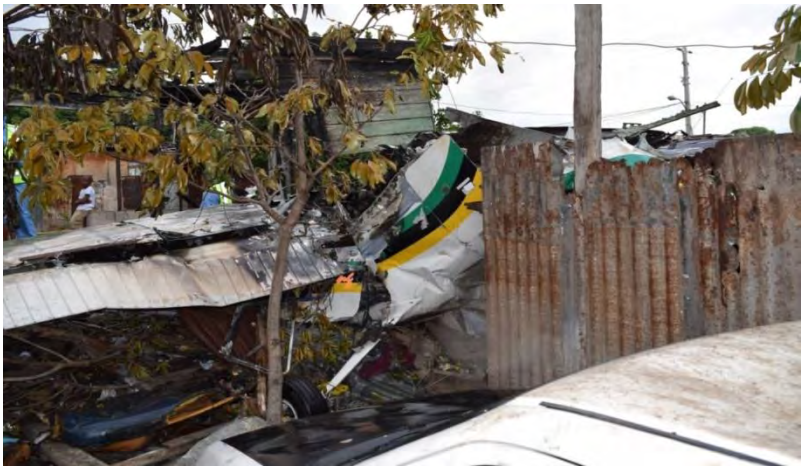


Figure 1 Position of Aircraft on Impact

The wreckage distribution was largely confined to the immediate ground impact site. The nose section and forward cabin area were crushed and displaced rearward along the airplane's longitudinal axis.

The nose cone of the propeller was crushed, it came to rest on the concrete base of an abandoned and partially burnt-out wooden building, the propeller was securely attached to the engine and the bolts were secured with locking wire. Blade No. 1 showed no leading edge damage or bending, Blade No. 2 was observed with the tip bended aft about 90 degrees, approximately 9 inches from the tip, there was damage to the leading edge of this blade as seen in Figure 2.

Figure 2 Aircraft Propeller and Engine

The engine cowling was partially attached to the aircraft as seen in Figure 3; the lower cowl was badly deformed and there was evidence of fire damage in the lower engine compartment, the engine was attached to the firewall, and the engine mount rods were deformed.

Figure 3 Engine Compartment

The flywheel was bolted to the crankshaft, a part of the circumference was broken off and the starter gear ring was partially detached from it as seen in Figure 4.

Figure 4 Flywheel and Starter Ring Gear

The carburetor was broken at the parting face to the fuel bowl as seen in Figure 5 and a part of the throttle body of the carburetor was separated from the engine; there were fire damage signatures to it, and the float was burnt. The engine throttle cable was observed to be attached to the throttle control lever; the rest of the throttle body of the carburetor was attached to the engine.

Figure 5 Part of the Carburetor

All four engine cylinders were attached to the crankcase for the engine as seen in Figure 6; all eight spark plugs were installed in the cylinders with their leads attached.

Figure 6 Engine Crankcase with Cylinders

The dual magneto was securely attached to the aft of the engine as seen Figure 7. Fire damage to the exterior of the unit was observed.

Figure 7 Aft View of the Engine

There was fire damage along the fuselage from the engine to the front of the baggage door at Fuselage Station FS 90.00. The upper fuselage skin from the forward wing spar to Fuselage Station 108 was burnt out as seen in Figure 8. The lower fuselage skin showed evidence of buckling beginning at Fuselage Station 80.00; the empennage was bent downward at an angle of approximately 90 degrees at Fuselage Station 108.

Figure 8 Burnt Out Fuselage of the Aircraft

The vertical stabilizer along with the rudder and both horizontal stabilizers along with both elevators were securely attached to the empennage of the aircraft as seen in Figure 9. The elevator trim tab was securely attached to the R/H elevator, the flight control cables along with their pulleys were observed, flight control continuity was established from the fuselage through to the tail. The empennage was detached from the aircraft and the flight control cables were cut to facilitate removal of the aircraft from the crash site to Tinson Pen Aerodrome.

Figure 9 Empennage with Vertical and Horizontal Stabilizers

The L/H wing had extensive fire damage to the upper and lower wing skin surfaces from the wing root to the wing tip, including the aileron, the primary and secondary flight control surfaces were deformed, but were attached to the wing surface as seen in Figure 10. The flight control cables, pulleys and bell cranks were observed and flight control continuity was established throughout the wing. The wing was detached from the aircraft and the flight control cables were cut to facilitate movement of the aircraft to the Tinson Pen Aerodrome.

Figure 10 Left Hand Wing

The R/H wing had fire damage to the upper and lower skin surfaces from the wing root to Wing Station 71.37; there was impact damage to the leading edge of the wing as seen in Figure 11. There were cuts in the lower skin surface at Wing Station 172. There was a diagonal wrinkle in the upper wing surface beginning just forward of the inboard edge of the aileron and extending to the leading edge at Wing Station 172. The flight control cables, pulleys and bell cranks were observed, flight control continuity was established throughout the wing. The wing was detached from the aircraft and the flight control cables were cut to facilitate movement of the aircraft from the accident site.

Figure 11 Right Hand Wing

The wing flap jackscrew is located in the right hand wing. The flap jackscrew extension was measured at 0.0 inches, corresponding to a zero degree flap extension as seen in Figure 12.

Figure 12 Wing Flap Jackscrew

The Nose Landing Gear (NLG) was attached to the engine firewall which was folded under the aircraft as seen in Figure 13. The shimmy dampener was still intact, and the steering rod actuator was sheared at the NLG attachment. The torque links were attached, the strut was inflated as well as the tyre.

Figure 13 Nose Landing Gear

The engine firewall was deformed and displaced rearward; it was extensively damaged by fire as seen in Figure 14. The battery box was deformed and the battery was partially burnt.

S

Figure 14 Engine Firewall

The fuel strainer assembly which was secured to the lower R/H side of the engine firewall was disassembled and inspected; areas of pitting were observed on the inside of the fuel bowl as seen in Figure 15. The filter was dirty as seen in Figure 16.

Figure 15 Fuel Bowl

Figure 16 Fuel Filter

The L/H and R/H main landing gear (MLG) were securely attached to the fuselage, the wheels and brakes were attached to the units and both tyres were inflated as seen in Figures 17 and 18.

Figure 17 Left Hand Main Landing Gear

Figure 18 Right Hand Main Landing Gear

The fuel selector handle was observed in the "both" position as seen in Figure 19.

Figure 19 Fuel Selector

The engine throttle and mixture controls were fire damaged and appeared to be in the full forward position as seen in Figure 20.

Figure 20 Engine Controls

The engine instruments, navigational instruments and the radios were fire damaged as seen in Figure 21.

Figure 21 Engine, Navigation, Instruments and Radios

The R/H seat safety restraint buckle was observed in the latched configuration and the webbing was cut and damaged by fire as seen in Figure 22.

Figure 22 The Right Hand Seat Safety Restraint Belt

The L/H seat safety restraint webbing was observed to be cut and damaged by fire as seen in Figure 23; the buckle was not found.

Figure 23 The Left Hand Seat Safety Restraint Belt

The L/H seat back was intact; the seat was fitted with a secondary stop as seen in Figure 24.

Figure 24 Left Front Seat

The R/H seat back was broken and there was impact damage to the seat frame as seen in Figure 25. No secondary stop was observed on this seat.

Figure 25 Right Front Seat

The L/H side of the rear passenger seat had extensive burns as seen in Figure 26.

Figure 26 Rear Passenger Seat

1.13 Medical and Pathological Information

An autopsy was performed on the flight instructor on November 16, 2016 by a Consultant Forensic Pathologist of the Legal Medicine Unit in the Ministry of National Security. The cause of death was determined to be Shock and Haemorrhage, Polytrauma and Multiple Blunt force Injuries due to aircraft collision with ground.

The Institute of Forensic Science and Legal Medicine performed toxicology on specimens from the flight instructor. The test on the flight instructor's specimen did not reveal any positive findings of toxicological significance.

An autopsy was performed on the student pilot on November 16, 2016 by a Consultant Forensic Pathologist of the Legal Medicine Unit in the Ministry of National Security. The cause of death was determined to be Shock and Haemorrhage, Polytrauma and Multiple Blunt Force Injuries due to aircraft collision with ground.

The Institute of Forensic Science and Legal Medicine performed toxicology on specimens from the student pilot. The test on the student pilot's specimen did not reveal any positive findings of toxological significance.

An autopsy was performed on the passenger on November 16, 2016 by a Consultant Forensic Pathologist of the Legal Medicine Unit in the Ministry of National Security. The cause of death was determined to be Shock and Haemorrhage, Polytrauma and Multiple Blunt Force Injuries associated with ante mortem burn injury due to collision with the ground.

The Institute of Forensic Science & Legal Medicine performed toxicology on specimens from the passenger. The test on the passenger's specimen did not reveal any positive findings of toxological significance.

1.14 Fire

Ground witnesses stated that the fire occurred after the aircraft made impact with the ground, the left hand wing upper and lower surfaces were extensively damaged by fire, the right hand wing had fire damage on both the upper surface and the lower surface from the wing root to wing station 71.37. There was fire damage along the fuselage from the lower engine cowl to fuselage station 108.00 as seen in Figure 27.

Figure 27 Fire Damage to the Aircraft Fuselage

The cockpit of the aircraft was extensively damaged by fire as seen in Figure 28.

Figure 28 Aircraft Cockpit

There was also fire damage to the zinc perimeter fence on which the aircraft made impact with the ground and to the car in the adjacent property as seen in Figure 29.

