AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:		**CA18/2/3/10144**	
Aircraft Registration	ZS-AXE	**Date of Accident**		8 April 2022		**Time of Accident**	1050Z
Type of Aircraft	Piper PA-38-112 (Tomahawk)			**Type of Operation**		Training (Part 141)	
Pilot-in-command Licence Type	Commercial Pilot Licence (CPL)			**Age**	27	**Licence Valid**	Yes
Pilot-in-command Flying Experience		**Total Flying Hours**		316.7		**Hours on Type**	137
Last Point of Departure	Cape Town International Airport (FACT), Western Cape Province						
Next Point of Intended Landing	Cape Town International Airport (FACT), Western Cape Province						
Damage to Aircraft	Substantial						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Private farm near Diemerskraal Aerodrome at Global Positioning System (GPS) determined to be 33°35'0.10" South 018°54'47.45" East, at 300ft above mean sea level (AMSL)							
Meteorological Information	Wind direction 130°, Wind speed: 11 Knots (kts), Visibility 9999, Cloud coverage/base: FEW035; Temperature: 22°C, Dewpoint: 7°C QNH: 1025 hPa						
Number of People On-board	2+0	**Number of People Injured**	1	**Number of People Killed**	0	**Other (On Ground)**	0

Synopsis

On Friday, 8 April 2022 at approximately 0940Z, a flight instructor and a student pilot on-board a Piper PA-38-112 (Tomahawk) aircraft with registration ZS-AXE took off on a training flight from Cape Town International Airport (FACT) in the Western Cape province, to Diemerskraal Aerodrome in the same province. The intention of the flight was to conduct touch-and-go circuit training at Diemerskraal Aerodrome, and then return to FACT. The flight was conducted under visual meteorological conditions (VMC) by day and under the provisions of Part 141 of the Civil Aviation Regulations (CAR) 2011 as amended.

The crew stated that during the flight, they omitted to conduct some of the in-flight and approach checks as required by the Standard Operating Procedures (SOP) as there was a discussion in the cockpit about the prevailing weather conditions in the area of Diemerskraal Aerodrome, which had a significant crosswind at the time from both sides of the runway orientated 04 and 22. The flight instructor and the student pilot had attempted to contact the aerodrome owner to acquire a detailed weather update, but this was in vain. The flight instructor and the student pilot confirmed that during the flight and the joining phase at the aerodrome, they did not change the selected fuel tank. When they arrived at the aerodrome, there was a strong crosswind, however, the flight instructor decided to demonstrate the crosswind technique to the student pilot. According to the instructor, a maximum rudder with the appropriate bank angle to the left-wing technique to maintain constant course was established on long final and was maintained until touchdown. After the initial touch-and-go circuit, the flight instructor decided that they should return to FACT as he felt that the wind was too strong, and the environment was not conducive for training. During the initial climb at a height of approximately 150 feet (ft) above ground level (AGL), the engine started to lose power and surged, whereafter, it stopped. The flight instructor and the student pilot had little time to react and, thus, they opted to land straight ahead on an open field.

During the forced landing on an uneven ground, the aircraft contacted the ground with its right main landing gear first and rolled for 17 metres (m) before both the left gear and the nose gear hit the ground and continued to roll for approximately 7m; then the aircraft bounced. The aircraft contacted the ground for the second time with all three landing gears and continued to roll for approximately 5m before it bounced again. On the third contact with the ground, the aircraft impacted the ground with the nose first, which caused the nose landing gear to bend backwards. The instructor hurt his back during the accident sequence and the student pilot was not injured.

Post-accident investigation revealed that the prolonged low-wing technique used to counter the crosswind with low fuel content in the tank caused fuel to migrate towards the left wingtip (moving from the fuel outlet point of the tank), which resulted in total loss of fuel flow to the engine.

Probable Cause and Contributory Factor			
A prolonged low-wing technique used to counter the crosswind whilst the fuel content was low in the tank caused fuel to migrate towards the left wingtip (moving from the fuel outlet point of the tank), which led to total loss of fuel flow to the engine. **Contributory factor**: Failure to monitor or manage fuel, which led to the loss of engine power.			
SRP Date	20 September 2022	Publication Date	28 September 2022

Occurrence Details

Reference Number	**:** CA18/2/3/10144
Occurrence Category	**:** Category 2
Type of Operation	**:** Training (Part 141)
Name of Operator	**:** Cape Town Flying Club
Aircraft Registration	**:** ZS-AXE
Aircraft Make and Model	**:** Piper PA-38-112
Nationality	**:** South African
Place	**:** Private farm near Diemerskraal Aerodrome
Date and Time	**:** 8 April 2022 at 1050Z
Injuries	**:** Serious
Damage	**:** Substantial

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 and Incident Investigations Division (AIID) of the South African Civil Aviation Authority (SACAA) was notified of the occurrence on 8 April 2022 at 1100Z. The AIID did not dispatch an investigator to the accident site, and thus, the investigation was conducted remotely. The occurrence was classified as an accident according to Part 12 of the CAR 2011 and ICAO STD Annex 13 definitions. Notifications were sent to the State of Registry/Operator/Design/Manufacturer in accordance with Part 12 of the CAR 2011 and ICAO Annex 13 Chapter 4. The States did not appoint an accredited representative and advisor.

