



Section/division

Accident and Incident Investigations Division

Form Number: CA 12-12a

AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference: CA18/2/3/9550	
Aircraft Registration		ZS-PYJ	Date of Accident		11 May 2016
Type of Aircraft		Cessna C172	Type of Operation		Training Part 91
Pilot-in-command Licence Type		PPL	Age	26	Licence Valid Yes
Pilot-in-command Flying Experience		Total Flying Hours	141,2	Hours on Type	66,8
Last point of departure		Grand Central Airport FAGC – Gauteng			
Next point of intended landing		Grand Central Airport FAGC – Gauteng			
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)					
Open field at 550m in the direction 120 degree from the threshold at GPS: S25° 59' 48.53", E028° 08' 58.03"					
Meteorological Information		Wind direction: 340; Wind speed: 6 kt; Wind Temperature: 12 °C; Visibility: Night (IFR).			
Number of people on board	1+1	No. of people injured	2	No. of people killed	0
Synopsis					
<p>A pilot accompanied by a passenger was engaged on an hour-building exercise when the accident occurred. On the day of the accident, the pilot was conducting a navigational exercise during night visual meteorological conditions. The pilot intended to do a full stop landing at FAGC on the return flight, when the aircraft lost engine power on the short final approach to Runway 35. During a forced landing roll on an open area with an uneven surface, the aircraft hit several anthills. The aircraft flipped over and hit the ground on its vertical stabiliser.</p> <p>The pilot and his passenger sustained minor injuries during the accident sequence. The aircraft sustained substantial damage to the nose landing gear, the propeller front cone, the engine, right wing strut and the vertical fin.</p> <p>The post-accident investigation revealed that the aircraft engine stopped due to fuel exhaustion.</p>					
Probable Cause:					
The accident resulted from an unsuccessful forced landing following loss of power.					
Contributing Factors					
1. The engine power was lost due to fuel exhaustion during flight. 2. Poor flight planning. 3. Uneven landing surface					
SRP Date		11 October 2016	Release Date		

**AIRCRAFT ACCIDENT REPORT**

Name of Owner : Flight Training Services
Name of Operator : Private
Manufacturer : Cessna Aircraft Company
Model : Cessna 172K
Nationality : South African
Registration Marks : ZS-PYJ
Place : Midrand, Gauteng
Date : 11 May 2016
Time : 0130Z

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (2011) this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and not to establish legal liability.

Disclaimer:

This report is produced without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION**1.1 History of Flight**

1.1.1 On the day of the accident, the pilot of the rented aircraft was accompanied by a passenger (also a pilot) during a night navigational exercise. During his first flight, the pilot uplifted 30 US gallons of fuel, filling up the tanks. The first flight was conducted uneventfully at around 16:00Z on the 10 May 2016. On the second flight, the pilot stated that he took the same route with the same fuel amount (full tanks) on board the aircraft, after uplifting 37,2 US gallons of fuel. Take-off was at 20:50Z of 10 May 2016 and routed via Krugersdorp Airport (FAKD), where he conducted one

orbit overhead and then proceeded with his flight towards FAGC. The aircraft experienced a strong tailwind until it was below the terminal manoeuvring area (TMA). He then flew back to pass over FAGC as he proceeded to Rustenburg Airport (FARG) and then Pilanesberg Airport (FAPS) prior to his return to FAGC.

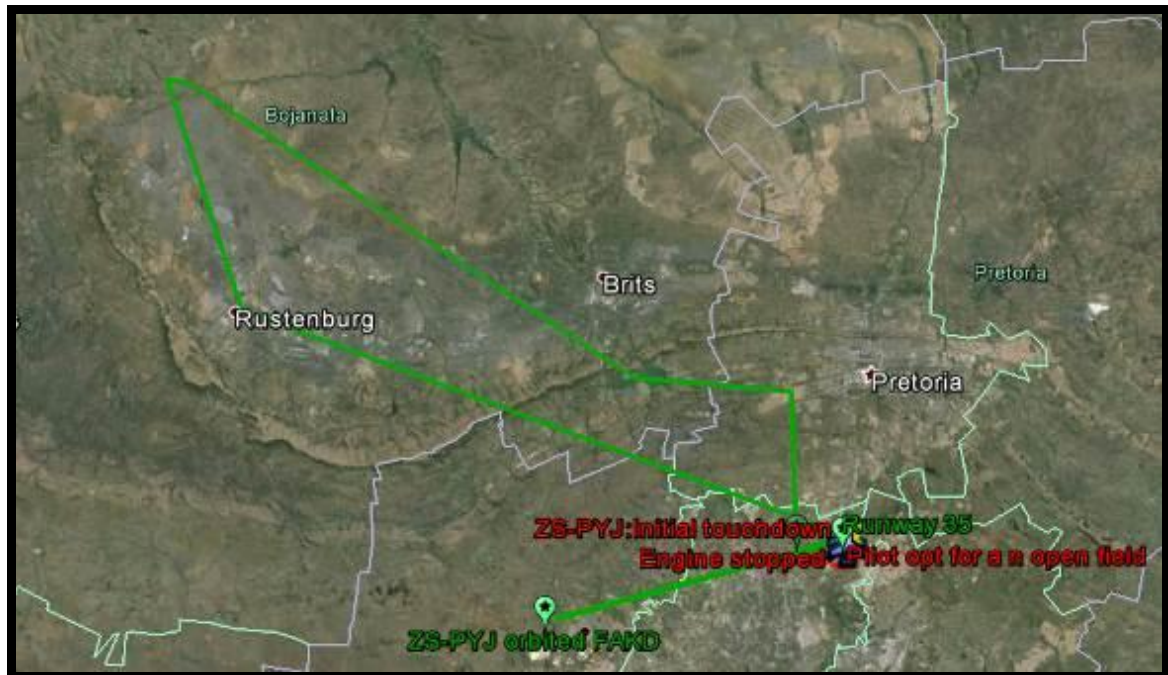


Figure 1: Route taken by the pilot on Google map

- 1.1.2 On his return the pilot flew via Hartbeespoort Dam and continued flying over the Atteridgeville area in the early hour of the next day on 11 May 2016. The FAGC aerodrome fire-fighting and rescue was monitoring all flight calls on the radio frequency in the area, and stated that the pilot was overheard saying that he was low on fuel when he reported two minutes away from the airfield. It was just after joining the left circuit for the landing approach for Runway 35 at FAGC while flying over Kyalami area.
- 1.1.3 The pilot reported on final approach for clearance of any air traffic that could be in the area. While he was on finals and turning left for approach on Runway 35, the pilot reported engine failure. He noticed that the engine had stopped and attempted three unsuccessful engine restarts. On the short final of Runway 35, the aircraft did a forced landing on an uneven open field next to electrical power poles. It collided several times with some anthills and bounced along its landing roll route until it flipped over.

- 1.1.4 The accident occurred on the short final approach to Runway 35 at a distance of approximately 550 m at an angle of 120 degrees from the Runway 35 threshold. It occurred during night visual meteorological conditions while the pilot was conducting a night navigation exercise. The forced landing took place on an open field with GPS coordinates S25° 59' 48.53", E028° 08' 58.03" and a field elevation of 5 238 ft above mean sea level (AMSL).

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	–	–	–	–
Serious	–	–	–	–
Minor	1	–	1	–
None	–	–	–	–

1.3 Damage to Aircraft

- 1.13.1 The aircraft sustained substantial damage to the nose landing gear, nose section, left wing struts and the vertical stabiliser.



Figure 2: Aircraft damage

1.4 Other Damage

1.4.1 No other damage was reported.

1.5 Personnel Information

1.5.1 During the investigation interview, the pilot indicated to the investigating officer that he was aiming for a flight of 4,5 hours.

Nationality	Pakistani	Gender	Male	Age	26
Licence Number	02725273300	Licence Type	PPL		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Night				
Medical Expiry Date	31 May 2018				
Restrictions	Corrective lenses				
Previous Accidents	None				

Flying Experience:

Total Hours	141,2
Total Past 90 Days	58,3
Total on Type Past 90 Days	58,3
Total on Type	66,8

1.6 Aircraft Information

Airframe:

Type	C 172K	
Serial Number	172-5837/6	
Manufacturer	Cessna Aircraft Company	
Date of Manufacture	1969	
Total Airframe Hours (At time of Accident)	9 021,4	
Last MPI (Date & Hours)	28 April 2016	8 964,8
Hours since Last MPI	56,6	
C of A (Expiry Date)	22 May 2017	
C of R (Issue Date) (Present owner)	1 November 2007	
Operating Categories	Part 141	

Engine:

Type	Lycoming O-320-E2D
Serial Number	RL-30470-27A
Hours since New	1 675
Hours since Overhaul	TBO not yet reached

Propeller:

Type	McCauley IC172/MTM7653
Serial Number	E14720
Hours since New	1 454,7
Hours since Overhaul	TBO not yet reached

1.6.1 The Cessna 172 Skyhawk is a four-seat, single-engine Lycoming O-320-E2D, high fixed-wing aircraft made by the Cessna Aircraft Company. It has a tricycle non-retractable landing gear arrangement.

1.6.2 The Fuel System

The information about the fuel system was extracted from the Cessna 172 pilot's operating handbook.

Fuel is supplied to the engine from two tanks, one in each wing. With the fuel selector valve on BOTH, the total usable fuel for all flight conditions is 38 gallons for the standard tanks. Fuel from each tank flows by gravity to a selector valve. Fuel from the left, right or both tanks flows through a fuel strainer and carburettor to the engine induction system. The fuel selector valve should be in the BOTH position for take-off, climb, landing, and manoeuvres that involve prolonged slips or cruising flight.

Note: With low fuel (1/8th or less), a prolonged steep descent (1 500 feet or more) with partial power, full flaps and 80 MPH or greater should be avoided due to the possibility of the fuel tank outlets being uncovered, causing temporary fuel starvation. If starvation occurs, levelling the nose should restore power within 20 seconds.

Note: When the fuel selector valve handle is in the BOTH position in cruising flight, unequal fuel flow from each tank may occur if the wings are not exactly level. Resulting wing heaviness can be alleviated gradually by turning the selector valve handle to the tank in the “heavy” wing.

Note: It is not practical to measure the time required to consume all of the fuel in one tank and after switching to the opposite tank, except to assume an equal flight duration from the remaining fuel. The airspace in both fuel tanks is interconnected by a vent line and therefore, some sloshing of fuel between tanks can be expected when the tanks are nearly full and the wings are not level.

The aircraft weight was within limits with only two occupants on board and the aircraft allowed carrying full fuel capacity for the flight.

- 1.6.3 The aircraft documentation such as the maintenance logbooks, service bulletins and latest mandatory periodic inspections was reviewed. The information indicated that the aircraft was equipped in accordance with existing regulations. All service bulletins published by the engine and aircraft manufacturers had been adhered to and complied with by the aircraft maintenance organisation (AMO).

1.7 Meteorological Information

- 1.7.1 Meteorological information as obtained from the pilot questionnaire

Wind direction	340°	Wind speed	6 kt	Visibility	CAVOK
Temperature	12 °C	Cloud cover	None	Cloud base	None
Dew point	2 °C				

1.8 Aids to Navigation

- 1.8.1 The aircraft was equipped with the standard factory-fitted navigational equipment approved by the Regulator. There were no recorded defects to navigational equipment prior to the flight.

1.9 Communications

1.9.1 The aircraft was equipped with one VHF (very high frequency) radio approved by the Regulator. No defects of the communications equipment were recorded prior to the flight. At the time of the take-off flight, ATC FAGC was unstaffed. All communication of the flight in the surrounding area took place through the local frequency to check any traffic near or within the FAGC airspace. The radio frequency in the surrounding airspace of FAGC is 122,8 MHz, which is connected to FAGC's aerodrome fire-fighting and rescue and emergency service.

1.10 Aerodrome Information

1.10.1 The accident occurred during night meteorological conditions while the pilot was conducting a night navigation exercise and force-landed on an open field with GPS coordinates: S25° 59' 48.53", E028° 08' 58.03" and a field elevation of 5 238 ft AMSL.

Aerodrome Location	Midrand, Gauteng	
Aerodrome Co-ordinates	S25°59'13.44", E028°08'25.97"	
Aerodrome Elevation	5 327 ft	
Runway Designations	17/35	
Runway Dimensions	1 830 × 15 m	
Runway Used	Intended to use 35	
Runway Surface	Asphalt	
Approach Facilities	None	

1.11 Flight Recorders

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

1.12 Wreckage and Impact Information

1.12.1 The aircraft accident occurred on a short final during landing approach for Runway 35 at a distance of approximately 550 m at an angle 120 degrees from the threshold. The aircraft landed in an open area with an uneven surface, on a route next to electrical power lines. There are several anthills along the aircraft's route path. The aircraft's initial touchdown was at approximately 180 metres (GPS: S 25 59 52.76, E 028 9 1.05) away from the final resting point. According to the pilot's statement, he was aware of the area that he chose for the forced landing.



Figure 3: Google view of the aircraft touchdown path

1.12.2 After the initial touchdown during the forced landing, the aircraft bounced over some anthills on its main wheels whilst the nose gear was still in the air. Another two bounces over more anthills followed, along its landing roll path. On the last bounce, the nose-gear hit the ground hard and collapsed, upon which the aircraft flipped over. The nose landing gear broke the wheel fork assembly before it collapsed.



Figure 4: Google view of the final aircraft path



Figure 5: Shows the nose landing gear trail as it rips off

1.12.3 Apart from the damage to the collapsed landing gear, the engine mountings and cowlings were also damaged when the nose landing gear was ripped off. The aircraft then flipped over on its roof, with its nose facing the opposite direction. This caused the vertical stabiliser to hit the ground hard and caused compression damage. The propeller remained intact and undamaged, indicating that it was not turning at the time of the accident sequence. The aircraft engine was turning freely with no signs of anomalies following the post-accident on-site inspection. According to the flight accident assessor, the aircraft was considered a write-off. The on-site

investigation follow-up revealed that there was less than half a litre of fuel remaining in the left fuel tank. There were no signs of fuel leaks or spillage during and after the aircraft accident sequence.

1.13 Medical and Pathological Information

1.13.1 The pilot and his passenger were admitted to a hospital for injuries assessment through the medical team (ER24) that responded to the accident site. They sustained minor injuries and were later discharged.

1.14 Fire

1.14.1 There was no post- or pre-impact fire during the accident sequence.

1.15 Survival Aspects

1.15.1 The accident was considered survivable. The pilot and his passenger were restrained by their shoulder harnesses during the accident sequence.

1.16 Tests and Research

1.16.1 Following the on-site post-accident inspection, all damage on the aircraft systems and flight control surfaces were accounted for and attributed to impact damage. The engine was recovered and subjected to an engine bench test where the results showed no anomalies.

1.16.2 During the interview, the pilot indicated to the investigator that he was aiming to conduct a four-hour duration flight according to his knowledge of the aircraft operation with full fuel capacity.

Aircraft Fuel System

The following table shows the cruise and range performance of the aircraft type as per Cessna 1978 SKYHAWK C172 Pilot Operational Handbook (POH), Page 5.4, Figure 5-4.

Note: *Maximum cruise is normally limited to 75% power. Cruise speed for the standard model 172 is approximately one MPH less than shown above for the Skyhawk configuration.*

Gross weight of 2300 Lbs Standard Conditions Zero Wind Lean Mixture

ALT (FT)	RPM	GAL/HOUR	ENDURANCE (HOURS)	RANGE (MILES)
7500	2 700	8,4	4,5	600
	2 600	7,7	4,9	625
	2 500	7,1	5,3	645
	2 400	6,7	5,7	645
	2 300	6,2	6,1	640

A total fuel amount of 37,2 US gallons was uplifted at 1945 Z. Taking into account fuel burnt during start-up and taxiing prior to take-off estimated at approximately 10 minutes maximum, with the minimum fuel flow rate of 6,2 gallon per hour (gal/h) and a take-off to cruise altitude of 7 500 ft. The aircraft settings for this flight require maximum settings of 2 700 rpm and a minimum of 2 300 rpm with a fuel flow of 8,4 gal/h at maximum and 6,1 gal/h at minimum. The pilot reported that he was flying with aircraft power settings at maximum. For these rich fuel mixture settings, the flight would have lasted for 3,8 hours.

1.17 Organizational and Management Information

- 1.17.1 This was a hire-a-fly training flight operated under a private pilot licence for a night navigation exercise operated under provision of Standard Part 91 with an existing lease agreement in place.
- 1.17.2 The AMO that maintained the aircraft was approved by the Regulator in accordance with existing regulatory procedures, with a valid AMO approval certificate expiring on 31 May 2016.
- 1.17.3 The aircraft was registered to the operator as a training aircraft under provision of Standard Part 141 of the existing South African Civil Aviation Regulations of 2011, operating with the valid Training Approval Certificate which was to expire on 30 April 2017.

1.18 Additional Information

1.18.1 None

1.19 Useful or Effective Investigation Techniques

1.19.1 None

2. ANALYSIS

2.1 The pilot was qualified and licensed for the flight in accordance with existing regulatory procedures. His medical certificate indicated that the pilot was medically fit for the flight.

2.2 The pilot stated that he was aiming for a 4,5 hour flight with full fuel tanks during the time of the flight. The calculated flight duration from take-off until the time of forced landing was 4,6 hours. According to the flight performance recordings from the POH, a full tank fuel capacity at standard zero wind conditions and operating at 7 500 ft with a lean fuel mixture will last for 4,5 hours. However, at the time of the flight, engine power settings were at 2700 rpm with a variable mixture adjustment at low temperature conditions.

For the second flight, a fuel amount of 37,2 US gallons was uplifted. This is the total allowable carried amount of fuel, including the unusable fuel during flight operation. It shows that the pilot did not learn that it was not safe to take the same route, as he was lucky to make it to his destination on the first flight. To make things worse, during the second flight, the pilot executed one orbit overhead of FAKD, increasing the flight duration. Hence, given the flight operational conditions, the amount of fuel carried during both flights was not sufficient for the exercise route.

2.3 The aircraft was maintained and equipped accordingly by a Regulator-approved AMO in accordance with approved procedure. The POH requires that the flight be operated with at least 0,5 hours reserve fuel to execute a safe flight. During approach, while joining the circuit for FAGC Runway 35 for landing, the pilot reported he had two minutes' fuel remaining, indicating that he had overflowed his flight duration. This shows poor flight planning.

- 2.4 It is the investigator's opinion that the aircraft did not make it to its destination due to fuel exhaustion. The pilot reported that during a left turn when he was on finals for Runway 35 approach, the engine stopped completely. This was due to no fuel in both fuel tanks. This was also confirmed during the on-site investigation when no signs of fuel spillage were apparent and less than half a litre of fuel was found in either wing tank. The aircraft engine during post-investigation was subjected to engine bench runs tests and no anomalies were found.

3. CONCLUSION

3.1 Findings

- 3.1.1 The pilot was licensed and qualified for the flight in accordance with existing regulatory procedures.
- 3.1.2 The pilot held a valid medical certificate at the time and was medically fit for the flight.
- 3.1.3 According to the maintenance logbooks, the aircraft was maintained in accordance with existing approved procedures by an approved AMO.
- 3.1.4 The aircraft had a certificate of airworthiness in accordance with the existing regulatory procedures.
- 3.1.5 The on-site inspection revealed that the remaining fuel in both aircraft fuel tanks was insufficient.
- 3.1.6 The pilot's statement and actions show that his knowledge regarding the aircraft operations was inadequate. In his flight planning, he failed to take into account that the total duration of the aircraft operation is from starting the engine until landing.
- 3.1.7 Both flight durations indicate that the pilot's planned routes were not suitable for the total fuel carried in the aircraft tanks at full capacity.
- 3.1.8 The aircraft engine did not fail due to any mechanical faults, but due to fuel exhaustion.

3.1.9 The weather was not considered a contributing factor to the accident.

3.2 Probable Cause/s

3.2.1 The accident resulted from an unsuccessful forced landing following loss of power.

3.3 Contributing Factors

3.3.1 The engine power was lost due to fuel exhaustion during flight.

3.3.2 Poor flight planning.

3.3.3 Uneven landing surface (The aircraft flipped over subsequent to nose landing gear collapsed after it collided several time with the anthills along its forced landing roll path)

3.3.4 Disregard of standard operation procedures

4. SAFETY RECOMMENDATIONS

4.1 None

5. APPENDICES

5.1 None

END