Figure 29 Damaged Perimeter Fence and Car on Adjacent Property

1.15 Survival Aspects

No ELT was seen in the aircraft wreckage at the accident site

1.15.1 Facilities:
The Aerodrome had one foam tender, 'Fire #11', with a capacity of some 6820L mobile Water + 560L Aqueous Film-forming Foam (AFFF) Type B, manned by a crew of three, sunrise to sunset, or on demand. One 20 lbs. CO2 portable and one 20 lbs. Purple K Cartridge portable fire extinguisher are also carried aboard 'Fire 11', in addition to crash axe and other ancillary equipment.

1.15.2 Response(s):

1.15.2.1 Jamaica Fire Brigade (JFB) York Park Fire Tender No 10-4, under command of the District Officer, upon notification at 1334 hours, covered the 4 km distance via uncertain route in 11 minutes and began dispensing foam at 1345 hrs. JFB' s foam-mix, however, being suitable only for Class A type fires (wood, paper etc.,) would not form a proper foam blanket on a Class B (aircraft fuel) fire, and therefore proved ineffectual and the fire continually rekindled. Unit 10-4 was supported by Fire Tenders from the Rollington Town and Trench Town Stations and a water-supply truck from York Park Station.

1.15.2.2 Tinson Pen Aerodrome (MKTP) Airport Rescue & Fire-fighting Service **(**ARFFS**)** upon notification at 1334 hrs., did not respond with Foam Tender 'Fire 11' by road, reportedly out of concern that the vehicle was not licensed to traverse the public road. ARFFS responded instead, 16 minutes after first notification, by

positioning the foam tender at the eastern extremity of Runway 14, and proceeding on foot, with portable extinguishers, at 1350 hrs, arriving on the accident site some minutes later. ARFFS portable extinguisher(s) proved ineffectual and the aircraft fuel-fire continued to blaze. At 1430 hrs., ARFFS 'Fire 11' departed MKTP under police escort, arriving at the accident site at 1440 hrs., and extinguished the blaze within 5 minutes dispensing foam-mix through JFB side-jets already deployed.

1.15.3 Rescue Operations

The impact was not survivable for the two occupants in the pilot seats.The occupant in the aft seat of the aircraft was taken out by persons at the site sometime between 1335 hrs. and 1345 hrs., placed in the back of a police pick-up truck and taken to the Kingston Public Hospital. He later succumbed to his injuries, including extensive burns caused by the fire.

1.15.4 Recovery Operations

At 5:09 pm hydraulic tools were by the Jamaica Fire Brigade to extricate the bodies of the Flight Instructor and the Student Pilot form the wreckage where they were pronounced dead by doctors from the Ministry of Health.

1.16 Tests and Research

1.16.1 Engine Teardown Examination

A teardown examination of the engine was conducted at Lycoming Engine's facility in Williamsport, Pennsylvania, USA in the presence of the JCAA, NTSB, Lycoming & Textron Aviation Inc. Investigators.

The carburetor showed fire damage signatures along with varying amounts of impact damage. The venturi remained attached to the oil sump, but the floats were missing as shown in Figure 30. The engine control positions were undetermined due to impact damage and component damage. The carburetor bowl was separated from the aircraft as seen in Figure 31. The air box was destroyed by impact and could not be further examined.

Figure 30 Carburetor Venturi

Figure 31 Carburetor Bowl

The magneto was secure in its mount at time of examination, the magneto hold down nuts were tight at the time of removal. Heavy fire damage as seen in Figure 32 precluded timing of the magneto due to internal damage and fire consumed parts. The magneto could not rotate at the time of examination.

Figure 32 Engine Magneto

The spark plugs were secure at each position. The spark plugs were removed, examined and photographed as seen in Figure 33. The spark plug electrodes remained mechanically undamaged, and according to the Champion Spark Plugs "Check-A-Plug" chart AV-27, the spark plug electrodes displayed coloration consistent with normal operation. The static oil soaking of the spark plugs (as noted) could be attributed to the engine positioning at mishap site and post recovery. Light corrosion was observed, this was likely due to post impact fire and heat.

Figure 33 Engine Spark Plugs

The ignition harness was damaged by impact and by fire; there was no further examination of this component.

The starter was securely attached at the mounting with impact damage to the bottom of the housing; there was no further examination of this component.

The rear-mounted vacuum pump was secure at the mounting pad but had sustained fire damage. Identification such as part number and serial number could not be obtained due to destroyed data tag.

The oil filter was not present with the engine at the time of examination. The oil suction filter screen was removed from the sump and found to be in a clean condition with a ridge of solder along one edge of the screen. The oil hoses and lines were in place but largely fire damaged.

A borescope inspection of the cylinders was conducted; there was light rust inside the cylinder wall of the No. 2 cylinder, the cylinder borescope did not reveal any other findings.

The No. 3 cylinder rocker arm cover was damaged; this was consistent with impact damage.

The No. 2 cylinder intake rocker arm did not have any shims under the rocker arm as seen in Figure 34.

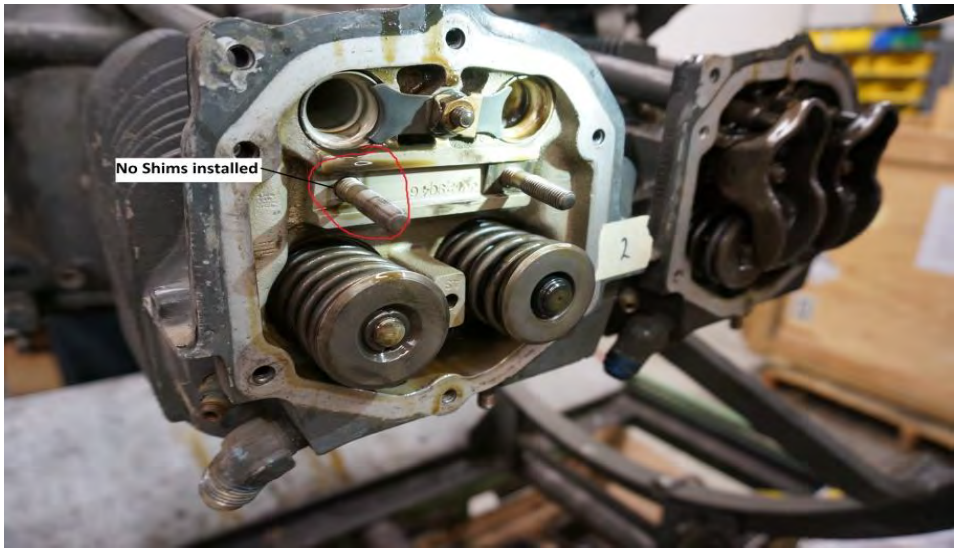


Figure 34 No. 2 Engine Cylinder

The engine internal timing was found to be out of time by one tooth between the crankshaft and camshaft as seen in Figure 35. This caused the timing mark on the starter ring gear support assembly to be about 7 teeth out of alignment with alignment dot (hole) on the starter bendix gear housing as seen in Figure 36; this translates to approximately 16.8 degrees out of time.

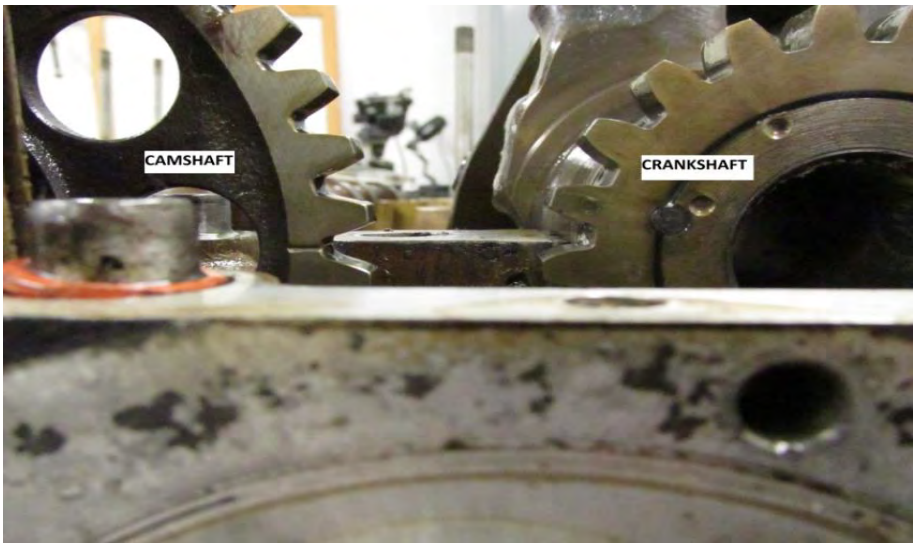


Figure 35 Engine Crankshaft and Camshaft

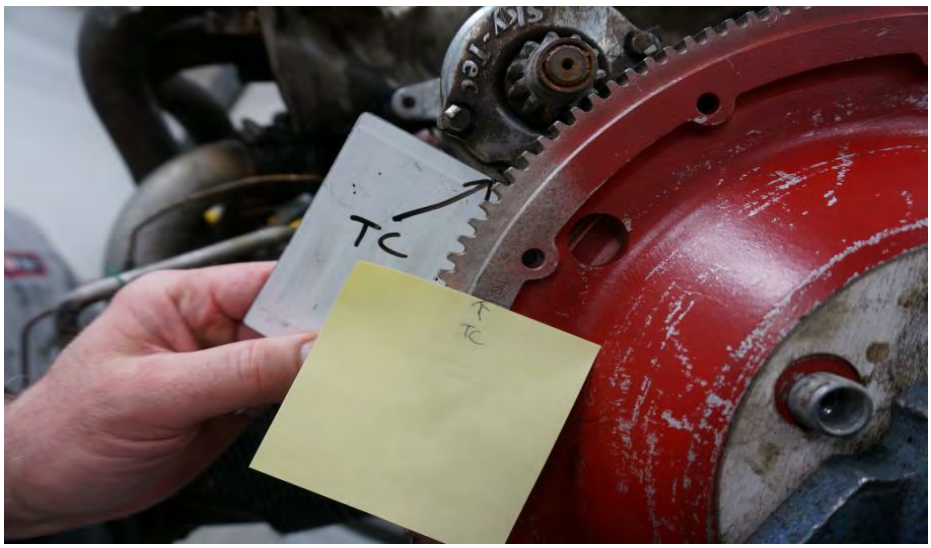


Figure 36 Starter Ring Gear Support Assembly

The intake valve installed in the No. 2 engine cylinder was incorrect as indicated by its short length when compared to the other intake valves as seen in Figure 37; this suspect part has a Lycoming part number, but is not correct for this engine model or type certificate.