Notes:

1. *Whenever the following words are mentioned in this report, they shall mean the following:*
   Accident — this investigated accident
   Aircraft — the Piper PA-38-112 Tomahawk 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
'	Minutes
"	Seconds
°	Degree
°C	Degree Celsius
AGL	Above Ground Level
AIID	Accident and Incident Investigations Division
AMO	Aircraft Maintenance Organisation
AMSL	Above Mean Sea Level
ATO	Approved Training Organisation
CAR	Civil Aviation Regulations
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CPL	Commercial Pilot Licence
CTFC	Cape Town Flying Club
CRS	Certificate of Release to Service
CVR	Cockpit Voice Recorder
FACT	Cape Town International Airport
FDR	Flight Data Recorder
ft	Feet
GPS	Global Positioning System Coordinates
hPa	Hectopascal
hrs	Hours
kt	Knots
km	Kilometre
Lt	Litre
m	Metres
METAR	Meteorological Aerodrome Report
PIC	Pilot-in-command
POH	Pilot's Operating Handbook
SACAA	South African Civil Aviation Authority
SAWS	South African Weather Service
SB	Service Bulletin
SI	Service Instruction
SL	Service Letter
SOP	Standard Operating Procedures
SPL	Student Pilot Licence
VMC	Visual Meteorological Conditions

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1. On Friday, 8 April 2022 at approximately 0940Z, a flight instructor and a student pilot on-board a Piper PA-38-112 (Tomahawk) aircraft with registration ZS-AXE took off on a training flight from Cape Town International Airport (FACT) in the Western Cape province, to Diemerskraal Aerodrome in the same province. The intention of the flight was to conduct touch-and-go circuit training. The flight was conducted under visual meteorological conditions (VMC) by day and under the provisions of Part 141 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2. According to the flight instructor and the student pilot, a total of 20 US gallons (75.7 litres) of Avgas was uplifted, with each fuel tank refuelled with 10 US gallons. The start-up was conducted; however, the crew could not recall which fuel tank they had selected at start-up. The aircraft was later taxied to the designated general aviation run-up area for further checks prior to take-off and departure at FACT using Runway 19. The instructor and the student pilot reported that when they were approximately 600 feet (ft) above ground level (AGL), they commenced with the after-take-off checks, which included switching off the electrical fuel pump. Upon switching off the electrical fuel pump, the flight instructor noticed a drop in fuel pressure. He then switched the electrical fuel pump on again. The flight instructor stated that he was not comfortable with the fuel pressure, therefore, he lowered the nose and reduced power; these interventions normalised the fuel flow pressure. The flight instructor continued with the flight and kept the electrical fuel pump on during the flight.

1.1.3. The student pilot was familiar with the flight checks, which he repeated every 15 to 20 minutes during the flight, although the flight instructor was the pilot flying. The crew stated that during the flight, they omitted to conduct some of the in-flight and approach frequent checks required (FREDA checks) which included checks such as fuel system, fuel quantity, tank selection, as required by the Standard Operating Procedures (SOP). This was because the pilots had a discussion in the cockpit about the prevailing weather conditions around the Diemerskraal Aerodrome area, which had a significant crosswind at the time from both sides of the runway, orientated 04 and 22. The flight instructor and the student pilot stated that they had attempted to contact the aerodrome owner to acquire a detailed weather update, but this was in vain. The flight instructor and the student pilot confirmed that during the flight and at the joining phase at Diemerskraal Aerodrome, no fuel tank change was made.

1.1.4. According to the flight instructor, when they arrived at the aerodrome, they experienced a strong crosswind, however, he decided to demonstrate the crosswind technique to the student pilot. He established a maximum rudder with the appropriate bank angle to the left-wing technique to maintain constant course on long final; this technique was maintained until touchdown. After the initial circuit, the flight instructor decided that they should return to FACT as he felt that the wind was too strong and the environment not conducive for training. During the climb at a height of approximately 150ft AGL, the engine started to lose power and surged, whereafter, it stopped. The instructor and the student pilot had little time to react and, thus, the flight instructor opted to land straight ahead on an open field.

1.1.5. During the forced landing on an uneven ground, the aircraft contacted the ground with its right main landing gear first and rolled for 17 metres (m) before both the left gear and the nose gear hit the ground and continued to roll for approximately 7m; then the aircraft bounced. The aircraft contacted the ground for the second time with all three landing gears and continued to roll for approximately 5m before it bounced again. On the third contact with the ground, the aircraft impacted the ground with the nose first, which caused the nose landing gear to bend backwards. The aircraft came to a stop in a nose-down attitude.

1.1.6. The student pilot disembarked the aircraft unassisted and, thereafter, helped the flight instructor out of the aircraft to a safe distance where he laid him down. The instructor had a severe back pain. The student pilot then contacted the operator who, in turn, informed the relevant authorities about the accident. Emergency medical personnel attended to the flight instructor at the scene after their arrival. He was later transported to a hospital by ambulance. The student pilot was not injured during the accident sequence. The aircraft sustained damage to the nose section and nose landing gear, as well as the propeller hub.

1.1.7. The accident occurred on a private farm at Global Positioning System (GPS) determined to be 33°35'0.10" South 018°54'47.45" East, at an elevation of 300ft.

