PRELIMINARY ACCIDENT REPORT

Accident and Incident Investigations Division

Accident
- Preliminary Report -
AIID Ref No: CA18/2/3/10087

Figure 1: The Cessna 177 Cardinal aircraft, ZS-EZM. (Source: Pilot)

Description:

On 7 December 2021, a pilot and a passenger on-board a Cessna 177 Cardinal aircraft with registration ZS-EZM were on a private flight from Grand Central Aerodrome (FAGC) to the Johannesburg General Flying (GF) area, with the intention to land back at FAGC. According to the pilot, approximately 35 minutes into the flight whilst 7000 feet overhead Lawley residential area, which is located on the south of Lenasia in Johannesburg, the engine started to run rough and eventually stopped. The pilot noted that fuel gauges read zero litres whilst carrying out fault finding and engine restart procedures. The pilot presumed that the engine had stopped due to fuel exhaustion. He then glided the aircraft towards Baragwanath Aerodrome (FASY); however, the aircraft lost height too rapidly, resulting in the aircraft undershooting Runway (RWY) 31 by approximately 300 metres before the threshold. During landing, the nose landing gear impacted the hard rugged terrain, which led to an abrupt halt of the aircraft. The aircraft was substantially damaged; however, the occupants did not sustain injuries during the accident sequence.

INTRODUCTION

Reference Number	**:** CA18/2/3/10087
Type of Operation	**:** Private
Manufacturer	**:** Cessna Aircraft Company
Model	**:** Cessna 177, Cardinal
Nationality	**:** South African
Registration Mark	**:** ZS-EZM
Place	**:** 300m east of Baragwanath Aerodrome (FASY), Gauteng Province
Date	**:** 7 December 2021
Time	**:** 0635Z

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 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 apportion blame or liability****.*

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.

Investigation Process:

The accident was notified to the Accident and Incident Investigations Division (AIID) on 7 December 2021 at about 0645Z. The investigator will conduct an off-site (desktop) investigation. The AIID is leading the investigation as the Republic of South Africa is the State of Occurrence.

Notes:
1. Whenever the following words are mentioned in this report, they shall mean the following:

- *Accident — this investigated accident*
- *Aircraft — the Cessna C177 Cardinal involved in this accident*
- *Investigation — the investigation into the circumstances of this accident*
- *Pilot — the pilot involved in this accident*
- *Report — this accident report*

2. Photos and figures used in this report were taken from different sources and may have been adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows, or lines.

Disclaimer:

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ABBREVIATION	DESCRIPTION
°	Degrees
°C	Degrees Celsius
AIID	Accident and Incident Investigations Division
AMSL	Above Mean Sea Level
CAR	Civil Aviation Regulations
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CPL	Commercial Pilot Licence
CRS	Certificate of Release to Service
FAGC	Grand Central Aerodrome
FAOR	O.R. Tambo Aerodrome
FASY	Baragwanath Aerodrome
ft	Feet
GFA	General Flying Area
GPS	Global Positioning System
hPa	Hectopascal
kg	Kilograms
km	Kilometres
kt	Knots
m	Metres
MHz	Megahertz
MPI	Mandatory Periodic Inspection
RWY	Runway
QNH	Altitude Above Mean Sea Level
SACAA	South African Civil Aviation Authority
TBO	Time Between Overhaul
USG	US Gallons
VMC	Visual Meteorological Conditions
Z	Zulu (Term for Universal Co-ordinated Time - Zero Hours Greenwich)

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1. On 7 December 2021, a pilot and a passenger on-board a Cessna 177 Cardinal aircraft with registration ZS-EZM took off on a private flight from Grand Central Aerodrome (FAGC) to the Johannesburg General Flying (GF) area, with the intention to land back at FAGC. Visual Meteorological Conditions (VMC) by day prevailed at the time of flight and no flight plan was filed. Fine weather conditions also prevailed at the time leading to the accident.