Figure 37 No. 2 Intake Valve as compared to another Intake Valve

The No. 3 cylinder intake and exhaust tappets were heavily pitted on the face and showed damage to the edges as seen in Figures 38 and 39.

Figure 38 No. 3 Intake Tappet

Figure 39 No. 3 Exhaust Tappet

The No. 4 cylinder intake tappet was heavily pitted on the face with jagged edges along the circumference of the tappet as seen in Figure 40.

Figure 40 No.4 Intake Tappet

The connecting rod bushings showed some signs scratching as seen in Figure 41. There was also scoring of the piston skirts.

Figure 41 Connecting Rod Bushing

The camshaft shows damage to all lobes of varying degrees, both to the face and edges of the lobes. The No. 4 intake lobe showed the greatest amount of damage. Spalling and worn edges were observed along with corrosion as seen in Figure 42.

Figure 42 Engine Camshaft

The engine does not show to have been updated to (-T) mod configuration per Lycoming Service Instruction 1406.

The oil pressure relief valve had a hexagonal nut and two washers installed in lieu of the specified washers as stated in the Illustrated Parts Catalog (IPC) for spring tension adjustment as seen in Figure 43.

Figure 43 Oil Pressure Relief Valve

The intake and exhaust were found to be open and free, there were no obstructions.

SUMMARY

The engine examination revealed no evidence of pre-impact catastrophic mechanical malfunction or fire. Mechanical continuity was established during the hand rotation of the crankshaft and thumb compression check of the cylinders. The cylinder(s) bore scope examination showed light rust on the No. 2 cylinder walls, remaining cylinders were unremarkable. The spark plug electrodes remained mechanically undamaged and exhibited coloration consistent with normal operation. The internal timing of the engine was found to be off by 1 tooth when the timing mark of the crankshaft was properly indexed to the parting face of the engine case. The No. 2 engine cylinder intake valve was incorrect as noted by its short length when compared to the three remaining intake valves; this suspect valve has a Lycoming part number, just not for this engine model or type certificate. The No. 2 engine cylinder intake valve also did not have any shims under the rocker arms. The camshaft showed signs of wear on lobes ranging from worn to extremely worn conditions with heavy pitting and corrosion exhibited. The No. 3 engine cylinder intake and exhaust tappets and the No. 4 engine cylinder intake tappet showed heavy wear, pitting and spalling on the faces and edges of the tappets.

1.16.2 Aviation Gasoline (AVGAS) Analysis

A sample of AVGAS was taken from the batch of fuel which was purchased and pumped in the aircraft (N101KA) from the fuel farm at Tinson Pen Aerodrome the day before the

accident; the sample was sent for testing at Panair Laboratory in Florida, USA. The test results reflect that the fuel sample met ASTM D-910 specifications for Avgas 100 LL.

1.17 Organizational and Management Information

1.17.1 Jamaica Civil Aviation Authority

1.17.1.1 Safety Oversight

Safety oversight is defined as a function by means of which states ensure effective implementation of the safety-related Standards and Recommended Practices (SARPS) and associated procedures contained in the Annexes to the Convention on International Civil Aviation and related ICAO documents, and is the foundation upon which safe global aircraft operations are built.

A part of the Jamaica Civil Aviation Authority's mandate is to provide safety and security oversight in keeping with the Civil Aviation Act and the State's obligations under the Convention on International Civil Aviation.

The critical elements of the State's safety oversight system include:

1. Primary aviation legislation;
2. Specific operating regulations;
3. State civil aviation system and safety oversight functions;
4. Technical personnel qualification and training
5. Technical guidance , tools and the provision of safety-critical information;
6. Licensing, certification, authorizations and approval obligations;
7. Surveillance obligations; and
8. Resolution of safety concerns

Primary Aviation Legislation

The Civil Aviation Act is the primary aviation legislation in Jamaica that sets out the establishment of the Jamaica Civil Aviation Authority (JCAA), the extent of its authority and empowerment of its Director General and provision for the independent investigation of accidents and incidents to ensure impartial and objective investigations to correct shortcomings in the system, not only within the aviation industry but also within the JCAA.

Specific Operating Regulations

The Civil Aviation Regulations, 2012 is the specific operating regulations in Jamaica which sets out in details the minimum requirements to be met by all service providers, regardless of the size and complexity of their civil aviation activity that satisfactory compliance will result in the desired level of safety.

Civil Aviation Regulations, 2012, Regulation No. 29 states *"No person shall operate or cause to be operated, an aircraft registered in Jamaica or a foreign-registered aircraft operating in Jamaican airspace, in which a Certificate of Airworthiness is in force unless*

– (a) the aircraft is maintained in accordance with a maintenance programme approved by the State of Registry, or approved by the Authority pursuant to the Fifth and Tenth Schedules, and applicable to the type of operation;"

The Civil Aviation Regulations, 2012, the Ninth Schedule, prescribes the requirements for certifying and administering an Approved Training Organization (ATO).

The Civil Aviation Regulations, 2012, the Ninth Schedule, Paragraph 9.020 (Application for Issuance or Amendment), Sub paragraph 9.020 (m) states "*Each FTU, as indicated shall have and maintain at least the following management personnel, or their equivalent who are qualified and competent to perform their required duties:*

(1) An Accountable Manager (Level 1 and 2 FTU)
(2) A Chief Flight Instructor (CFI) (Level 1 and 2 FTU)
(3) An Assistant Chief Flight Instructor (A/CFI) (Level 1 FTU)
(4) A Quality Assurance Manager; and
(5) A Director of Maintenance (Maintenance Manager), if the ATO has an AMO or Maintenance Coordinator (Level 1 and 2 FTU)

The Civil Aviation Regulations, 2012, Appendix 1 to 9.050 (Contents of Training and Procedures Manual) states "*The training and procedures manual may be issued in separate parts and shall contain at least the following information:*" sub paragraph 9.050 (6) states "*the name duties and qualifications of the Quality Assurance Manager*".

The Civil Aviation Regulations, 2012, Paragraph 9.063 (Quality Assurance System) states "*Each ATO shall establish a quality assurance system acceptable to the Authority which ensures that training and instructional practices comply with the requirements specified in this schedule*".

The Civil Aviation Regulations, 2012, the Ninth Schedule, Paragraph 9.070 (Inspection), sub paragraph 9.070 (b) states "*Inspections shall be repeated on a twelve month basis, which may be extended to a twenty-four month basis if, in opinion of the Authority, the holder continues to meet the requirements under which it was originally certificated*".

The Civil Aviation Regulations, 2012, the Ninth Schedule, Paragraph 9.120 (Aircraft Requirements), sub paragraph 9.120 (a) states "*An applicant for, or holder of an ATO certificate shall ensure, for each aircraft used for flight instruction and solo flights:*" sub paragraph 9.120 (a) (2) states "*that each aircraft is maintained and inspected in accordance with the requirements of the Fifth Schedule…"*

The Civil Aviation Regulations, 2012, the Ninth Schedule, does not include any provisions for an ATO to conduct maintenance of its aircraft under its Certificate.

The Civil Aviation Regulations, 2012 the Ninth Schedule, does not include any provisions for an ATO to lease foreign registered aircraft.

The Civil Aviation Regulations, 2012, has no specific operating regulations that govern the operation of Unmanned Aerial Vehicles' in Jamaica's airspace.

The Civil Aviation Regulations 2012 has no expressed requirement for an Approved Training Organization to submit and receive approval for a Security Programme.

State Civil Aviation System and Oversight Functions

In 1996 the Jamaica Civil Aviation Authority was established, headed by a Director-General, supported by the appropriate and adequate technical and non-technical staff, and provided with adequate financial resources.

Section 6C of the Civil Aviation Act empowers the Authority to appoint and employ such officers and employees and agents as it thinks necessary for the proper carrying out of the provisions of the Act. The Director General is made responsible for the day-to-day management and operation of the Authority.

The Flight Safety Department is the unit within the JCAA which is tasked with the responsibility of carrying out safety oversight of civil aviation in Jamaica.

A Delegation of Functions Document was issued by the Director General, which authorizes the personnel listed therein to perform functions on behalf of the Director General, Jamaica Civil Aviation Authority.

Technical Personnel Qualification and Training

To effectively fulfil its responsibilities, the JCAA must be properly staffed with qualified personnel capable of accomplishing the required wide range of technical duties involved in safety oversight.

The minimum requirements for Aviation Safety Inspectors are set out in the Flight Safety Administration Procedures Manual (FSAM), Appendix I – Job Descriptions Flight Safety. The training guidelines for Aviation Safety Inspectors are set out in Section 3.4 and Appendix A.