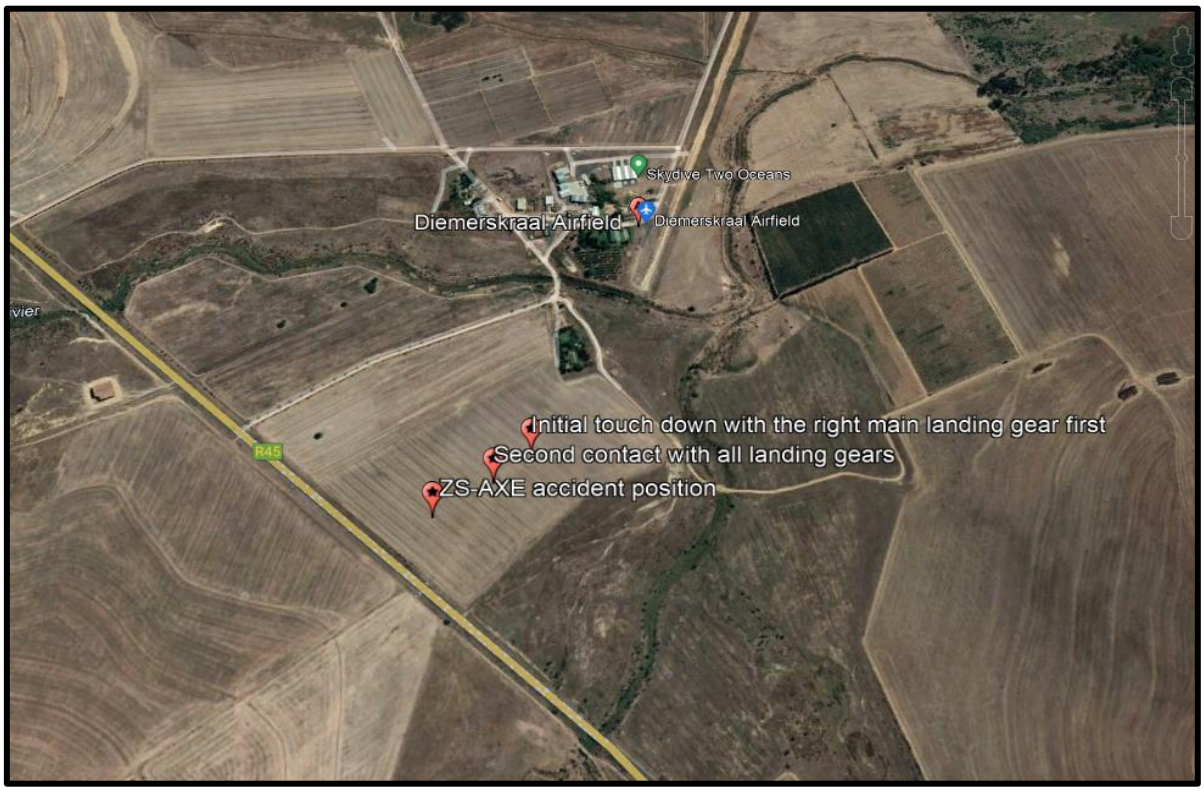

Figure 1: Aerial view of the accident site. (Source: Google)

1.2. Injuries to Persons

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

Note: Other means people on the ground.

1.3. Damage to Aircraft

1.3.1. The aircraft sustained substantial damage to the nose landing gear and nose section, as well as the propeller hub.

Figure 2: The aircraft as it came to rest. (Source: ATO)

1.4. Other Damage

1.4.1. Fuel spillage on the ground, which was limited to the area where the aircraft came to rest following the accident sequence.

1.5. Personnel Information

1.5.1 Instructor:

Nationality	South African	Gender	Male	Age	27
Licence Type	Commercial Pilot Licence (CPL) Aeroplane				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument, Flight Instructor Grade 3				
Medical Expiry Date	28 February 2023				
Restrictions	None				
Previous Accidents	None				

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

Flying Experience:

Total Hours	316.7
Total Past 24 Hours	2.4
Total Past 7 Days	5.6
Total Past 90 Days	37.1
Total on Type Past 90 Days	33.5
Total on Type	137.0

1.5.2 The flight instructor was initially issued a Commercial Pilot Licence (CPL) by the Regulator (SACAA) on 11 February 2021. The licence revalidation was issued by the Regulator on 18 January 2022 with an expiry date of 31 January 2023. His Class 1 medical certificate was valid and issued on 24 February 2022 with an expiry date of 28 February 2023. He had accumulated a total of 316.7 flight hours, of which 137 hours were on the aircraft type.

1.5.3 The student pilot was issued a Student Pilot Licence (SPL) by the Regulator on 21 February 2022 with an expiry date of 20 February 2023. His Class 2 medical certificate was issued on 15 December 2021 with an expiry date of 15 December 2026. The student pilot had accumulated a total of 15.7 hours on the aircraft type.

1.6. Aircraft Information

1.6.1. The information below is an extract from the Pilot's Operating Handbook (POH), PA-38-112 Tomahawk:

The Piper Tomahawk is a two-seat single engine and tricycle fixed gear aircraft with a low cantilever wing configuration and a T-tail. In alignment with the initial premise of building the ultimate flight trainer based on the market consensus, the differentiating design features of the Tomahawk are exactly what the surveyed flight instructors requested.