1.1.2. According to the pilot, during pre-flight inspection, the aircraft had a total (both tanks) of approximately 24 gallons (USG) (91 litres) of usable fuel at take-off, which was enough for a flight endurance of about 2.5 hours.

1.1.3. The pair took off on a private flight from FAGC at approximately 0600Z. The flight was estimated to be 1.3 hours long. However, at 0635Z, approximately 35 minutes into the flight at 7000 feet (ft) whilst flying north overhead Lawley residential area, which is located on the south of Lenasia in Johannesburg, the engine started to run rough.

Figure 2: Global Positioning System information of flight stages. (Source: Pilot)

1.1.4. Thereafter, the pilot carried out a fault-finding procedure, but could not identify anything faulty. The engine continued to run rough and eventually stopped whilst the fuel selector setting was on both fuel tanks. The pilot noted that the fuel quantity indicator, fuel flow and the fuel pressure gauges were all at zero units; therefore, he presumed that the cause was fuel exhaustion.

1.1.5. The pilot then glided the aircraft towards Baragwanath Aerodrome (FASY); however, it lost height rapidly, resulting in the aircraft undershooting Runway (RWY) 31 by approximately 300 metres (m) before the threshold. During landing, the nose landing gear impacted the hard rugged terrain, which resulted in an abrupt halt of the aircraft. The aircraft was substantially damaged during the accident sequence; however, the occupants did not sustain injuries; they disembarked the aircraft without assistance.

1.1.6. The aircraft landed on an open field 300m before the threshold of RWY 31 at FASY at Global Positioning System (GPS) co-ordinates determined to be 26°21’05.2” South 027°47’10.8” East, at 5439ft above mean sea level (AMSL).

Figure 3: Aerial view of the accident site's proximity to FASY RWY 31. (Source: Google Earth Pro)

1.2. Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other
Fatal	-	-	-	-	-
Serious	-	-	-	-	-
Minor	-	-	-	-	-
None	1	-	1	2	-
Total	**1**	**-**	**1**	**2**	**-**

Note: Other means people on ground.

1.3. Damage to Aircraft

1.3.1. The aircraft was substantially damaged.

Figure 4: The aircraft post-accident. (Source: Pilot)

1.4. Other Damage

1.4.1. None.

1.5. Personnel Information

Nationality	South African	Gender	Male	Age	23
Licence Number	0275001405	Licence Type	Commercial Pilot Licence (CPL)		
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument, Instructor Grade 2				
Medical Class	Class 1				
Medical Issue Date	27 January 2021	Medical Expiry Date	31 January 2022		
Restrictions	Suitable corrective lenses				
Previous Accidents	None				

Note: Previous accidents refer to past accidents the pilot was involved in, when relevant to this accident.

Flying Experience:

Total Hours	724.1
Total Past 24 Hours	48.5
Total Past 7 Days	0
Total Past 90 Days	48.5
Total on Type Past 90 Days	16.8
Total on Type	36.4

1.6. Aircraft Information

1.6.1. The Cessna 177 Cardinal is a four-seat, high-wing, fixed tricycle-gear aircraft manufactured in 1968 and powered by a Lycoming IO-360 200-horsepower (hp) engine, equipped with a two-blade, fixed-pitch, Hartzell propeller.

Airframe:

Manufacturer/Model	Cessna 177 Cardinal	
Serial Number	177-00296	
Year of Manufacture	1968	
Total Airframe Hours (At Time of Accident)	3 082.84	
Last MPI (Date & Hours)	11 December 2020	3 047.99
Hours Since Last MPI	34.85	
C of A (Issue Date)	8 September 1988	
C of A Expiry Date	30 April 2022	
C of R (Issue Date) (Present Owner)	10 March 2021	
Type of Fuel Used in the Aircraft	Avgas 100 LL	
Operating Categories	Part 91	
Previous Accidents	None	

Note: Previous accidents refer to past accidents the aircraft was involved in, when relevant to this accident.