FSAM Section 3.4 states "*The JCAA expects the Flight Safety Inspectors to operate with a high degree of knowledge in order to make decisions critical to public safety and security……. The policy requires that each Inspector and technical support staff shall attend at least one refresher or new technology oriented course each year, once the individual's initial formal training is completed*".

The FSAM Section 3.4.2 states "*Airworthiness Inspectors will be given manufacturer's endorsement courses (ATA 104 Level III) on the specific aircraft types that they will be providing oversight for*".

There was no documentation seen on the training file of the Airworthiness Inspector who was assigned to the ATO at the time of the accident, which demonstrated that manufacturer's endorsement courses on the specific aircraft types operated by the ATO were provided. The Delegation of Functions document seen on file included

authorization to the Inspector for General Aviation aircraft, and the JCAA Licence held by the Inspector included class ratings for all piston engined aircraft 2730kg or less Maximum Certificated Take-off Weight (MCTOW).

The Airworthiness Inspector who was ordinarily assigned to the ATO was acting in the position of Manager of the Airworthiness Section at the time of the accident; there was no documentation seen on his training file which demonstrated that the manufacturer's endorsement course on the aircraft type involved in the accident was provided to the Inspector.
The last record on file of training for the Airworthiness Inspector assigned to the ATO at the time of the accident was a Resolution of Safety Concerns Course which was completed in August 2015.

The Principal Operations Inspector who was assigned to the ATO was acting as the Manager of Flight Operations Oversight at the time of the accident

There was documentation on the training file of the Principal Operations Inspector who was assigned to the ATO that the Inspector was trained in Pilot School Certification.

The Flight Operations Inspector who conducted the last Base Inspection of the ATO prior to the accident was not trained in ATO Certification nor was he granted delegation by the Authority at the time the inspection was conducted.

There was no documentation seen on the training files of Flight Safety Inspectors to confirm that they had received Audit Procedures Training.

Technical Guidance, Tools and the Provision of Safety Critical Information
The JCAA is responsible for the provision of technical guidance (including processes and procedures), tools (including facilities and equipment) and safety-critical information, as applicable, to the technical personnel to enable them to perform their safety oversight functions in accordance with established requirements and in a standardized manner. In addition this includes the provision of technical guidance by the JCAA to the aviation industry on the implementation of applicable regulations and instructions.

The Jamaica Civil Aviation Authority had no written technical guidance procedures on the certification of Aviation Training Organizations (ATO) at the time of the accident.

The Jamaica Civil Aviation Authority had no written technical guidance procedures for the certification of Air Navigation Service Providers at the time of the accident.

A Flight Safety Notification, FSN-GN-2015-01 R1 (Operations of Unmanned Aerial Vehicles), dated April 20, 2015 was published by the JCAA. The operating restrictions in the notification sates that for "*Recreational (Hobbyists) - Unmanned Aerial Vehicles shall not be operated within 16500 feet (5000 metres) of any aerodrome or rotorcraft designated landing zones, such as helipads*" . It also states that for Professional (Commercial and Non-Commercial Operators) "*All commercial operators must apply to*

the Jamaica Civil Aviation Authority for a Special Aerial Work Permit before each flight. All entities or persons wishing operate a UAV, as referenced in this paragraph shall:

- *Apply to the JCAA in writing for approval, providing all details of the intended operation*
- *Not fly the aircraft, unless written permission has been received from the Authority, stating any applicable restrictions or conditions".*

The Jamaica Civil Aviation Authority Audit Procedures Manual (2nd Edition) dated August 2004 does not conform to the Civil Aviation Regulations of Jamaica.

Licensing, Certification, Authorizations and Approval Obligations

The JCAA is responsible for the implementation of processes and procedures to ensure that personnel and organizations performing an aviation activity meet the established requirements before they are allowed to exercise the privilege of a licence, certificate, authorization and/or approval to conduct the relevant aviation activity.

On December 1, 2004 the Civil Aviation Regulations, 2004 were promulgated, given the promulgation of these new regulations and with specific reference to Regulation # 90, there was a need to re-certify all holders of aviation documents to the standards of the new regulations with their accompanying Schedules. To this end, Transition Procedure Guidelines dated December 8, 2004 were provided by the JCAA to its Flight Safety Division to guide the process of change. There is no documentation seen on the Flight Safety Division files kept for this operator to demonstrate that the re-certification of this certificate holder was accomplished.

Operations Specifications form a part of the Approved Training Organization's (ATO) Certificate, they contain authorizations approvals and limitations issued by the Authority in accordance with the standards which are applicable to the training conducted by the ATO.

An application dated July 21, 2015 was made by the ATO to add Textron Aviation Inc. (formerly Cessna Aircraft Company) Aircraft, Model 172 N, Reg. No. 101KA to its Operations Specifications A3 (Aeroplane Authorizations) . On July 30, 2015 Operations Specifications A3 was amended to add the aircraft to the ATO. No copy of the aircraft lease between the owner and the operator has been seen on files of the Flight Safety Department.

Operations Specification A6 (Management Personnel) at Revision No. 19, dated September 20, 2016 was issued to the certificate holder, setting out to the names and positions of personnel it is authorized to employ to fill management positions. Only three of the five required management positions were listed, namely:

1. Accountable Manager
2. Chief Flight Instructor
3. Maintenance Coordinator

There were no Assistant Chief Flight Instructor or Quality Assurance Manager Positions listed on the document, nor was there any documentation seen on the Flight Safety Department files to demonstrate that a deviation was granted by the Jamaica Civil

Aviation Authority from this requirement to CATC. The persons listed for the positions of Chief Flight Instructor and Maintenance Coordinator in the Operations Specifications, advised that they were no longer working for the operator at the time of the accident.

A review of the Flight Safety Division's documentation revealed no record of an Application being made for an Aerodrome Certificate for or on behalf of the Tinson Pen Aerodrome.

Surveillance Obligations

The JCAA Flight Safety surveillance guidance procedures are set out in Section 18 of the Flight Safety Administration Manual (FSAM). The Flight Safety Division develops Safety & Security Oversight Surveillance Plans. The Civil Aviation Safety Oversight Reporting and Tracking System (CASORTS) is an IT based tool used for the planning, tracking and closing out of Safety Oversight Tasks. The FSAM sets out the minimum surveillance tasks to be accomplished.

The FSAM states that prior to the conduct of inspections, Inspectors shall thoroughly prepare themselves for the inspections to be conducted, and shall make copies of all checklists which will be required and review their contents.

The FSAM Section 18 (Flight Safety Surveillance Plans) states in Section 18.4 that: *Oversight Surveillance Plans will contain at a minimum the following tasks:*

Type of Inspection	*Frequency*
Base Inspection	*2 per year*
Records (aircraft)	*1 per year*
Records (Training, PEL, Programmes)	*4 per year*
Regulatory Audit	*Once every two (2) years*

At the time of the accident the Airworthiness Safety Oversight Surveillance Plan for 2016-2017 did not include tasks for the inspection of foreign registered aircraft being operated by certified operators in Jamaica.

There was no documentation found in the Flight Safety Department files of Textron Aviation Inc. (formerly Cessna Aircraft Company) aircraft Model 172 N, Reg. No. N101KA being inspected or its records being reviewed by Flight Safety Inspectors prior to the aircraft being added to CATC's Operations Specifications A3 (Aeroplane Authorizations).

An Operations Base Inspection of the ATO was conducted on July 31, 2015.

An Operations Base Inspection along with two Training Records Inspections were accomplished on July 19, 2016, however the Base Inspection was incomplete as per the Base Inspection Form FS212a used to carry out the task.

There was no documentation found in the Flight Safety Division to demonstrate that a Regulatory Audit was ever conducted of CATC.

At the time of the accident the Civil Aviation Safety Oversight Reporting and Tracking System was not functional.

Resolution of Safety Concerns
The JCAA is responsible for the implementation of processes and procedures to resolve identified deficiencies impacting aviation safety which may be detected by the JCAA FSD or other persons.
The procedures to resolve identified deficiencies impacting aviation safety are set out in the FSAM and the Compliance and Enforcement Manual.

Three Enforcement Investigation Reports (EIR's) were opened by the JCAA on CATC for events that took place on March 27, 2015, April 3, 2015 and May 18, 2015, at the date of the accident all three EIR's were still opened.

Two hard landing incidents took place on May 18, 2015 and November 18, 2015, at the date of the accident one was closed and the other was still opened.

Letters dated December 10th and 21st, 2015 were written by the Jamaica Civil Aviation Authority to invite representatives of CATC to a meeting regarding runway excursions in the year, in the interest of flight safety. A response was sent via letter dated December 11, 2015 in which the Accountable Manager acknowledged receipt of the letter, and asking that the JCAA Investigation Report of the runway incursions and additional reports regarding three Enforcement Investigation Reports be provided. A meeting between the JCAA and Flight Instructors was held on December 31, 2015 to which the Accountable Manager was absent. A follow up letter was sent to the Accountable Manager on January 14, 2016 inviting him to meet with the Authority, in a response dated January 15, 2016, the Accountable Manager declined the invitation as he would not be on the island on the suggested date for the meeting., he also outlined measures which the ATO was implementing, a further request was made for the documents previously requested in his letter of December 11, 2015. Another letter dated February 22, 2016 was sent by the JCAA inviting the Accountable Manager to meet with them, in his response, the Accountable Manager stated in his letter of March 1, 2016, that he had no intention of meeting with the Authority until the information requested in his letter of December 11, 2015 was provided.

1.17.1.2 Air Navigation Services
The Air Navigation Services Division of the Jamaica Civil Aviation Authority is tasked with providing air navigation services within the Kingston Flight Information Region as mandated by the Civil Aviation Act, and the Convention on International Civil Aviation.

Air Traffic Services at Tinson Pen Aerodrome

Aerodrome air traffic service is provided in the form of flight information service from a standalone tower to the east of the terminal building; this facility is operated by the Jamaica Civil Aviation Authority (JCAA) Air Navigation Services Division.

"An Aerodrome Flight Information Service Unit (AFISU) provides services to aircraft flying within the aerodrome traffic zone and operating on the manoeuvring area of non-controlled aerodromes and where required, to aircraft operating within a traffic information zone (TIZ)." [ATS MANOPS Errata 2012]

Alerts and information on the weather, traffic, and essential aerodrome information are some of the services provided by the flight information service unit. This unit is not an air traffic control unit and as such the officers do not have the authority to issue clearances or instructions to aircraft, vehicles or personnel

Investigation Documents provided by Air Traffic Services

- Data Recording Facility (Radar) Tape (the aircraft was never visible on the radar scope)
- Meteorological report
- Flight Progress Strip
- Tinson Pen Tower Watch Log
- NMIA Unit Chief report and
- Flight Information Officers written reports

At the time of the accident the Air Navigation Service Provider was not certified by the Regulatory Authority, as required by Civil Aviation Regulations 2012, 24th "A" Schedule Subpart C.

At the time of the accident, the Air Traffic Services Manual of Operations (MANOPS) 3rd Edition Errata Version 2012 had not been approved by the Flight Safety Division of the JCAA as required by the Civil Aviation Regulations 2012, 24th "A" Schedule, 24.045.

There was no Unit Specific Manual as required by the Civil Aviation Regulations 2012, 24th "A" Schedule, 24.045.

There was an Emergency Checklist available as required by the Civil Aviation Regulations 2012, 24th "A" Schedule 24.057; however this checklist has not been approved by the Flight Safety Division. This checklist was used by the officers on duty during the notification process.

Despite the initial request on November 10, 2016 for documentation pertinent to the accident and several follow up requests thereafter (including a letter dated November 18, 2016), the information from the Air Navigation Services Division was received by the IIC on November 23, 2016.

Though written statements were provided by both Flight Information Officers who were at Tinson Pen on the date of the accident, they did not make themselves available to be

interviewed by the Investigation Team, despite repeated requests from the Investigator-in-Charge.

1.17.1.3 Aircraft Accident Investigation
The JCAA Flight Safety Division (FSD) is the organization tasked with the responsibility to investigate aircraft accidents and incidents in Jamaica.

At the first accident site visit made by the accident investigation team, there was no site security present.
On November 11, 2016, the day after the accident, authorization was given by the FSD to CATC, to remove the aircraft wreckage from the accident site to be stored at a facility owned by them.

1.17.2 Caribbean Aviation Training Center
Caribbean Aviation Training Center (CATC) was launched in February 2001; it is an approved Cessna Pilot Center.

CATC is a Flight Training Unit/ Approved Training Organization (ATO). It is located at the Tinson Pen Aerodrome. The current Aviation Training Organization Certificate [No. 017T] was issued on August 13, 2015, the certificate states that it "***will continue in effect unless sooner surrendered, suspended or revoked.***"

On July 30, 2015, the aircraft, Textron Aviation Inc. (formerly, Cessna Aircraft Co.), Aircraft Model: 172N, Registration No. N101KA was added to its Operations Specifications A3.

The Maintenance Program which was being used by CATC to maintain the aircraft was not approved by the State of Registry.

CATC was carrying out maintenance on its US registered aircraft using its own personnel.

CATC did not have a quality assurance system acceptable to the Authority to ensure that training and instructional practices complied with the requirements specified in the Civil Aviation Regulations, 2012, the Ninth Schedule

Policies and Procedures
The Air Training Organization Manual, at Revision 4, dated January 12, 2016 was approved by the JCAA on March 16, 2016.

Section 1 (Introduction) of the Air Training Organization Manual states that the airplanes are maintained by an approved maintenance facility, and that CATC provides an approved maintenance program and MEL for all airplanes. It also states that copies of the lease arrangements are to be provided to the Authority.

The management positions in the manual as listed on page S1-1 are as follows:

Managing Director/ Director of Operations *Captain Errol Stewart*
Maintenance Co-coordinator *Umish Ramharack*
Chief Pilot *Reynell Barnes*
Chief Flight Instructor (All Courses) *Reynell Barnes*
Safety Officer *Handa Ayton*

Section 3 (Aircraft Maintenance) of the Air Training Organization Manual states that "*all aircraft operated by Caribbean Aviation Training Center are maintained by Tara Courier Services/ Airspeed"*. It also states that "*all maintenance is carried out in accordance with the Maintenance Control Manual*".

Section 4 (Personnel, Aircraft, Airport and Facility Requirements) of the Air Training Organization Manual states "*the maintenance of the training aircraft is the responsibility of the Maintenance Coordinator. Qualifications and responsibilities are set out in Section 6*".

Section 5 of the Air Training Organization Manual on page S5-7 under the heading Reporting Aircraft Defects, states that "*All defects must be reported…… The defect shall be reported immediately to the Maintenance Coordinator or the engineer on duty at the Approved Maintenance Organization"***.** It goes on to state that "*Should no maintenance staff be available, enter the defect in the appropriate space in the aircraft technical log. Inform an Instructor or desk staff of your intentions to do so as this action may ground the aircraft for maintenance, then either rectifies the defect, or may, in some cases, defer rectification until a later in accordance with approved maintenance procedures***"**.

Section 6 (Qualifications of the Chief Flying Instructor and Maintenance Co-ordinator) of the Air Training Organization Manual under the position of Chief Maintenance Engineer states the following:

(a) Caribbean Aviation Training Center at present contracts out all its maintenance of aircraft of Approved Maintenance Organizations and therefore does not employ a maintenance engineer.
(b) The responsibility for ensuring that all aircraft operated by Caribbean Aviation Training Center are maintained to the standards required by CAR's is that of the Maintenance Co-ordinator.
(c) The Maintenance Co-ordinator must know the appropriate parts of the Maintenance Control Manual necessary for the proper performance of his duties; and
(d) The Maintenance Co-ordinator must know the provisions of the Civil Aviation (Air Navigation) Regulations and Civil Aviation Directives necessary for the proper performance of his duties.

The Air Training Organization Manual did not include the qualifications required for the position of Maintenance Coordinator as set out in the Civil Aviation Regulations.

The Air Training Organization Manual did not include quality assurance procedures as required by the Civil Aviation Regulations.

The Maintenance Control Manual at Revision 9, dated July 19, 2016 was approved by the Jamaica Civil Aviation Authority on August 29, 2016

Section 1 (Introduction and Description) of the Maintenance Control Manual states that "*any Approved Maintenance Organization (AMO), holding a valid certification from the JCAA maintains Caribbean Aviation Training Center Ltd.'s aircraft in accordance with current Jamaica Civil Aviation Authority (JCAA) standards*".

Section 2.1 (Company Personnel) of the Maintenance Control Manual lists the following positions:

Managing Director/ CEO	*Capt. Errol Stewart*
Director of Maintenance	*(see Ops Spec A6)*
Chief Inspector	*(see Ops Spec A6)*

Section 3.1.3 (Receiving Inspection) of the Maintenance Control Manual states that "*all aeronautical products to be used by CATC, shall be subject to the requirements of the JCAR's and must be accompanied by the required certification documentation, e.g. FAA Form 8130-3. Manufacturers or Suppliers Certificate of Conformity where part is manufactured to Technical Standard Order, Airworthiness Approval. CATC will acknowledge parts accompanied by an invoice. The function of the Goods Receiving Process in the Technical Stores is to ensure that incoming parts and material meet regulatory, CATC and AMO requirements. Records are kept to enable complete traceability of stock to an approved supplier. CATC will only use services of approved repair stations and acquire aircraft parts and material from Approved Vendors.*
NB:

- *A class I product is defined as a complete aircraft, aircraft engine or propeller*".

Section 3.1 (Technical Stores) states "*The procurement and storage of parts and materials for maintenance of company aircraft will be accomplished by the Director of Maintenance. ……Completed parts order request will be submitted to the Managing Director/CEO for final approval to placing an order. It is the responsibility of the Director of Maintenance to ensure that only parts purchased from reputable sources with proper certification shall be used in the maintenance of company aircraft. All approved part documentation such as FAA 8130-3 form will be kept on the file with the inspection work package. The chief Inspector is responsible for vetting parts suppliers and will keep a list of supplies found to be acceptable. Procurement of parts must be made using this list*".

Section 3.1.5 (Goods Received Inspection) of the Maintenance Control Manual states
"*On receipt, the following procedure must be followed:*
5. Class I products (Type certificated products) shall have Authorized Release Certificate (ARC) 8130-3 forms and/or export C of A certificates or other like certification as the required Documentation"

Section 4.1.1 (Maintenance Contracts) of the Maintenance Control Manual states that "*all maintenance on company aircraft will be contracted to the AMO as per Appendix C of this manual*". Appendix C lists Tara Courier Service Limited and Airspeed Jamaica Limited as contracted AMO's.

Section 4.3 (Defect Control and Minimum Equipment List) of the Maintenance Control Manual states that "*pilots will record all defects in the aircraft technical (journey) log as soon as possible after the flight, and prior to further flight*".

Section 4.8 (Aircraft Logbooks) of the Maintenance Control Manual sates that "*the logbook will be kept onboard the aircraft while in operation and a copy of the previous log page on the ground. Each log page shall be in triplicates: one (1) original (white) and two (2) copies (pink and yellow). The yellow page will be pulled by maintenance, the original staying with the aircraft, and pink copy routed to operations*".
Section 4.12 (Aircraft Release to Service) of the Maintenance Control Manual states that "*the Certificate of Release to Service shall be issued in accordance with the applicable regulation. No person shall fly an aircraft for hire unless it has a valid Certificate of Release to Service signed by an appropriately licensed AME. It must capture his/her name, signature, license number, date, work performed, corrective action taken and the approved technical data used in the maintenance event*".

Management Structure
The persons listed for the positions of Chief Flight Instructor and Maintenance Coordinator were no longer working for the operator at the time of the accident.

The management persons listed in the Air Training Organizational Manual differs from some of the persons listed in the Operations Specifications A6.

There was no Assistant Chief Flight Instructor or Quality Assurance Manager listed as being employed by the ATO at the time of the accident.

The management positions listed in the Maintenance Control Manual differ from the positions listed in Operations Specification A6 and the Air Training Organizational Manual.

There was no persons approved for the positions of Director of Maintenance & Chief Inspector at the time of the accident

1.17.3 Tinson Pen Aerodrome
Tinson Pen Aerodrome, ICAO airport designator MKTP, is operated by the Airports Authority of Jamaica (AAJ), an entity established under the Airports Authority Act in 1974. The management at the aerodrome is not entirely autonomous and decisions regarding operations, maintenance and finance generally require channeling through NMIA Airports Limited (NMIAL) which is a wholly owned subsidiary of AAJ.

The Aerodrome Operator Manual used by the aerodrome operator was in draft form and was therefore not approved by the Jamaica Civil Aviation Authority as required.

Section 3 (Aircraft accident off airport) of the Tinson Pen Aerodrome Emergency Response Procedures Manual states "*in the event of an aircraft accident off the airport but within the 5km radius from the aerodrome beacon, the KTP has the responsibility to coordinate the rescue operations. Accidents occurring outside this boundary are responded to as stipulated by the JCAA or NMIAL Snr. Director Operations*".

The fire truck operated by the aerodrome was positioned to the northeast side of the Aerodrome, after noticing that the black smoke had disappeared, the Airport Protection Assistant 1 set off by foot to the accident site with two portable fire extinguishers and a crash axe through the perimeter fence into Greenwich Farm.

The MKTP Aerodrome Fire Tender was not registered to traverse public roads; approval was sought from the MKTP Operations Officer for the Aerodrome Foam Tender to be dispatched to the accident site. Whilst at the accident site, the Operations Officer subsequently requested permission for JCF to escort the Foam Tender to the accident site, the Foam Tender was repositioned to the site and the fire was extinguished.

Tinson Pen Aerodrome had not submitted a Security Programme for Approval by the Jamaica Civil Aviation Authority.

1.17.4 Jamaica Fire Brigade

The Jamaica Fire Brigade is the organization established under the Fire Brigade Act in 1988 to minimize the loss of lives, injury to persons and damage to property from fires, natural disasters, accidents and other emergencies.

The York Park Fire Station responded to a call of a downed aircraft which was received at 1:34pm. The response was made with fire unit No. 10-4 which arrived on the scene at 1:46pm, assistance was later provided by fire unit No. 5-96 (Trench Town) and Water tanker No 8-6 (York Park), fire unit No. 5-77(Rollington Town) arrived after and was placed on standby. Another fire unit No. 6-6 arrived on the scene from York Park

An Assistant Commissioner and twenty nine (29) fire fighters from the Jamaica Fire Brigade responded to the call.

The foam mix (3%) used by the Jamaica Fire Brigade was not effective in putting out the fire at the accident site.

There is no aviation fire-fighting component in the Training Program of the Jamaica Fire Brigade.

2.0 ANALYSIS

2.1 Pilot Decision Making

The pilot's decision to continue the take-off phase of the flight after experiencing a partial loss of engine power shortly after liftoff along with the decision to turn the aircraft rather than the accepted practice of maintaining a flight path straight ahead adversely affected the outcome of the flight resulting in a stall caused by failure to maintain airspeed.

This accident demonstrates the need for guidance to be developed in the area of pilot decision making for general aviation pilots. The circumstances of this accident could be instructive to other general aviation pilots in raising their awareness of potential decision making errors

2.2 Aircraft Performance

From the information provided, the aircraft was below the maximum weight and the center of gravity was within the limits as set out in the aircraft type certificate data sheet. The statements provided by witnesses indicated that the aircraft's rate of climb and speed were slow and that shortly after the aircraft made a left turn, it rapidly rolled off on a wing and descended steeply to the ground in a near vertical flight path, consistent with a stall. Based on the number of discrepancies observed with the subject engine during the examination consisting of the internal timing incorrectly being set between crankshaft and camshaft by one full tooth, the condition of the camshaft and tappets being severely worn, the engine did not have the potential of making the specified horsepower of 160 BHP at 2700 RPM. There was no evidence of any airframe or control malfunction during takeoff and subsequent crash.

2.3 Human Factors

A review of the medical history and clinical findings at last aviation medical examination of the instructor, student pilot and passenger revealed nothing of significance that could reasonably contribute to sudden incapacitation or error of judgment during flight.
Post mortem findings of all three victims were consistent with Shock and Haemorrhage, Polytrauma and Multiple Blunt Force Injuries.

2.4 Jamaica Civil Aviation Authority Safety Oversight

The lack of written guidance procedures for the certification of Approved Training Organizations (as is the case for Air Operator Certificates) impaired the Flight Safety Divisions ability to evaluate the effectiveness of the ATO's policies, methods, procedures and instructions as described in its manuals to determine if it had demonstrated its ability to comply with the regulations before beginning its operations.

The Flight Safety Division's procedures did not include any instructions for the inspection of an aircraft and its records prior to the aircraft being added to the ATO's Operations Specifications (as is the case for Air Operator Certificates).

The Flight Safety Division's safety oversight of this ATO was not very effective in that it failed to detect the lack of full complement of key management personnel and the deficiencies in its procedures; also it failed to have the ATO correct the deficiencies that it identified in a timely and satisfactory manner.

Flight Safety Inspectors were assigned tasks for which they had not received the required regulatory training and qualifications.

2.5 Jamaica Civil Aviation Authority Air Traffic Services

Although there were some deficiencies of ATS's operations, there were no air traffic control factors that contributed to the cause of the accident.

2.6 Jamaica Civil Aviation Authority Aircraft Accident Investigation

The JCAA' s failure to have in place a formal arrangement for the provision of security at an aircraft accident site, or formal arrangements for the movement and secure storage of aircraft wreckage can adversely impact the outcome of an aircraft accident investigation process as the aircraft wreckage could be tampered with or crucial components could be removed or disturbed.

2.7 Caribbean Aviation Training Center

The ATO's lack of the full complement of key management personnel who were qualified and competent, particularly with regard to the Chief Flight Instructor & Assistant Chief Flight Instructor adversely affected the ATO's ability to ensure continuity of supervision of its flight operations.

The ATO's lack of quality assurance procedures and a Quality Assurance Manager impaired the ATO's ability to monitor compliance with and adequacy of its procedures required to ensure safe operational practices and airworthy aircraft.

The vacancy of the Maintenance Coordinator position impaired the ATO's ability to ensure timely and satisfactory completion of all aircraft maintenance related activity and compliance with the airworthiness requirements of its aircraft.

The decision by the ATO to conduct maintenance on its own aircraft was contrary to the policies and procedures set out in its Air Training Organization Manual., further, the ATO did not have a Director of Maintenance or a Chief Inspector at the time of the accident. The absence of Maintenance Director adversely affected the ATO's ability to ensure the satisfactory and timely completion of aircraft maintenance functions required in accordance with the ATO's Maintenance Program for its aircraft. The absence of the Chief Inspector adversely affected the ATO's ability to monitor that its activities were being performed in accordance with the maintenance requirements and accepted procedures.

2.8 Tinson Pen Aerodrome

Although the accident did not happen on the aerodrome, there were some deficiencies found in aspects of the operations of the aerodrome that had an adverse effect on the emergency response. These include the ambiguities in the draft Emergency Response Procedures Manual to be used by ARFF personnel, and the delayed decision to dispatch the ARFF Foam Tender to the accident Site.

2.9 Jamaica Fire Brigade

The Jamaica Fire Brigade responded promptly to the emergency call with an adequate number of units and personnel. However, they were not equipped with the type of foam needed to extinguish the fire.

3.0 CONCLUSION

3.1 Findings as to Causes and Contributing Factors

(Definition: "***Each Finding identifies an element that has been shown, through the results of analysis, to have operated in the occurrence or to have almost certainly have operated in the occurrence. These Findings are related to the unsafe acts, unsafe conditions or safety deficiencies which are associated with the safety significant events that played a major role in causing or contributing to the occurrence***".)