The aircraft is fitted with a Lycoming O-235-L2-C engine and a Sensenich 72CK-0-56 two-bladed propeller.

Airframe:

Manufacturer/Model	Piper Aircraft Corporation/ PA-38-112	
Serial Number	38-79A0265	
Year of Manufacture	1979	
Total Airframe Hours (At Time of Accident)	7873.21	
Last Inspection (Date & Hours)	1 March 2022	7785.31
Hours Since Last Inspection	87.9	
CRS Issue Date	1 March 2022	
C of A (Issue Date & Expiry Date)	1 March 2021	30 April 2022
C of R (Issue Date) (Present Owner)	26 May 2021	
Type of Fuel Used	Avgas LL100	
Operating Category	Part 141	
Previous Accidents	None	

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

Engine:

Manufacturer/Model	Lycoming
Serial Number	L19483-1S
Part Number	O-235-L2-C
Hours Since New	2708.85
Hours Since Overhaul	1051.86

Propeller:

Manufacturer/Model	Sensenich
Serial Number	KV518
Part Number	72CK-0-56
Hours Since New	2257.7
Hours Since Overhaul	377.23

1.6.2 The aircraft maintenance documents, such as the mandatory periodic inspection (MPI) document, logbooks and all engine and airframe manufacturer-published Service Bulletins (SB), Service Instructions (SI) and Service Letters (SL) were reviewed. The aircraft was issued a Certificate of Airworthiness on 1 March 2021 with an expiry date of 30 April 2022. The aircraft's maintenance was conducted by an aircraft maintenance organisation (AMO) with a valid AMO-approval certificate that was issued by the Regulator on 4 September 2021 with an expiry date of 30 November 2022. The AMO issued the aircraft a Certificate of Release to Service (CRS) on 1 March 2021 following the MPI.

1.6.3 On the day of the flight, the crew uplifted a total of 20 US gallons (75.7 litres) of Avgas distributed evenly with 10 US gallons in each tank.

The information below is an extract from the Pilot's Operating Handbook (POH), PA-38-112 Tomahawk:

The fuel system

The fuel system should be simple, self-explanatory, and easy to access. Fuel is stored in two, sixteen-US gallon (1 US gallon usable) fuel tanks, giving the aircraft a total of thirty-two (32) US gallons of which (30 US gallons usable). The tanks are secured to the leading edge of each wing with rivets. When installed, a filler neck indicator aids in determining fuel remaining when the tanks are not full. The fuel tank selector control is located in the centre of the engine control quadrant. The button on the selector cover must be depressed and held while the handle is moved to the OFF position. The button releases automatically when the handle is moved back to the ON position. A fuel quantity gauge for each tank is located on either side of the fuel tank sector, each gauge on the same side as the corresponding fuel tank.

An auxiliary electrical fuel pump is provided in case the engine-driven pump fails. The electrical pump should be ON for take-offs and landings and when switching tanks. The fuel pump switch is located in the switch paned to the left of the throttle quadrant. The fuel drains should be opened daily prior to the first flight to check for water or sediments. Each tank has an individual drain at the bottom, inboard rear corner. A fuel strainer, located on the lower left front of the fire wall, has a drain which is accessible from outside the left nose section. The strainer should also be drained before the first flight of the day. The fuel pressure gauge is mounted in a gauge cluster located to the right of the control quadrant. An engine priming system is installed to facilitate starting.

Loss of fuel pressure

If loss of fuel pressure occurs, turn ON the electrical fuel pump and check that the fuel selector is on a tank containing fuel. If the problem is not an empty tank, land as soon as practical and have the engine-driven fuel pump and fuel system checked.

1.6.4. **Engine power loss during take-off (if airborne)**

If the engine failure occurs after the aircraft has lifted off, and if there is insufficient landing area remaining for a touchdown and stop, maintain a safe airspeed to avoid a stall. Close the throttle, pull the mixture control to idle cut-off, and turn OFF the fuel selector, the master switch, and the magnetos. Use of flaps depends upon the circumstances; however, normally full flaps allow the slowest and softest touchdown. Maintain directional control and land straight ahead. All low altitude turns should be avoided except for slight and gentle deviations to avoid obstacles. A preferred crash landing straight ahead is preferable to risking a stall which could result in an uncontrolled roll and crash out of a turn.

1.7. Meteorological Information

1.7.1 The weather information below was obtained from the Meteorological Aerodrome Report (METAR) that was issued by the South African Weather Service (SAWS) for FACT on 8 April 2022 at 1000Z.

FACT 081000Z 13011KT 9999 FEW035 22/06 Q1025 NOSIG=

Wind Direction	130°	Wind Speed	11kt	Visibility	9999m
Temperature	22°C	Cloud Cover	FEW	Cloud Base	3500ft
Dew Point	7°C	QNH	1025		

1.7.2 The prevailing weather conditions indicated crosswinds from the left when Runway 22 was used.

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 flight.

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 flight.

1.10. Aerodrome Information

1.10.1 The accident occurred on a private farm, approximately 540m from the threshold of Runway 04 at Diemerskraal Aerodrome in the Western Cape province.

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. Observation of the aircraft wreckage:

The aircraft accident occurred on an open field in a private farm with an uneven surface. The ground surface had plough lanes which were perpendicular at 90º (degree) to the aircraft's landing path.