Engine:

Manufacturer/Model	Lycoming IO-360
Serial Number	L-5698-58A
Hours Since New	2957.41
Hours Since Overhaul	300.78

Propeller:

Manufacturer/Model	Hartzell HC-C3YR-1RF
Serial Number	DY4609B
Hours Since New	348.29
Hours Since Overhaul	52.34

1.6.2. There were no technical defects with the airframe, engine, propeller or installed systems and components recorded in the logbooks and flight folio.

1.6.3. According to the pilot, the aircraft had approximately 24 USG (91L) of total usable fuel in both tanks at take-off, which was enough for a flight endurance of approximately 2.8 hours at 65% or 2.2 hours at 75% cruise.

1.6.4. The pilot confirmed that the fuel quantity was determined by using a Perspex dipstick prior to the flight.

1.6.5. Fuel System (Source: Cessna 177 and Cardinal Owner's Manual, 1968)

Fuel is supplied to the engine from two integral fuel bladder tanks, one in each wing. Usable fuel in each tank for all flight conditions is 24 USG (91 litres) when filled (48 USG or 182 litres in total).

A 21-USG (79 litres) level marker in the form of a white line, just inside the filler neck, is provided.

Fuel from each wing fuel tank flows through a selector valve, small reservoir, and fuel shut-off valve, to the fuel strainer; thereafter, it is routed to an engine-driven pump which delivers fuel under pressure to the carburettor. The electric auxiliary fuel pump (runs) parallel to the engine-driven pump and is used when fuel pressure drops below 2 pounds per square inch (psi).

It is not necessary to have the auxiliary fuel pump operating during normal take-off and landing since gravity feed will supply adequate fuel flow to the carburettor with the engine-driven pump inoperative. However, gravity flow is considerably reduced at maximum performance take-off and climb attitudes, and the auxiliary fuel pump would be required should the engine-driven pump fail during these manoeuvres.