1. The pilot(s) elected to continue the take-off phase after experiencing a partial loss of engine power.
2. The pilot(s) initiated a turn towards the north (left of runway course), while failing to maintain sufficient airspeed, resulting in a stall and spin condition causing loss of control and impact with the terrain.
3. There was a maintenance entry in the current engine logbook which stated that the engine was overhauled on June 17, 2014 by One Stop Aviation (Repair Station No. XR3R981L) under Work Order 25624 with an engine total time recorded as 1580.3 hours.
4. CATC was unable to provide a copy of the Authorised Release Certificates for the engine and the propeller under which they were stated to have been overhauled as required by their procedures despite numerous requests.
5. CATC was unable to provide a copy of the work order of the Repair Station under which the engine was stated to have been overhauled despite numerous requests.
6. The Repair Station identified in the maintenance entry was contacted in order to obtain a copy of the work order; in their response it was reported that the maintenance entry was forged and that they did not have any information regarding this engine.
7. The engine which was installed on the aircraft did not conform to its type design as the No. 2 engine cylinder intake valve was incorrect for model and type.
8. The engine internal timing was out of time by one tooth between the crankshaft and camshaft. This caused the timing mark on the starter ring gear support assembly to be

about seven (7) teeth out of alignment with the alignment dot (hole) on the starter bendix gear housing or 16.8 degrees out of time.

9. The engine camshaft showed signs of wear on lobes ranging from worn to extremely worn conditions with heavy pitting and corrosion exhibited.
10. The No. 3 engine cylinder intake and exhaust valve tappets and the No. 4 engine cylinder valve tappet showed heavy wear, pitting and spalling on the faces and edges of the tappets.
11. CATC's Air Training Organization Manual did not include the name, duties and qualifications of the Quality Assurance Manager.
12. CATC's Air Training Organization Manual did not include a description of the ATO's quality assurance system.
13. CATC did not have a quality assurance system which ensures that training and instructional practices comply with the requirements specified in the Civil Aviation Regulations, 2012, the Ninth Schedule.
14. Two management positions listed in CATC's Operations Specification A6 were vacant at the time of the accident, namely, Chief Flight Instructor and Maintenance Coordinator.
15. Two management positions required by the Civil Aviation Regulations, 2012, for ATO's namely, Quality Assurance Manager and Assistant Chief Flight Instructor were not listed in CATC's Operations Specification A6 or in their Air Training Organization Manual.

3.2 Findings as to Risk

1. The Maintenance Program that CATC used to maintain the aircraft (N101KA) was not approved by the State of Registry as required by Regulation No. 29 of the Civil Aviation Regulations, 2012.
2. There were a number of Corrosion Prevention and Control Program Inspections itemized in the ADLOG aircraft maintenance records for the aircraft, however there was no entry made in these records that reflected that the tasks were accomplished.
3. The Airworthiness Directive (AD) records presented by CATC for the aircraft were incomplete.
4. The maintenance records presented reflect that the Pitot/Static Check and Transponder Check were last accomplished on August 18, 2014.
5. Not all reported aircraft defects were being recorded in the aircraft technical log book.
6. That there was a number of service checks which were accomplished on the aircraft for which no Certificates of Release to Service were executed.
7. Not all portions of CATC's aircraft technical logbook for the aircraft was completed as required.
8. CATC was carrying out maintenance on its US registered aircraft at the time of the accident contrary to instructions in its approved manuals which state that all maintenance on company aircraft will be contacted to an Approved Maintenance Organization.
9. There were no persons approved for the positions of Director of Maintenance and Chief Inspector as set out in Section 2.1 of CATC's Maintenance Control Manual at the time of the accident.

10. The defect reporting procedures set out in CATC's Air Training Organization Manual contradicted those found in their Maintenance Control Manual.
11. A number of the procedures in the Air Training Organization Manual were not being adhered to by CATC's employees and its students.
12. A number of procedures in the Maintenance Control Manual were not being adhered to by CATC's employees.
13. Prior to take off a UAV was observed to be operating in the vicinity of the hangar used by CATC at Tinson Pen Aerodrome.
14. There were no specific operating regulations in the Civil Aviation Regulations, 2012, governing the operation of UAV's at the time of the accident.
15. Some of the JCAA Technical Personnel who were assigned to do surveillance tasks on the ATO were not properly trained and qualified prior to their assignment.
16. The Jamaica Civil Aviation Authority had no written guidance procedures for use by its Inspectors in the certification of Approved Training Organizations and Air Navigation Service Providers at the time of the accident.
17. The JCAA Audit Procedures Manual was not in conformance to the Civil Aviation Regulations of Jamaica.
18. The Jamaica Civil Aviation Authority's safety oversight of the ATO's procedures and operations was inadequate.
19. There was no documentation seen in the Flight Safety Department files to demonstrate that this Approved Training Organization was recertified in accordance with Regulation 90 of the Civil Aviation Regulations, 2004, and Transition Procedure Guidelines, dated December 8, 2004.
20. The Jamaica Civil Aviation Authority's monitoring system had been ineffective in identifying and making the operator correct the procedural lapses.
21. There was no certificated Automatic Weather Observation System (AWOS) at the ATS Tower as required by the Civil Aviation Regulations, 2012, the Twenty Fourth "A" Schedule, Paragraph 24.079 (b) (5) (viii) and the Letter of Agreement between the Air Traffic Services and the Meteorological Service.
22. There was no audible alarm at the ATS tower to alert emergency services as required by Civil Aviation Regulations, 2012, the Twenty Fourth "A" Schedule, Paragraph 24.079 (b) (5) (xv).
23. There was no voice recording equipment at the ATS Tower as required by Civil Aviation Regulations, 2012, the Twenty Fourth "A" Schedule, Paragraph 24.079 (b) (5) (xiii).
24. The Air Navigation Service Provider has not completed certification as required by the Civil Aviation Regulations, 2012, the Twenty Fourth "A" Schedule, Subpart C.
25. The Air Traffic Services Manual of Operations (MANOPS) 3rd Edition Errata Version 2012 had not been approved by the Flight Safety Division of JCAA as required by the Civil Aviation Regulations, 2012, the Twenty Fourth "A" Schedule.
26. There was no Unit Specific ATS Manual as required by the Civil Aviation Regulations, 2012, the Twenty Fourth "A" Schedule, Paragraph 24.045.
27. There was no security in place at the accident site after fire was extinguished and the bodies were recovered from the aircraft.

28. The JCAA has no arrangements with a logistic or salvage company for the removal of aircraft from an accident site to a place where the onsite investigation may be conducted.
29. The JCAA has no arrangement for the safe and secure storage of aircraft wreckage while it conducts its investigations.
30. Tinson Pen Aerodrome was not approved or certified as required by Regulation No. 91 and 92 of the Civil Aviation Regulations, 2012.
31. The Aerodrome Operator Manuals being used by the Tinson Pen Aerodrome were in draft form and were not approved by the Jamaica Civil Aviation Authority as required by Regulation No 106 of the Civil Aviation Regulations, 2012.
32. The Tinson Pen Aerodrome ARFF Fire Tender arrived at the aircraft accident site a little over 1 hour after the aircraft accident occurred.
33. The aircraft fire was extinguished within five minutes of the ARFF Fire Tender's arrival at the aircraft accident site.
34. The Tinson Pen Aerodrome did not have an approved Security Programme as required by Regulation No. 235 of the Civil Aviation Regulations, 2012
35. The foam mix used by the Jamaica Fire Brigade Fire Tenders which responded to the call was not effective in putting out the fuel-fed fire.
36. There is no aviation fire-fighting component in the training program of the Jamaica Fire Brigade.

4.0 SAFETY RECOMMENDATIONS

4.1 Safety Action Taken

None.

4.2 Safety Action Required

Aircraft Operator – Caribbean Aviation Training Center

1. That Caribbean Aviation Training Center takes immediate steps to employ the required management personnel as listed in Section 1.17.1.1 of this report, who are qualified and competent to perform their required duties.
2. That Caribbean Aviation Training Center takes immediate steps to amend its Air Training Organization Manual to ensure it contains a description of the ATO's quality assurance system as required by Civil Aviation Regulations, 2012, the Ninth Schedule, Appendix 1 to 9.053, item (3).
3. That Caribbean Aviation Training Center takes immediate steps to amend its Air Training Organization Manual to ensure that it contains the name, duties and qualification of the Quality Assurance Manager as required by Civil Aviation Regulations, 2012, the Ninth Schedule, Appendix 1 to 9.053, item (6).
4. That Caribbean Aviation Training Center takes immediate steps to establish a quality assurance system which ensures that training and instructional practices

comply with the requirements of the Civil Aviation Regulations, 2012, the Ninth Schedule.

5. That Caribbean Aviation Training Center take steps to ensure that all aircraft operated by it have a maintenance programme approved by the State of Registry in accordance with Regulation 29 of the Civil Aviation Regulations, 2012 and its Air Training Organization Manual set out in Section 1.17.2 of this report.
6. That Caribbean Aviation Training Center takes immediate steps to ensure that all Corrosion Prevention and Control Program Inspections applicable to their aircraft are accomplished and properly recorded to reflect their accomplishment.
7. That Caribbean Aviation Training Center takes immediate steps to ensure that the Airworthiness Directive (AD) records for all its aircraft are complete and in compliance.
8. That Caribbean Aviation Training Center takes immediate steps to ensure that all Special Inspection Items applicable to its aircraft have been accomplished and properly recorded in its maintenance records.
9. That Caribbean Aviation Training Center takes steps to ensure that all aircraft defects are recorded in the aircraft technical log books.
10. That Caribbean Aviation Training Center takes steps to ensure that whenever maintenance is accomplished on its aircraft, Certificates of Release to Service are executed.
11. That Caribbean Aviation Training Center take steps to ensure that the Aircraft Technical Log books are properly completed.
12. That Caribbean Aviation Training Center gets approval from the Jamaica Civil Aviation Authority prior to conducting maintenance on its own aircraft.
13. That Caribbean Aviation Training Center introduces controls to ensure that its policies and procedures as set out in its Air Training Organization Manual and Maintenance Control Manual are adhered to at all times by its employees and students.
14. That Caribbean Aviation Training Center takes immediate steps to correct the conflicting procedures set out in the Air Training Organization Manual and its Maintenance Control Manual with regards to aircraft defect control.

Jamaica Civil Aviation Authority – Flight Safety Division

1. That the Jamaica Civil Aviation Authority should take immediate steps to develop guidance procedures on the certification of Approved Training Organizations for use by its Inspectors.
2. That the Jamaica Civil Aviation Authority takes immediate steps to recertify Caribbean Aviation Training Center as an Approved Training Organization.
3. That the Jamaica Civil Aviation Authority takes steps to have its Technical Personnel trained and qualified prior to their assignment as set out in Section 1.17.1.1 of this report.
4. That the Jamaica Civil Aviation Authority take steps to have its Audit Procedures Manual amended to conform to the Civil Aviation Regulations
5. That the Jamaica Civil Aviation Authority take steps to include Audit Procedures Training in its training plan for all Flight Safety Inspectors.

6. That the Jamaica Civil Aviation Authority should take immediate steps to develop guidance procedures on the certification of Air Navigation Services Providers for use by its Inspectors.
7. That the Jamaica Civil Aviation Authority should take steps to complete the certification the Air Navigation Service Provider (which would include all manuals and documents).
8. That the Jamaica Civil Aviation Authority should take steps to have the Tinson Pen Aerodrome Certificated.

Jamaica Civil Aviation Authority – Air Navigation Services

1. That the Jamaica Civil Aviation Authority should take immediate steps to install and commission a voice recording system at the Tinson Pen Tower.
2. That the Jamaica Civil Aviation Authority should take immediate steps to commission an audible alarm to alert the Emergency Services at the Tinson Pen Tower.
3. That the Jamaica Civil Aviation Authority should take steps to commission a Meteorological Service certified Automated Weather Observation System at Tinson Pen.
4. That the Jamaica Civil Aviation Authority should take steps to provide air traffic information requested by accident/incident investigation teams in a timelier manner.

Jamaica Civil Aviation Authority – Aircraft Accident Investigation

1. That the Jamaica Civil Aviation Authority takes immediate steps to put in place an agreement/ arrangement with a security organization for the security of aircraft accident sites.
2. That the Jamaica Civil Aviation Authority takes immediate steps to put in place an agreement/ arrangement with a logistic company for the movement of aircraft wreckage from the accident site to a secure location where the investigation can continue unimpeded.
3. That the Jamaica Civil Aviation Authority takes immediate steps to put in place an arrangement with a facility for the safe and secure storage of aircraft wreckage whiles it conducts its investigations.

Jamaica Civil Aviation Authority – Regulations

1. That the Jamaica Civil Aviation Authority makes recommendations to the Minister for the amendment of the Civil Aviation Regulations, in particular the Fifth Schedule Subparts C, D, E and F to make these requirements applicable also to foreign registered aircraft operating in Jamaica. This would allow for the proper oversight of foreign registered aircraft used under the Ninth Schedule.
2. That the Jamaica Civil Aviation Authority makes recommendations to the Minister for the amendment of the Civil Aviation Regulations to include provisions for an ATO to lease foreign registered aircraft.
3. That the Jamaica Civil Aviation Authority make recommendations to the Minister for the amendment of the Civil Aviation Regulations to include provisions for the registration, certification, operation and maintenance of UAV's.

Aerodrome – Tinson Pen Aerodrome

1. That the Aerodrome Operator pursues the goal of meeting the Jamaica Civil Aviation Authority requirement of aerodrome certification.
2. That the Aerodrome operator develop detailed training lesson plans for required training subjects of initial and recurrent training for its personnel.
3. That the Aerodrome Operator takes immediate steps to expedite production of a complete, comprehensive and unambiguous Aerodrome Operator's Manual, providing proper guidance for its personnel as well as third parties associated with critical areas of aerodrome operation, including Aerodrome Emergency Procedures.
4. That the Aerodrome Operator include in its Aerodrome Emergency Response Procedures Manual a detailed description of the off-aerodrome areas for which the aerodrome ARFFS will provide response, and the nature and extent of such response.
5. That the Aerodrome Operator submit a Security Programme for approval to the Jamaica Civil Aviation Authority as required by Regulation No. 235 of the Civil Aviation Regulations, 2012.

Jamaica Fire Brigade

1. That the Jamaica Fire Brigade include aviation fire-fighting in its Training Programme.
2. That the Jamaica Fire Brigade has available for its use, the foam mix used in aviation accidents.

EXHIBIT 1

RECORDING TACH TIME | TODAY'S FLIGHT

ENGINE CERTIFICATE — **FAA Repair Station XR3R981L**

JUNE 17, 2014
Engine TT: 1580.3

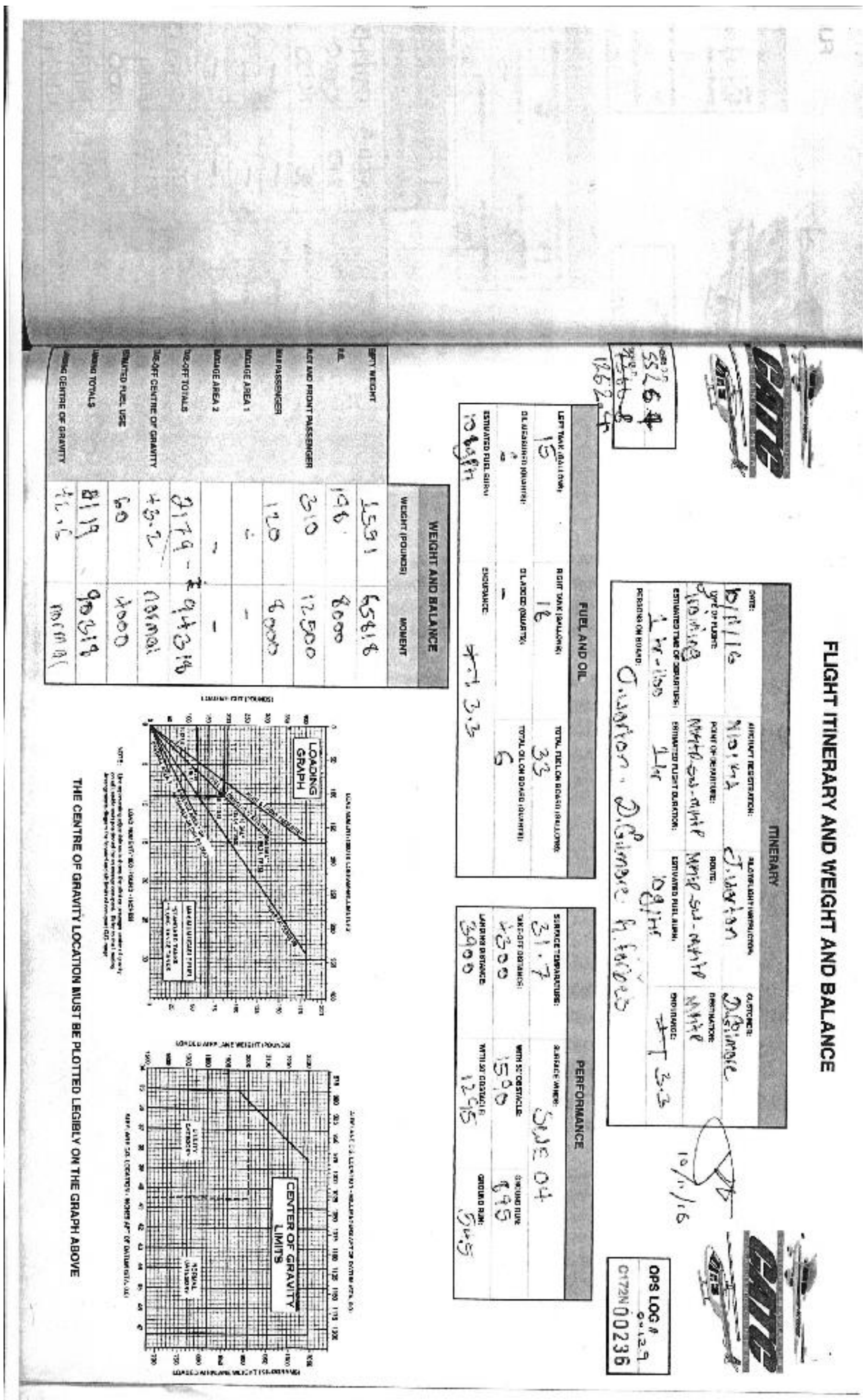
Major overhaul engine in accordance with manufacturers specification and current federal aviation regulations. All current airworthiness directives complied with at overhaul. Magnaflux and Zyglo inspection of appropriate parts. Work Order No. 25624 on file at One Stop Aviation, Oceanside, CA; engine reassembled, test run, and OK to return to service.

LYCOMING Model O-320 H2AD Serial No. L 3872-76

Authorized Representative _____

AIRCRAFT Tach Time @ Installation _____ "0" SMOH

EXHIBIT NO. 2


FLIGHT ITINERARY AND WEIGHT AND BALANCE
ITINERARY
PERFORMANCE
FUEL AND OIL
WEIGHT AND BALANCE
LOADING GRAPH
CENTER OF GRAVITY LIMITS
THE CENTRE OF GRAVITY LOCATION MUST BE PLOTTED LEGIBLY ON THE GRAPH ABOVE
OPS LOG #
C172N 00236