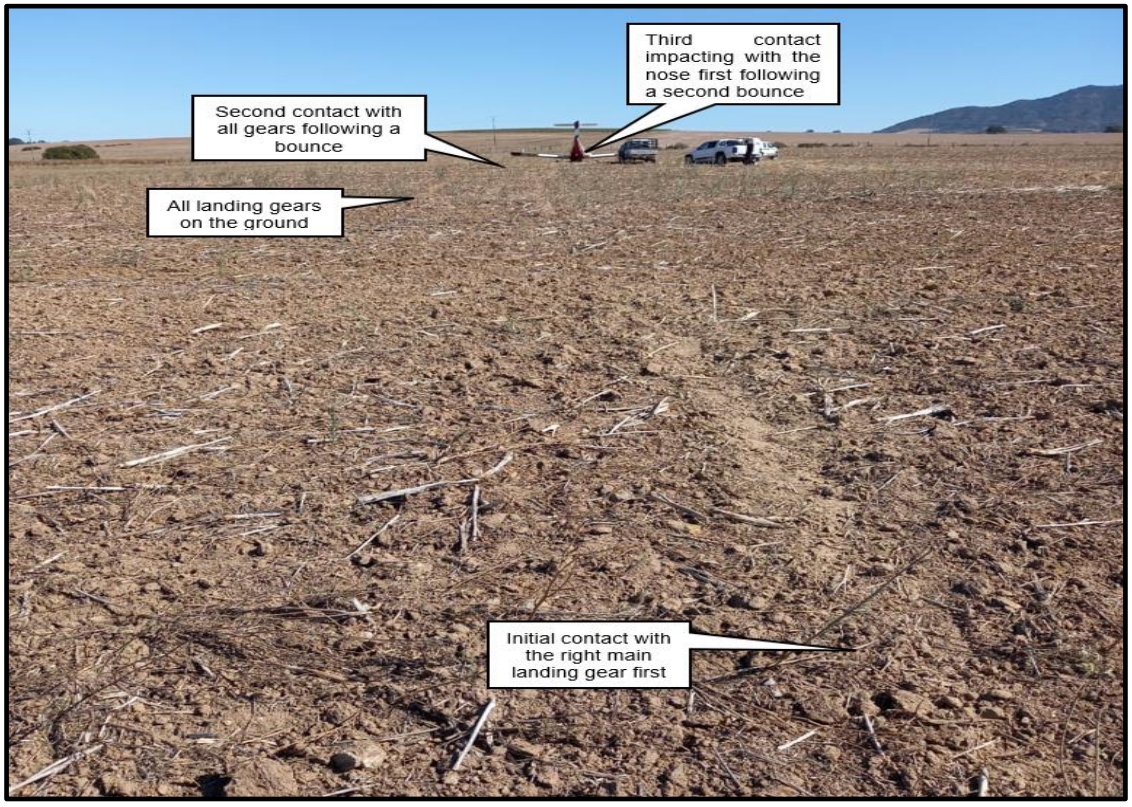

Figure 4: The aircraft's ground markings during the accident. (Source: Operator)

- Initially, the aircraft contacted the ground with its right main landing gear first and rolled for 17 metres (m) before both the left gear and the nose gear hit the ground and continued to roll for approximately 7m; then the aircraft bounced. The second contact was with all three landing gears, and the aircraft continue to roll for approximately 5m before it bounced again. On the third contact with the ground, the aircraft impacted the ground with the nose first, which caused the nose landing gear to bend backwards. The aircraft came to a stop in a nose-down attitude.

Figure 5: The damaged propeller hub and propeller blades.

- The propeller hub and the nose section sustained substantial damage due to impact with the ground during the accident sequence. One of the propeller blades was bent. The damage on the propeller blade was consistent with the propeller that was not turning or windmilling at the time of impact with the ground.

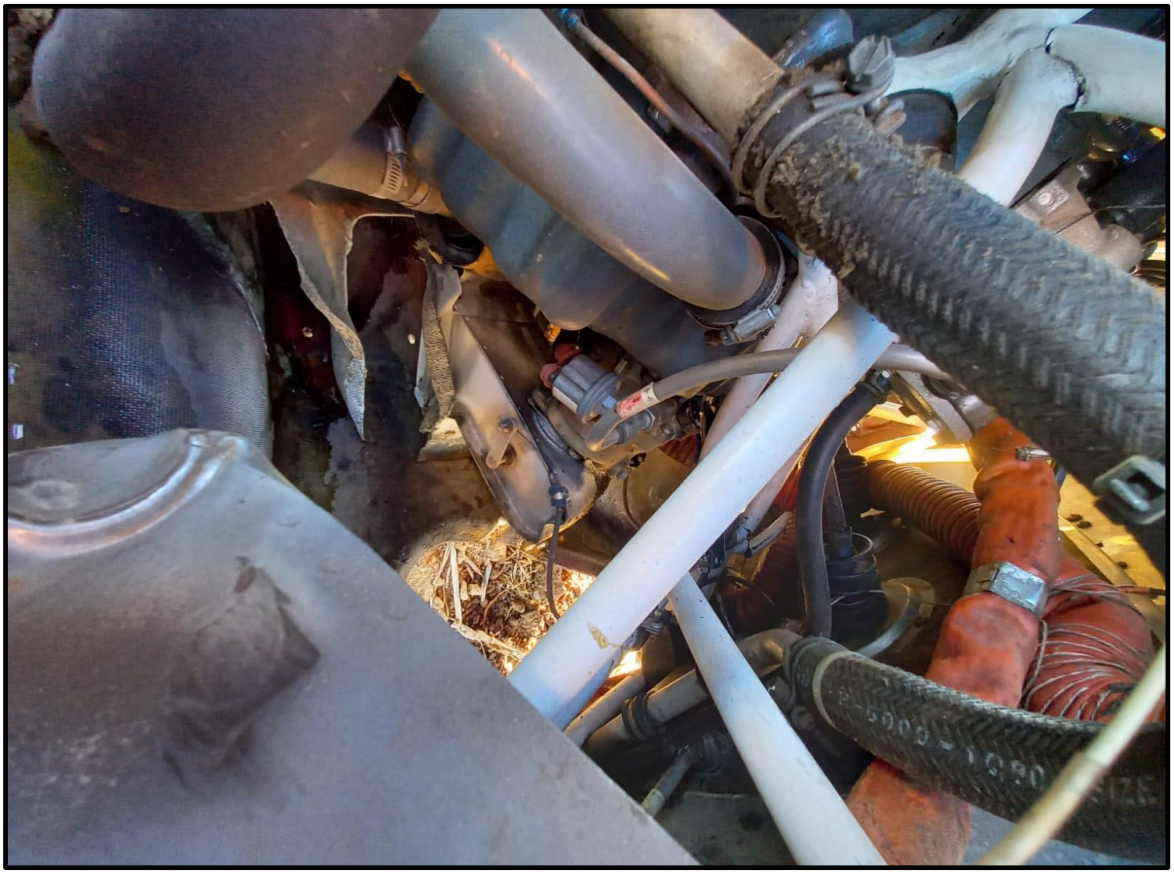

Figure 6: Damages sustained in the engine compartment and the bent engine mountings.

- The engine compartment, firewall and the engine mountings sustained impact damages.
- The nose landing gear was observed bent backwards and was damaged further when it thrust (jabbed) into the bottom part of the nose compartment.
- There was evidence of fuel leak from the bottom of the fuselage. The damage around the area where fuel was leaking could be associated with damage caused during the accident sequence.

1.13. Medical and Pathological Information

1.13.1. None.

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 there was no damage to the cockpit and cabin areas that would have caused serious injuries to both occupants. Both occupants had made use of the aircraft's safety harnesses. The instructor pilot sustained a back injury and was admitted and kept in hospital for seven days.

1.16. Tests and Research

1.16.1. The information below is a report received from the operator following the tests and analysis of the accident sequence:

Following the accident, the operator grounded all its fleet to investigate the suspected possible fuel contamination with their fuel supplier, but this suspicion was eliminated. The other aircraft type fleet was returned to service, apart from the two Tomahawks (ZS-AXE and ZS-POP) aircraft type, which were left grounded pending further investigation. The accident aircraft's fuel pumps were removed by the AMO and were bench-tested. Both mechanical driven and electrical fuel pumps were fully functional and were found serviceable. The two similar aircraft type fuel systems were also inspected and tested, and all was in order.

The investigation was further expanded to the aircraft operations on which the initial indications suggested that the loss of engine power could have been due to insufficient fuel delivery as a result of low fuel flow pressure. The operator's safety team further reviewed the pilot's statement in relation to the training conducted based on the weather conditions as per the instructor's statement which led him to demonstrate the crosswind technique. According to the instructor, a maximum rudder with the appropriate bank angle to maintain constant course was established on long final and maintained until touch down.

The internal investigation established that the crew used a wing-low technique method to counter the strong crosswind from the left. The Cape Town Flying Club (CTFC) Safety Team considered the possibility of fuel unpotting of the fuel tank outlet (due to the sideslip angle). It also has to be noted that the ground roll was very short.

To establish the probability of the above, a flight simulation was carried out using a similar aircraft type, ZS-POP, in conditions in which the accident flight was subjected to, as close as possible. The objective of the test flight was to establish the effect of the prolonged high sideslip angle on the fuel delivery system of the Tomahawk aircraft type. The team undertook the simulated flight on 21 April 2022. The evaluations were authorised by the accountable manager at CTFC with all costs borne by the operator. The tests were carried out at Diemerskraal Aerodrome. In addition to the data available in the POH, the aircraft was equipped with normal flight instruments including AI (altitude indicator), Turn Co-ordinator and a Fuel pressure gauge. All instruments were found serviceable.

Methodology

The sideslip tests were commenced at 3000ft with a descent to 2000ft at which point the go-around would be initiated. The aircraft would be configured for a normal approach with a 21° flaps selection. The fuel booster pump was set to ON for the first test and OFF for the second

test. The left fuel tank, which contained 4 gallons, was selected and a line feature was used – and the flight line was north/south. A video recording was also used during the tests to establish timelines and confirm readings.

Tests results table

TIME UTC	**Occurrence**	**Altitude** Feet(ft)	**Fuel Pressure**	**Rudder**	**Bank** °	**Tank** L/R	**ROD** Ft/min	**Power** RPM	**Flap** °
14:02:05	Start of test	3000	Normal	Full R	13 L	L	900	1900	21
14:03:01	Fuel Pressure start to drop	2200	Drop	Full R	13 L	L	900	1900	21
14:03:09	Fuel Pressure zero	2000	Zero	Full R	13 L	L	1200	1900	21
14:03:11	Control centralised	2000	Zero	Central	0	L	0	2500	21
14:03:20	Fuel Pressure normal	2100	Normal	Central	0	L	0	2500	21
14:03:21	Climb	2150	Normal	Central	0	L	CLIMB	2500	21

Analysis

The results showed that when the left tank unpotted at 14:02:05, the fuel remaining in the fuel lines ensured fuel pump functionality until 14:03:01. At that point, fuel pressure began to drop and reached zero at 14:03:09. The remaining fuel in the carburettor bowl kept the engine running, thereafter. If the controls were not centralised at 14:03:11, the engine could have failed as soon as the carburettor bowl emptied.

Conclusions

The prolonged sideslip (flying cross controlled) could lead to low-wing fuel tank unpotting, which would lead to a possible loss of engine power. Although the POH safety tips (section 10.3(i)) warns against this matter, it deems a possible engine failure only a high risk if the sideslip is prolonged more than a descent of 2000ft. During the test flight conducted by the CFTC (and possibly what the accident flight experienced), the altitude lost during the slipping before total loss of fuel pressure was only 1000ft.

It is further given that a similar fuel system is used by the PA28 aircraft type, therefore, it is likely that this revelation is not restricted to the PA38 aircraft type only.

1.16.2. According to the Piper Aircraft Corporation, PA38-112, Tomahawk, Section 10, Safety Tips.

Prolonged slips or skids which result in excess of 2000ft of altitude loss, or other radical or extreme manoeuvres which could cause uncovering of the fuel outlet must be avoided as fuel flow interruption may occur when the tank being used is not full.

1.17. Organisational and Management Information

1.17.1. The flight was conducted in accordance with the provisions of Part 141 of the Civil Aviation Regulation (CAR) 2011 as amended.

1.17.2. The aircraft was operated as a training aircraft by an approved training organisation (ATO) which was issued an ATO certificate on 11 November 2021 with an expiry date of 31 August 2024. The aircraft was endorsed on the ATO's operation specifications under Class 4 of Category A ratings.

1.17.3. The aircraft maintenance organisation (AMO) that maintained the aircraft had a valid AMO-approval certificate that was issued by the Regulator on 4 September 2021 with an expiry date of 30 September 2022.

1.18. Additional Information

1.18.1 None.

1.19. Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1. General

From the available evidence, the following analysis was made with respect to this accident. This shall not be read as apportioning blame or liability to any organisation or individual.

2.2. Analysis

2.2.1. The flight instructor was issued a Commercial Pilot Licence and a Grade 3 instructor rating. His licence was issued on 11 February 2021. The licence revalidation was issued on 18 January 2022 with an expiry date of 31 January 2023. His Class 1 medical certificate was issued on 24 February 2022 with an expiry date of 28 February 2023. The pilot had flown a total of 316 hours, of which 137 hours were on the aircraft type.

2.2.2. The student pilot was issued a Student Pilot Licence on 21 February 2022 with an expiry date of 20 February 2023. His Class 2 medical certificate was issued on 15 December 2021 with an expiry date of 15 December 2026. The student pilot had flown a total of 15.7 hours on the aircraft type.

2.2.3. The aircraft was issued a Certificate of Airworthiness by the Regulator on 1 March 2021 with an expiry date of 30 April 2022. The AMO issued the aircraft a Certificate of Release to Service on 1 March 2021 following the MPI. The AMO that maintained the aircraft had a valid AMO-approval certificate that was issued on 4 September 2021 with an expiry date of 30 September 2022.

2.2.4. The aircraft was operated as a training aircraft by an approved ATO with a valid certificate which was issued on 11 November 2021 with an expiry date of 31 August 2024. The aircraft was endorsed on the ATO's operation specifications under Class 4 of Category A ratings.

2.2.5. The forced landing was performed on an open field on a private farmland that had an uneven surface with plough lanes which were perpendicular (90º) to the flight path. Due to the aircraft's unstable approach attitude and speed, the aircraft contacted the ground hard, which resulted in the aircraft bouncing twice, with the nose section impacting the ground first after

the second bounce. The propeller hub and the nose section sustained substantial damage due to impact forces.

2.2.6. According to the flight instructor's report of the event, he established a maximum rudder with the appropriate bank angle to maintain constant course on long final, which was maintained until touch down. He then noticed fuel pressure reduction before the engine lost power, surged and stopped. Follow-up inspection checks and tests on both fuel pumps revealed no anomalies. It was also established that the crew used a low-wing technique method to counter the crosswind from the left. During descent, the aircraft was at a height that was below 1000ft, which led to fuel unpotting on the selected left fuel tank. Although the aircraft's height was below 1000ft, the low-wing technique was prolonged, causing fuel to unpot. During the touch-and-go demonstration, the landing roll was too short for the aircraft's fuel flow interruption to resolve, causing further fuel starvation which led to engine power loss and stoppage.

2.2.7. Section 10 of the POH's Safety Tips states that *the prolonged sideslip or skids which results in excess of 2000ft of altitude loss, or other radical or extreme manoeuvres which could cause uncovering of the fuel outlet must be avoided as fuel flow interruption may occur when the selected fuel tank is not full*. This was also proven during the flight tests conducted by the operator's safety team following the accident. The prolonged sideslip (flying cross controlled) could lead to fuel tank unpotting, which would in turn, lead to a possible loss of engine power.

2.2.8. Also, further tests revealed that although the POH Safety Tips (section 10.3(i)) warns against this matter, it deems a possible engine failure only a high risk if a sideslip is prolonged for more than 2000ft of descent. The test flight conducted determined that the accident flight was also deemed possible to experience fuel flow interruption and a total loss of fuel pressure during a sideslip technique at an altitude of approximately 1000ft. It was further stated that a similar fuel system is installed in the PA28 aircraft type. Therefore, it is likely that this event is not restricted to the PA38 aircraft type if the aircraft is subjected to similar flight conditions.

2.2.9. The aircraft's forced landing was conducted on an uneven surface area on a private farm which led to the aircraft bouncing twice before the nose gear contacted the ground and bent backwards, resulting in the nose section dropping and hitting the ground hard with the propeller hub. The aircraft sustained substantial damages during the accident sequence.

2.2.10. There was sufficient fuel on-board the aircraft, however, due to the operational limitations which were exceeded, the fuel flow was interrupted which led to an engine power loss.

2.2.11. The instructor sustained a back injury whilst the student pilot was unscathed.

2.2.12. Crosswind conditions prevailed in the area of Diemerskraal Aerodrome at the time of the accident.

3. CONCLUSION

3.1. General

From the available evidence, the following findings, causes and contributing factors 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 conclusion 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.
- **Causes —** are actions, omissions, events, conditions, or a combination thereof, which led to this accident.
- **Contributing factors —** are actions, omissions, events, conditions or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident occurring, or would have mitigated the severity of the consequences of the accident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil, or criminal liability.

3.2. Findings

3.2.1. The flight instructor was issued a Commercial Pilot Licence and a Grade 3 instructor rating. His licence was issued on 11 February 2021. The licence revalidation was issued on 18 January 2022 with an expiry date of 31 January 2023.

3.2.2. His Class 1 medical certificate was issued on 24 February 2022 with an expiry date of 28 February 2023. The pilot had flown a total of 316 hours, of which 137 hours were on the aircraft type.

3.2.3. The student pilot was issued a Student Pilot Licence on 21 February 2022 with an expiry date of 20 February 2023. His Class 2 medical certificate was issued on 15 December 2021 with an expiry date of 15 December 2026. The student pilot had flown a total of 15.7 hours on the aircraft type.

3.2.4. The aircraft was issued a Certificate of Airworthiness by the Regulator on 1 March 2021 with an expiry date of 30 April 2022. The AMO issued the aircraft a Certificate of Release to Service on 1 March 2021 following the MPI.

3.2.5. The AMO that maintained the aircraft had a valid AMO-approval certificate that was issued on 4 September 2021 with an expiry date of 30 September 2022.

3.2.6. The forced landing was performed in an open field on a private farmland.

3.2.7. The instructor sustained a back injury during the accident sequence whilst the student pilot was unscathed.

3.2.8. The cause of engine power loss was due to fuel unpotting (fuel flow interruption) during a prolonged sideslip technique used by the crew to counter the crosswind during a touch-and-go landing.

3.2.9. The same challenge is likely to be faced by the operators of PA28 aircraft type which has a similar fuel system installed in the PA38 aircraft type.

3.2.10. The aircraft was operated for training purposes by an approved ATO with a certificate which was issued on 11 November 2021 with an expiry date of 31 August 2024. The aircraft was endorsed on the ATO's operation specifications under Class 4 of Category A ratings.

3.2.11. Crosswind conditions prevailed in the area of Diemerskraal Aerodrome at the time of the accident.

3.3. Probable Cause/s

3.3.1 A prolonged low-wing technique used to counter the crosswind whilst the fuel content was low in the tank caused the fuel to migrate towards the left wingtip (moving from the fuel outlet point of the tank), which led to the total loss of fuel flow to the engine.

3.4. Contributing factor

3.4.1 Failure to monitor or manage fuel, which led to loss of engine power.

4. SAFETY RECOMMENDATIONS

4.1. General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report. The AIID expects that all safety issues identified by the investigation are addressed by the receiving States and organisations.

4.2. Safety Recommendation/s

4.2.1. Safety Actions

What was done by the operator (CTFC):

- Post-accident, the operator grounded its whole fleet to mitigate the initially suspected fuel contamination of their fuel supply. Upon receiving results of no fuel contamination, the other aircraft types were released to service, excluding the accident aircraft type.

- The aircraft similar to the accident aircraft type continued to be grounded for further investigation of their fuel system (both the serviceable and the accident aircraft). No anomalies relating to the mechanical and fuel system were found.

- The operator investigated the possibility of fuel uncovering (unpotting) during the low-wing technique in crosswind conditions, and results were likely to be the cause of engine power loss due to fuel flow interruption, which subsequently led to total fuel pressure loss.

5. APPENDICES

5.1. None.

This report is issued by:

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