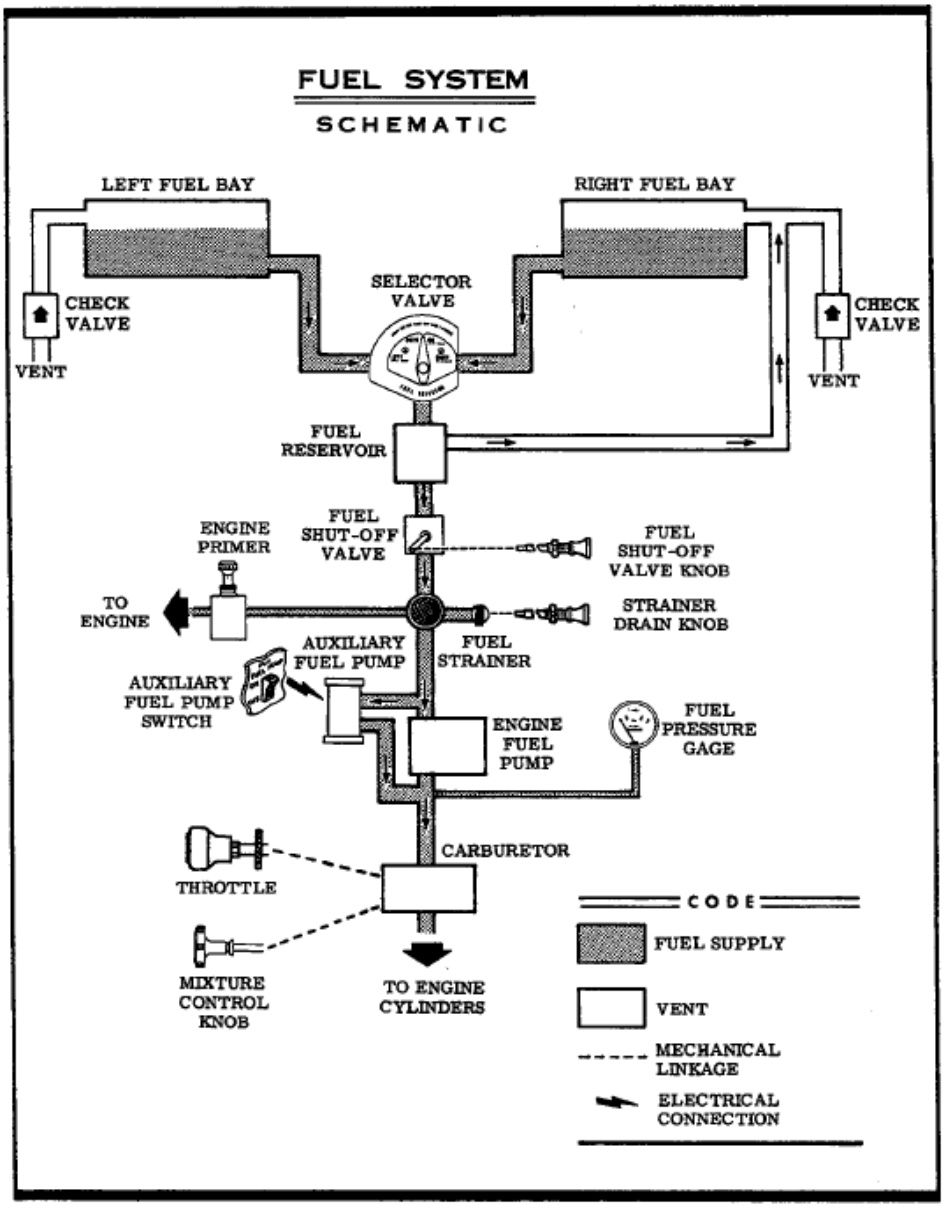

Diagram 1: Cessna 177 Fuel System Schematic. (Source: Cessna 177 Owner's Manual)

1.7. Meteorological Information

1.7.1. The weather information below was provided by the pilot who obtained it from O.R. Tambo Aerodrome (FAOR) weather office on the day of the accident prior to the flight. FAOR is located 52 kilometres (km) from the accident site.

Wind Direction	350°	Wind Speed	9 kts	Visibility	9999 m
Temperature	21°C	Cloud Cover	CAVOK	Cloud Base	CAVOK
Dew Point	15°C	QNH	1023 hPa		

1.8. Aids to Navigation

1.8.1. The aircraft was equipped with standard navigational equipment as approved by the Regulator (SACAA). There were no records indicating that the navigation system was unserviceable prior to the accident.

1.9. Communication

1.9.1. The aircraft was equipped with a standard communication system as approved by the Regulator. There were no recorded defects with the communication system prior to the accident.

1.10. Aerodrome Information

Aerodrome Location	Baragwanath Aerodrome (FASY), Soweto, Gauteng Province
Aerodrome Status	Unlicensed
Aerodrome Co-ordinates	26°20'47"South 027°46'31"East
Aerodrome Altitude	5 393 ft
Runway Headings	31/13
Runway Dimensions	1 113 m x 11 m
Runway Used	31
Runway Surface	Asphalt
Approach Facilities	None
Radio Frequency	122.350 MHz

1.11. Flight Recorders

1.11.1. The aircraft was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required by regulation to be fitted to the aircraft type.

1.12. Wreckage and Impact Information

1.12.1. According to the pilot, after the engine had stopped, he glided the aircraft towards FASY; however, the aircraft lost height rapidly, resulting in the aircraft undershooting RWY 31 and landing approximately 300m before the threshold on the hard rugged terrain. The nose gear impacted the hard rugged soil, which brought the aircraft to an abrupt halt.

1.12.2. The cradle separated from the engine. The firewall was damaged, whilst the nose landing strut broke off.

Figure 5: Damaged nose landing gear strut. (Source: Pilot)

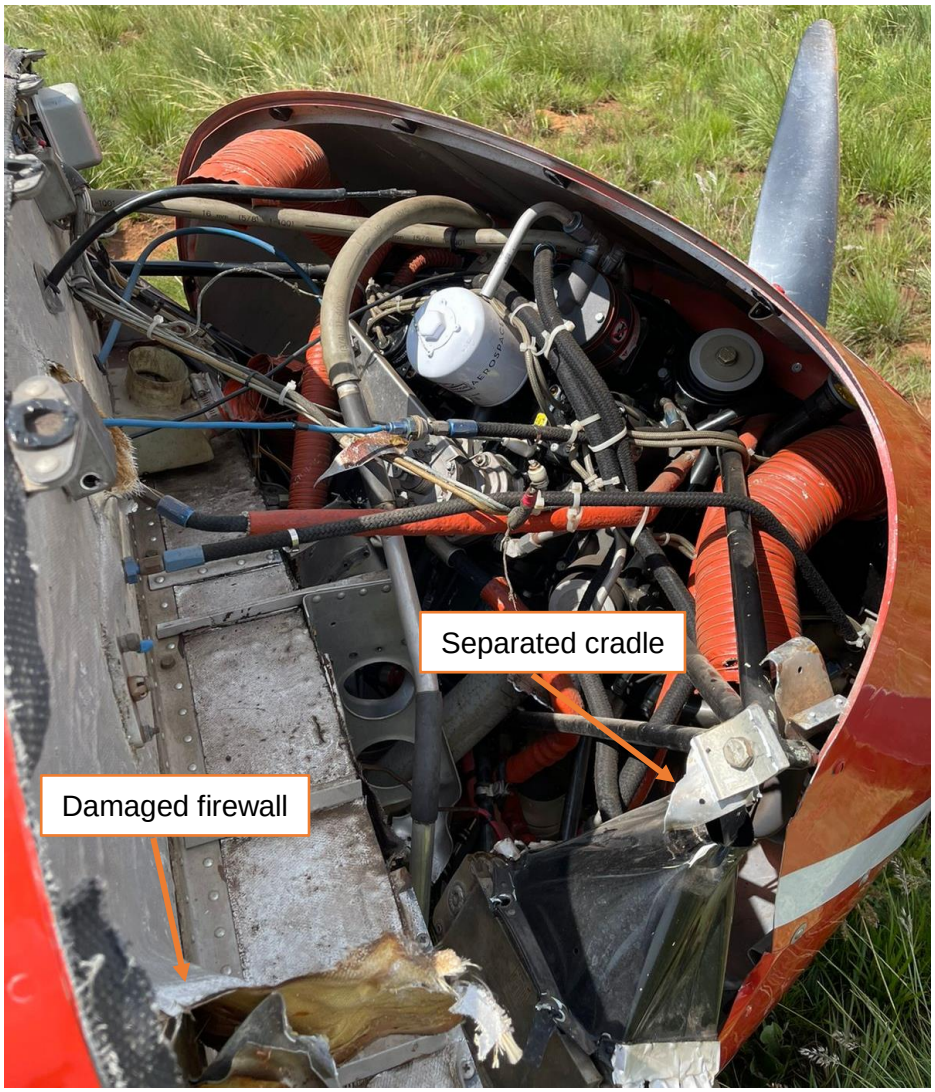

Figure 6: Damaged firewall and separated cradle from the engine. (Source: Pilot)

1.12.3. Post-accident, the pilot noticed residue of fuel, characterised by its blue colour, underneath the left fuel tank.

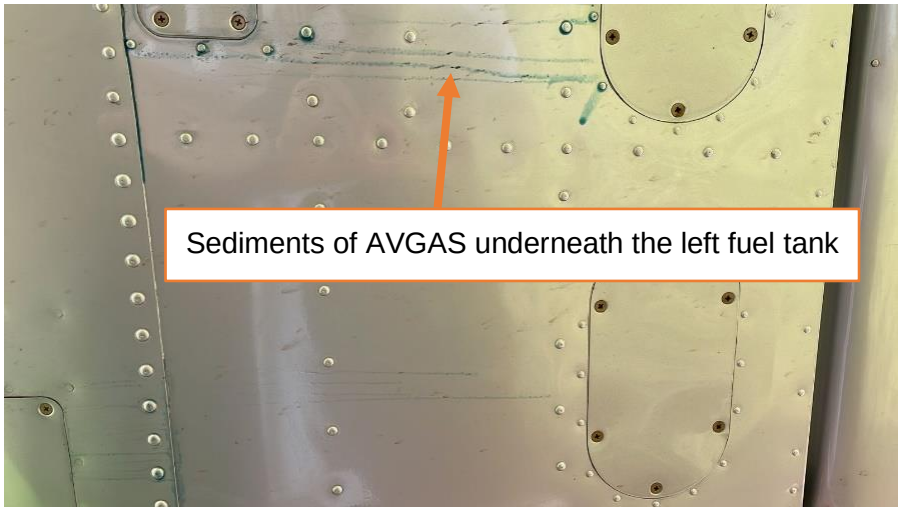

Figure 7: Sediments of AVGAS underneath the left fuel tank. (Source: Pilot)

1.12.4. According to the pilot, there were no mechanical anomalies with the fuel selector.

1.13. Medical and Pathological Information

1.13.1. Not applicable to this occurrence.

1.14. Fire

1.14.1. There was no evidence of a pre- or post-impact fire.

1.15. Survival Aspects

1.15.1. The accident was considered survivable as the cockpit and cabin structure remained intact after the accident.

1.16. Tests and Research

1.16.1. To be discussed in the final report.

1.17. Organisational and Management Information

1.17.1. The aircraft maintenance organisation (AMO) which carried out the last mandatory periodic inspection (MPI) was issued an AMO approval certificate by the SACAA on 18 June 2021 with an expiry date of 31 May 2022.

1.18. Additional Information

1.18.1. To be discussed in the final report.

1.19. Useful or Effective Investigation Techniques

1.19.1. To be discussed in the final report.

2. Findings

2.1. General

From the available evidence, the following preliminary findings were made with respect to this accident. These shall not be read as apportioning blame or liability to any organisation or individual.

To serve the objective of this investigation, the following sections are included in the conclusions heading:

- **Findings —** are statements of all significant conditions, events, or circumstances in this accident. The findings are significant steps in this accident sequence, but they are not always causal or indicate deficiencies.

The pilot

2.1.1. The pilot had a Commercial Pilot Licence (CPL) that was issued on 6 February 2021 with an expiry date of 28 February 2022. According to the pilot questionnaire, the pilot had flown a total of 724.1 hours, of which 36.4 were on the aircraft type.

2.1.2. The pilot was issued a Class 1 aviation medical certificate on 27 January 2021 with an expiry date of 31 January 2022, with restrictions to wear suitable corrective lenses.

The aircraft

2.1.3. The aircraft was issued a Certificate of Registration (C of R) for the present owner on 10 March 2021.

2.1.4. The aircraft was issued a Certificate of Airworthiness (C of A) on 8 September 1988 with an expiry date of 30 April 2022.

2.1.5. The aircraft was issued a Certificate of Release to Service (CRS) following its last mandatory periodic inspection (MPI) carried out on 30 July 2021 at 3 047.99 airframe hours. The aircraft had accumulated a further 34.85 airframe hours since the said inspection.

2.1.6. The AMO which carried out the last MPI was issued an AMO approval certificate by the SACAA on 18 June 2021 with an expiry date of 31 May 2022.

2.1.7. All control surfaces were accounted for and all damage to the aircraft was attributable to the impact forces.

2.1.8. According to the pilot, during pre-flight inspection, the total (both tanks) usable fuel was determined to be 24 gallons using a Perspex dipstick, which would have been enough

for a 2.8-hour flight at 65% cruise power or a 2.2-hour flight at 75% cruise power. However, the engine stopped due to fuel exhaustion (no usable fuel on-board), 35 minutes into the flight.

3. On-going Investigation

3.1 The AIID investigation is on-going and the investigator will be looking into other aspects of this occurrence which may or may not have safety implications.

This report is issued by:

Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa