AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9785		
Aircraft Registration	**ZU-FUO**	**Date of Accident**	10 May 2019		**Time of Accident**	1105Z	
Type of Aircraft	RT13B		**Type of Operation**		Private (Part 94)		
Pilot-in-command Licence Type	Private Pilot Licence		**Age**	75	**Licence Valid**	No	
Pilot-in-command Flying Experience	Total Flying Hours		3092.98		Hours on Type	354.6	
Last point of departure	Volksrust Aerodrome (FAVU), Mpumalanga Province						
Next point of intended landing	Mountain View Lodge, Mookgopong, Limpopo Province						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Mountain View Lodge at GPS co-ordinates S24°26'36.82" E028°26'26.10" at an elevation of 4 835 feet (ft) above mean sea level (AMSL)							
Meteorological Information	Temperature: 25°C; Dew Point: 13°C; Wind: 040° at 05 knots; QNH: 1021 hPa						
Number of people on board	1+1	**No. of people injured**	0	**No. of people killed**	2		
Synopsis							

On 10 May 2019, at approximately 0855Z, a pilot and a passenger took off from Volksrust Aerodrome (FAVU), in Mpumalanga province, to a private game lodge near Mookgopong, in Limpopo province.

A witness, who was a lodge employee as well as a licensed pilot, reported that he witnessed an aircraft approaching the runway from the west. It flew over the runway at a height of approximately 700 feet (ft) above ground level (AGL). The witness thought that the aim of the fly past was for the pilot to inspect the runway. However, at the end of the runway, the aircraft turned left to join the down-wind leg. During the left turn, he could hear that the engine was losing power, and he could also see that the aircraft was rapidly losing height.

The witness further stated that the aircraft then impacted a rocky hill located just north of the runway. A post-impact fire erupted; and the witness and other employees at the lodge rushed to the scene of the accident to extinguish the fire using dry powder fire extinguishers and water from a fire-extinguishing cart that was available at the lodge. The impact forces and the post-impact fire destroyed the aircraft; and both occupants were fatally injured.

The investigation revealed that it was likely that the pilot carried out the fly past on the runway at approximately 700ft AGL and made a left turn at the end of it. It was also likely that during the left turn and, because of low fuel and a steep turn, the engine may have been starved of fuel. The engine power loss during a left turn caused the aircraft to lose height and, hence, the subsequent crash due to the aircraft losing thrust and its ability to climb.

SRP Date	14 July 2020	Publication Date	22 July 2020

ABBREVIATION	DESCRIPTION
AGL	Above ground level
AIID	Accident and Incident Investigations Division
AMSL	Above mean sea level
AP	Approved Person
APC	Approved Person Class
ASTM	American Society for Testing and Materials
ATF	Authority to fly
CAR	Civil Aviation Regulations
C of R	Certificate of registration
CRS	Certificate of release to service
CVR	Cockpit voice recorder
EASA	European Aviation Safety Agency
EN	European Standard (Norme Européenne or Europäische Norm)
FAA	Federal Aviation Administration
FAER	Ellisras airport
FAPP	Polokwane airport
FAVU	Volksrust airport
FDR	Flight data recorder
ft	Foot/feet
GPS	Global Positioning System
Kt	Knot
Lt	Litre
METAR	Meteorological Terminal Aviation Routine
MOGAS	Motor Gasoline
MPI	Mandatory periodic inspection
MSN	Main serial number
NOSIG	No significant change in weather
NTCA	Non-type Certificated Aircraft
PPL(A)	Private Pilot Licence (Aircraft)
RAASA	Recreational Aviation Administration of South Africa
R/H	Right hand
RSA	Republic of South Africa
SACAA	South African Civil Aviation Authority
SAIB	Special Airworthiness Information Bulletin
SAWS	South African Weather Service
SEA (L)	Single Engine Aircraft (Land)
SIB	Safety Information Bulletin
TBA	To be announced
TBO	Time before overhaul
UTC	Co-ordinated Universal Time denoted by Z
Z	Zulu (representing Universal Co-ordinated Time)
θ	Theta (Represents the angular position of a vector)

Reference Number	**:**	CA18/2/3/9785
Name of Owner/Operator	**:**	Kemp J.M
Manufacturer	**:**	Kemp J.M
Model	**:**	RT13B
Nationality	**:**	South African
Registration Marks	**:**	ZU-FUO
Place	**:**	Mountain View Lodge, Mookgopong, Limpopo Province
Date	**:**	10 May 2019
Time	**:**	1105Z

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 (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****.*

Investigations Process:

The accident was reported to the Accident and Incident Investigations Division (AIID) on 10 May 2019 at about 1230Z. Two investigators went to Mookgopong on 10 May 2019. The investigators co-ordinated with all authorities on site by initiating the accident investigation process according to CAR Part 12 and investigation procedures.

The AIID appointed an investigator-in-charge (IIC) with an investigation team. The AIID sent notifications to the State of Registry, State of Operator and the State of Manufacture and Design. The National Transportation Safety Board (NTSB), which is representing the State of Manufacture, nominated a non-travelling accredited representative. The AIID of the South African Civil Aviation Authority (SACAA) is leading the investigation as the Republic of South Africa (RSA) 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 RT13B 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 be adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report are limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows or lines.

Disclaimer:

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1 On 10 May 2019 at approximately 0855Z, the aircraft with registration marks ZU-FUO took off from Volksrust Aerodrome (FAVU) in Mpumalanga province with a pilot and a passenger on-board. The pilot routed the aircraft to Mountain View private game lodge near Mookgopong, in Limpopo Province. The flight was conducted under the provisions of Part 94 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2 The witness, who was a lodge employee as well as a licensed pilot, reported that the aircraft approached the runway from the west. The aircraft flew over the runway at an approximate height of 700 feet (ft) above ground level (AGL). The witness thought that the aim of the fly past was for the pilot to inspect the runway. However, at the end of the runway, the aircraft turned left to join the down-wind leg. During the left turn, the witness could hear that the engine was losing power, and he could also see that the aircraft was rapidly losing height.

1.1.3 The aircraft impacted a rocky hill (terrain) located north of the runway and was destroyed on impact as well as by a post-impact fire which erupted thereafter. The fire consumed the cabin area and the in-board section of the wings of the aircraft. The wreckage was contained within a 13-metre radius.

1.1.4 The witness, as well as other lodge employees, rushed to the scene of the accident to extinguish the fire using dry powder fire extinguishers and water from a fire-extinguishing cart that was available at the lodge.

1.1.5 The pilot, who was seated on the left-hand seat, and the passenger, who was seated on the right-hand seat, were fatally injured during the accident sequence.

1.1.6 The accident occurred during daylight at Global Positioning System (GPS) co-ordinates determined to be S24°26’36.82” E028°26’26.10” at an elevation of 4 835ft above mean sea level (AMSL).

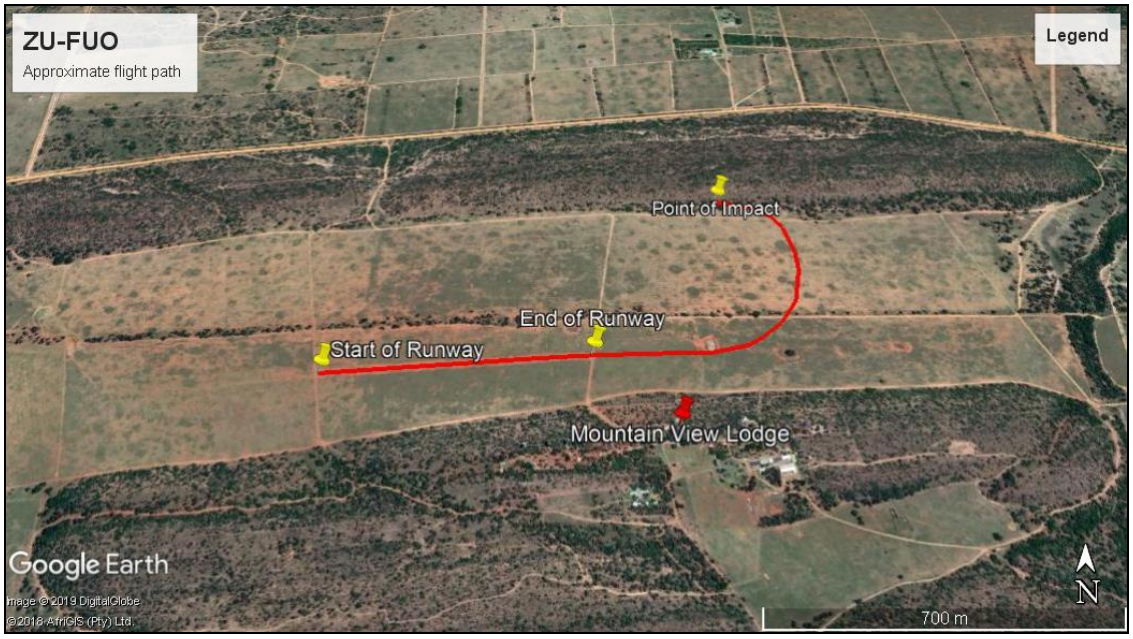

Figure 1: Google Earth overlay of the approximate flight path before impact.

1.2. Injuries to Persons

1.2.1 The pilot and the passenger were both South African citizens.

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

1.3. Damage to Aircraft

1.3.1 The aircraft was destroyed.

Figure 2: Aircraft as it came to rest.

1.4. Other Damage

1.4.1 None.

1.5. Personnel Information

Nationality	South African	Gender	Male	Age	75
Licence Number	0270259021	Licence Type	Private Pilot Licence		
Licence Valid	No	Type Endorsed	Yes		
Ratings	Night; Test Pilot (class 2)				
Medical Expiry Date	16 January 2020				
Restrictions	Corrective lenses				
Previous Accidents	Yes				

1.5.1 The pilot had a class 2 aviation medical certificate, which was valid from 16 January 2019 to 16 January 2020.

1.5.2 The pilot was initially issued a Private Pilot Licence Aircraft (PPL A) on 12 October 1992; and his last competency check was carried out on 27 February 2018. His licence was reissued with an expiry date of 28 February 2019. Attempts were made to search for information regarding the renewal of the pilot's licence or his last competency check for 2019, however, no records were found on the SACAA's pilot personnel file or on its licensing system. According to CAR 2011 Part 61.01.5, which states that, "*Unless a person maintains his/her licence or ratings valid by complying with the appropriate requirements prescribed in this part he/she shall not exercise the privileges granted by the licence or ratings.*"

1.5.3 The pilot, who was also the owner of the aircraft, was initially issued an Approved Person (AP) certificate for maintenance on non-type certified aircraft (NTCA) on 17 February 2007. His current NTCA certificate was issued on 9 January 2019 with an expiry date of 31 January 2021. The pilot was rated as an Approved Person Class 2 (APC2), according to CAR 2011 Part 66.04.4, to accomplish maintenance according to category A, C & W and APC1 for category X.

(a) Category A rating, for all types of—

i. aeroplanes registered in the Republic, either singly or in the groups referred to in sub-regulation (2); or

ii. rotorcraft registered in the Republic, either singly or in the groups referred to in sub-regulation (2);

(b) Category C rating, for all types of engines installed in—

i. aeroplanes registered in the Republic, either singly or in the groups referred to in subregulation (2); or

ii. rotorcraft registered in the Republic, either singly or in the groups referred to in subregulation (2); and

(c) Category W rating, for any—

i. avionic equipment.

According to the SA-CAR 66.04.4 Part (4) the categories of ratings for an APC1: inspection certificate for approved persons are:

(c) *Category X rating, for—*

i. the installation of compasses;

ii. installation of engine ignition equipment;

iii. the installation of variable-pitch propellers;

iv. the installation of instruments, including or excluding electrically operated instruments;

v. the installation of electrical equipment;

vi. the installation of automatic pilots; or

vii. the installation of avionic equipment, including or excluding equipment employing pulse techniques.

The AP (pilot) built ZS-FUO aircraft and the SACAA issued him a proving flight authority to fly certificate on 18 June 2013 after the AP presented a built history file (to the SACAA).

1.5.4 On 1 May 2005, the pilot was involved in an accident while piloting a Polliwagen aircraft with registration marks ZS-UXT at Wonderboom Aerodrome, with reference number CA18/2/3/7956. The cause of the accident was determined to be a result of an in-flight separation of a propeller blade.

1.5.5 On 1 February 2011, the pilot was involved in an incident while piloting a Piper PA-28R-180 (Veteran) aircraft with registration marks ZU-BBG, 50km north of Hluhluwe in KwaZulu-Natal, with reference number CA18/3/2/0823. The incident resulted in an unsuccessful forced landing following an engine failure. It was concluded that the oil port on the vacuum pump drive extension was not drilled at the engine factory, causing the shaft to cease due to lack of lubrication, as well as causing the dowel pin at the assessor main drive gear on the crankshaft to fail. As a result, the engine-driven components stopped functioning, causing the engine to fail.

Flying Experience:

Total Hours	3092.8
Total Past 90 Days	14.8
Total on Type Past 90 Days	3.6
Total on Type	354.6

1.5.6 The information in the table above was taken from the pilot's logbook from the time he started flying until the last entry, which was made on 1 March 2019.

1.6. Aircraft Information

Airframe

Type	RT13B	
Serial Number	TR015	
Manufacturer	Kemp J.M.	
Date of Manufacture	2010	
Total Airframe Hours (At time of Accident)	5214.6	
Last MPI (Date & Hours)	6 January 2019	5209.8
Hours Since Last MPI	4.8	
Authority to Fly (Issue Date)	8 January 2019	
C of R (Issue Date) (Present owner)	30 Augustus 2012	
Operating Categories	Standard	

1.6.1 The aircraft was originally a 1978 model Piper PA-38-112 Tomahawk (MSN: 38-78A0720), placed under the Production Built category with registration marks ZS-KHV. In 2012, the owner registered the aircraft in the NTCA category as a model RT13B. The aircraft was allocated registration marks ZU-FUO in accordance with Part 21 of the CAR 2011 as amended.

1.6.2 The type data certificate sheet (TDCS) holder for the Piper PA-38-112 (Tomahawk) is Piper Aircraft Inc. It was not clear who held the TDCS for the RT13B aircraft after having been registered under the non-type certificated aircraft (NTCA) by the Regulator (SACAA). It was also not clear which manufacturer supported this aircraft type and engine. Records from the Regulator did not indicate who the TDSC holder was and which manufacturer supported the aircraft in terms of maintenance schedules and parts.

1.6.3 The first entry in the aircraft's logbook for ZU-FUO was on 6 June 2013 at 4860 airframe hours. A proving flight authority to fly certificate was issued on 18 June 2013 after the owner presented a built history file (to the SACAA). The proving flight authority to fly had an expiry date of 6 December 2013 or at 25 airframe hours, whichever occurs first. According to entries in the aircraft's logbook, test flights were carried out between 20 June 2013 (4860 airframe hours) and 20 November 2013 (4891.55 airframe hours). A total of 31.55 airframe

hours were flown when an entry in the aircraft logbook indicated that the first authority to fly (ATF) was issued on 24 November 2013. According to available information, there was a built documentation supporting the proving flight ATF.

1.6.4 The airframe and engine hours were recorded in the aircraft's logbook from 20 June 2013 until 6 January 2019 when the last entry was made during the last MPI at 5209.8 airframe hours and 209.67 engine hours. According to the pilot's logbook, he flew the aircraft for an additional 3 hours between the last MPI date (6 January 2019) and 1 March 2019, when the last entry was made in the pilot's logbook. That accounted for a total of 5214.6 airframe hours and 214.47 engine hours, including the accident flight on 10 May 2019. The hours for the accident flight on a direct flight path were estimated to be 1.8, taking into consideration the cruise speed of 185km/h and the distance of 346km travelled.

Engine

Type	Lycoming O-320-B1A
Serial Number	L1364-55A
Hours Since New	214.47
Hours Since Overhaul	214.47

1.6.5 According to available information, the aircraft was originally fitted with a Mazda rotary engine when it was registered in the NTCA category on 6 July 2013. At the time of the accident, the aircraft was fitted with a Lycoming O-320-B1A engine. The Lycoming engine was fitted on 3 May 2016 with 00 hours recorded and at 4950 airframe hours. During the last annual inspection on 6 January 2019, it was recorded that the engine accumulated 209.67 total hours. According to the pilot's son, the Lycoming engine that was installed at the time of the accident was overhauled by the owner at approximately 1800 total hours since new.

1.6.6 The TDCS holder for the Lycoming O-320-B1A is Lycoming Engines. The engine was not registered under NTCA by the Regulator (SACAA). The engine was to be maintained in accordance with the manufacturer's requirements as stated in Part 43 of the CAR 2011 as amended. Maintenance on this engine was supposed to have been carried out by an aircraft maintenance engineer (AME) with a C-rating as it was type-rated and as per Part 66 of the CAR 2011 as amended. The AP, who was certified in terms of Part 44 of the CAR 2011 as amended, could not undertake maintenance on a type engine.

Propeller

Type	Sensenich M76EMMS-0-60
Serial Number	45457K
Hours Since New	59.51 Hours
Hours Since Overhaul	TBO not reached

1.6.7 On 22 April 2014, a new Sensenich M76EMMS-0-60 metal propeller was fitted to the engine. During the last annual inspection on 6 January 2019, it was recorded that the propeller accumulated 54.71 total hours. It was noted that the Lycoming O-320-B1A engine was fitted with a 76-inch Sensenich M76EMMS-0-60 propeller. According to the Sensenich website, "*the 76-inch M76EMMS-0-60 propeller must be installed on the Lycoming O-360 series engines and not on a Lycoming O-320-B1A.*" No test records were found in the logbook to support the installation of this propeller or if it would sustain the flight characteristics of the R13B or PA-38-112 Tomahawk. This was not in line with the requirements of Part 24 of the CAR 2011 as amended.

Fuel

1.6.8 During the on-site investigation, 15 litres (l) of MOGAS fuel were drained from the left-hand wing tank. Lycoming approved the use of MOGAS for O-320-B1A engines. Fuel was stored in two 16 gallons wing tanks, which gave the aircraft a total of 30 gallons useable fuel. Fuel was distributed to the engine through a fuel tank selector control located in the centre of the engine control quadrant in the cockpit. According to the flight folio, there was no fuel uplift recorded on the day of the accident and on previous entries.

1.6.9 The Piper 38-112 Pilot Operating Handbook (POH), Chapter 2 (Limitations) indicates the following:

1. The total fuel capacity is 15 US gallons (7.5 US gallons in each tank)

2. Unuseable fuel is 2 US gallons (1 US gallons in each tank)

3. Useable fuel is 30 US gallons (15 US gallons in each tank)

4. Fuel remaining when quantity indicator reads zero cannot be used safely in flight.

1.7. Meteorological Information

1.7.1 An official weather report was requested from the South African Weather Service (SAWS). The information provided in the table below was obtained from the meteorological terminal aviation routine (METAR) message recorded at Ellisras Aerodrome (FAER), the closest station to the location of the accident.

Wind Direction	040°	Wind Speed	05Kt	Visibility	9999m
Temperature	25°C	Cloud Cover	FEW	Cloud Base	3000 ft
Dew Point	13°C	QNH	1021hPa		

1.8. Aids to Navigation

1.8.1 The aircraft was equipped with standard navigational equipment as approved by the Regulator (SACAA). No defects that could render the navigation system unserviceable were reported before the flight.

1.9. Communication

1.9.1 The aircraft was equipped with standard communication equipment as approved by the Regulator. No defects that could render the communication system unserviceable were reported before the flight.

1.10. Aerodrome Information

Aerodrome Location	Mountain View Lodge, near Mookgopong
Aerodrome Co-ordinates	24°26'37.16"S 028°26'26.50"E
Aerodrome Elevation	4816 ft AMSL
Runway Designations	09/27
Runway Dimensions	(571m × 30m)
Runway Used	09
Runway Surface	Grass
Approach Facilities	None

1.10.1 The pilot intended to land the aircraft on a private airstrip at Mountain View Lodge, near Mookgopong. The pilot conducted a fly past over the runway to conduct a runway inspection as he was not unfamiliar with it (runway). The landing would have been his first on this runway. The procedure to join overhead the unmanned airfield at 2000ft AGL was not adhered to.

1.10.2 During the on-site inspection of the runway, investigators noted that there was no windsock installed on the pole at the end of the it.

1.10.3 **Unmanned Airfields - transgressions and safety issues**

Source: http://www.caa.co.za/Documents/Unmanned%20Airfield%20-%20transgressions%20and%20safety%20issues.PDF

At unmanned airfields, the joining procedure by law is: Join overhead the field at 2000 ft AGL and observe the wind conditions. Descend on the "dead" side of the field and join the circuit at 1000 ft AGL.

The purpose of the overhead join is to allow either non-radio aircraft, or aircraft arriving at a non-radio airfield, to overfly the airfield at a safe height, to observe, determine the runway in use and circuit direction, and then descend into the circuit pattern.

1.10.3.1 The best course of action when visiting an unmanned aerodrome is:

- *Check the arrival procedures of the next destination first, before leaving.*
- *Effective radio communication and traffic awareness are all-important and will help prevent a collision.*
- *Keep the standard phraseology when communicating.*
- *Report your exact position to avoid confusion.*

1.10.4 Investigators completed an on-site inspection of the runway on 11 May 2019, which they found to be well-maintained. Obstacles around the airfield were limited to the electrical overhead wires at 370m to the east of the end of the runway.

1.10.5 Fifteen (15) litres (or three [3.9] US gallons) of motor gasoline (MOGAS) were drained from the left-hand side wing. A visual inspection confirmed that the fuel was clean and free from contamination. The flight controls were moved by hand and there was freedom of movement. Continuation of the flight control cable system was confirmed. The flight control chain system in the cockpit area, although burnt, was also checked and continuation was confirmed. The flaps were found in the up position.

1.11. Flight Recorders

1.11.1 The aircraft was neither 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 It was determined that the aircraft approached the accident site from an easterly direction in a slightly left-wing low attitude. Marks on the face of the rocks indicated that the right-hand (R/H) wing tip impacted the rocks on the ridge first. The aircraft continued on the same path for approximately 6m before impacting a tree and uprooting it with its left-hand horizontal stabiliser. The aircraft spun around its vertical axis and came to a halt facing a north-westerly direction after impacting hard on the large rocks with its nose section; the engine was pushed to the left. The left-hand main landing gear wheel assembly and nose landing gear separated from the aircraft during the impact sequence.

1.12.2 It was noted that the tip of one of the propeller blades broke off, while the other tip was still intact with no signs of rotational damage, which would be consistent with the engine not operating at impact. Both wings were damaged during the impact sequence.

Figure 4: A view of the wreckage taken from the front.

Figure 5: A view of the wreckage taken from the right-hand side showing the uprooted tree.

Figure 6: A view of the tail section taken from the left-hand side showing the impact marks on the leading edge.

Figure 7: A view of the engine and propeller.

Figure 8: A view of the landing gears and wheels.

1.13 Medical and Pathological Information

1.13.1 The pilot's post-mortem report was not available at the time of finalising this report. Any information that may have contributed to the accident will be communicated in a revised report if such information has a bearing on the cause of the accident.

1.14 Fire

1.14.1 A post-impact fire erupted.

1.15 Survival Aspects

1.15.1 The accident was considered not survivable due to the severe impact and fire damage to the cabin/cockpit area. The pilot, who was seated on the left-hand side, and the passenger, who was seated on the right-hand side, sustained fatal injuries during the accident sequence.

1.16 Tests and Research

1.16.1 Engine

A post-accident inspection revealed that the engine could turn freely by hand. An engine tear-down inspection was considered for this investigation, but due to the extensive heat damage to the engine components, a decision was made not to do a tear-down inspection to confirm if any internal parts had failed as this was considered unlikely.

1.16.2 Fuel Selector valve

The fuel selector valve was recovered from the wreckage during the follow-up inspection of the wreckage. The valve sustained severe fire damage, and the fuel selector valve shaft had melted. The fuel selector valve was stripped down by an approved AMO to determine the position and internal condition. However, the position and internal condition of the valve were undetermined due to the significant heat damage sustained during the post-impact fire.

It was further noted during the investigation that the fuel selector valve, which was the original Piper PA-38-112 Tomahawk part, was subject to inspection and lubrication every 400 hours, according to the Piper Aircraft Corporation PA-38-112 Tomahawk Maintenance Manual and Service Letter No. 944. There was no evidence in the aircraft's logbook or in the built history file that the valve was inspected and lubricated since it was introduced in the NTCA category. Copies of the required maintenance action are attached (see Appendix 1).

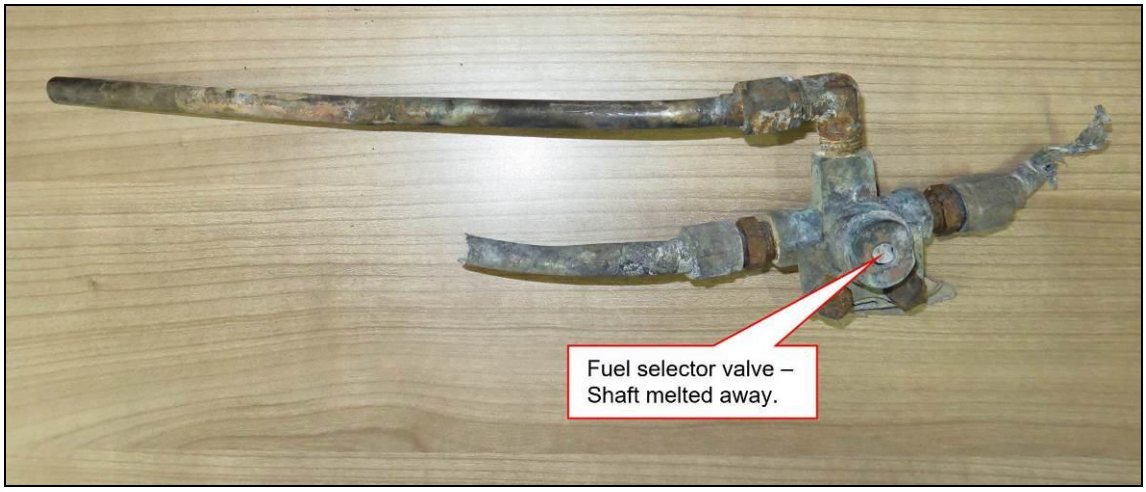

Figure 9: A fuel selector valve after it was recovered from the wreckage.

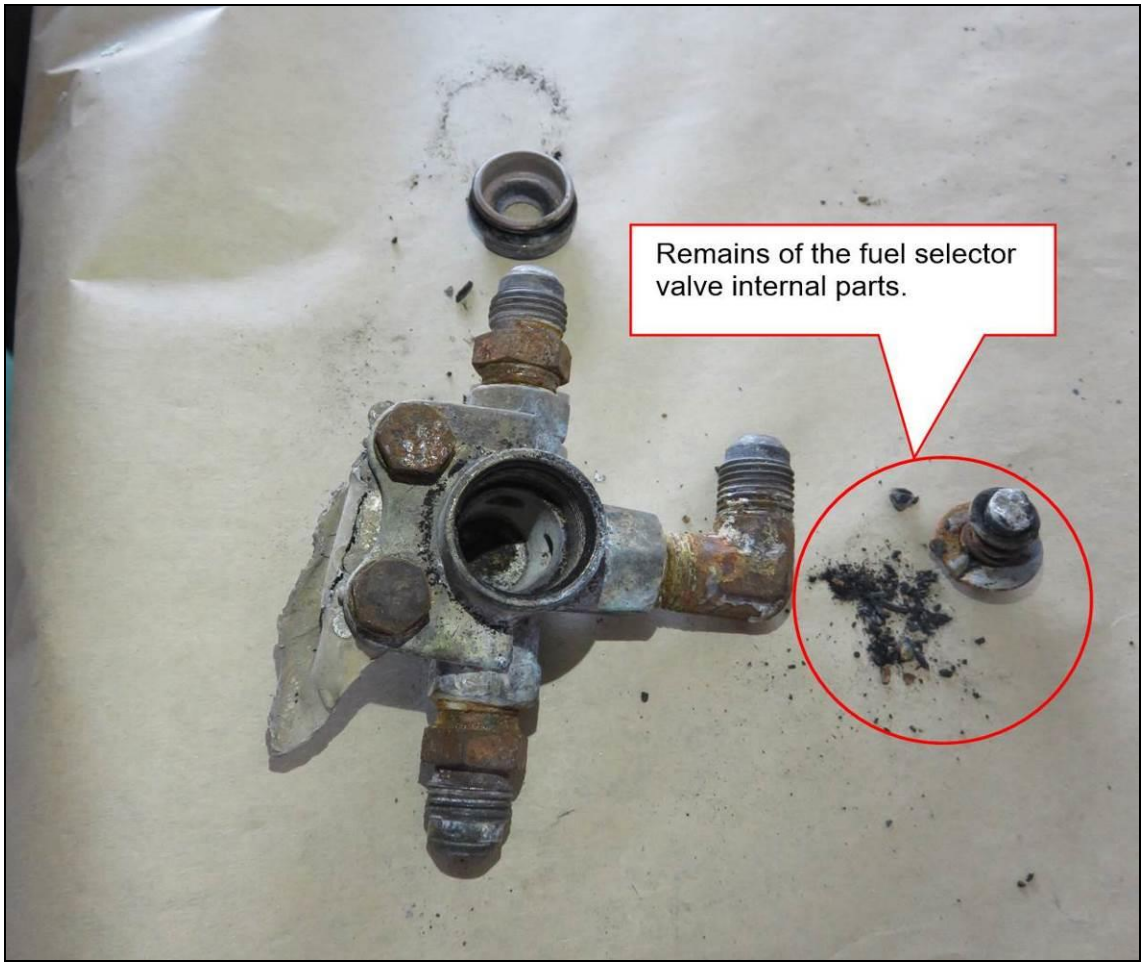

Figure 10: A fuel selector valve after it was disassembled at an approved AMO.

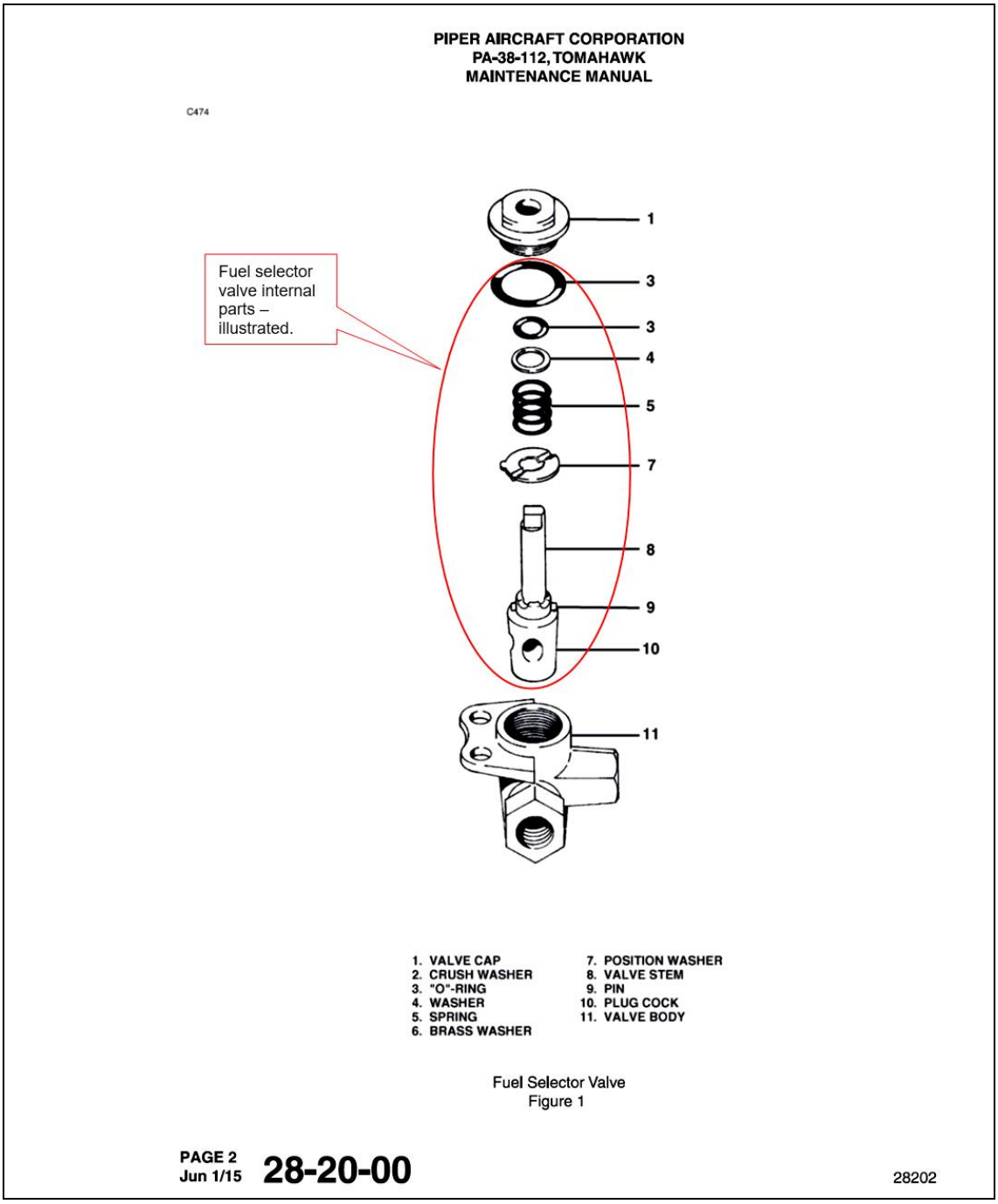

Figure 11: A parts breakdown of the fuel selector valve from the Piper Maintenance Manual.

1.17 Organisational and Management Information

1.17.1. The aircraft was privately owned and operated under NTCA category Part 94 of the CAR 2011 as amended.

1.17.2. The Regulator (SACAA) de-certified the aircraft as a type certified aircraft and was re-certified as a non-type certified aircraft (NTCA). It was, however, not clear what regulations were used to re-certify the aircraft as an NTCA aircraft or who owned the type data certification sheet (TDCS) for the airframe/aircraft.

1.17.3. The operator also changed the engine, which was fitted during the re-certification process, and refitted a Lycoming O-320-B1A which is a type certified engine. No evidence of the Regulators' approval was found for this engine fitment on the aircraft.

1.17.4. The pilot was initially issued an approved person (AP) certificate for NTCA on 17 February 2007 and reissued on 9 January 2019 with an expiry date of 31 January 2021. The pilot was rated APC2 on category A, C & W and APC1 on category X. The AP was not approved to work on the type certificated aircraft or engines.

1.18 Additional Information

1.18.1 Icing Probability: (Source: Skybrary)

Throttle Ice. *This is the most common, earliest to show and most serious carburettor icing. It is formed at or near a partly closed throttle valve (sometimes called the "butterfly valve"). The water vapour in the induction air condenses and freezes due to the venturi effect cooling the air as it passes the throttle valve. Since the temperature drop is usually around 3°C, the optimum temperature for forming throttle ice is between 0°C to +3°C although a combination of fuel and throttle ice could occur at higher ambient temperatures. Although "Carburettor Icing" is most likely to occur when the temperature and humidity are in the ranges indicated above, it can also occur under conditions not depicted.*

"Carburettor Icing" is much more likely at reduced power, so select carburettor heat before power is reduced for the descent, especially if you are intending to lift off again e.g. a practice forced landing.

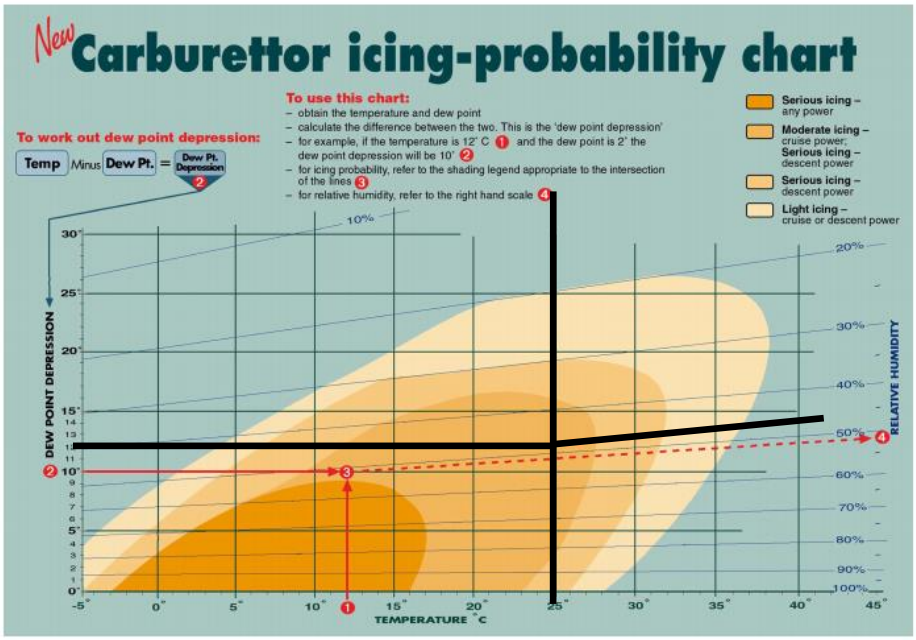

Figure 12: Carburettor icing probability graph. (Source: Google)

1.18.2 The reported weather conditions for FAER (temperature 25˚C and dew point 13˚C) placed the aircraft in the serious icing conditions section of the carburettor icing probability graph for the glide power phase of the flight. The reported weather conditions indicated that the relative humidity in the area was between 45% at the time of the accident.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1. General

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

2.2. Analysis

2.2.1 The pilot was an experienced pilot who was also an approved person (AP). The pilot accumulated a total of 3094.78 flying hours and 354.6 flying hours on the RT13B type. He was recognised amongst fellow aviators as a person with a keen interest in aviation with many years of experience as an aircraft builder and a pilot. The pilot was not approved to conduct maintenance on type certificated engine in line with Part 66 of the CAR 2011 as amended.

2.2.2 The pilot was issued a Private Pilot Licence (PPL) and was type-rated on the aircraft (RT13B). The licence was initially issued on 12 October 1992 and reissued in February 2018; it expired on 28 February 2019. There was no evidence indicating that the pilot was reissued a licence following the expiration of his licence on 28 February 2019, thus, contravening the CAR 2011 Part 61.01.5(7)(a).

2.2.3 The pilot was issued a Class 2 aviation medical certificate on 16 January 2019 with an expiry date of 16 January 2020.

2.2.4 This flight would have been the first flight the pilot undertook to the destined aerodrome.

2.2.5 The pilot was initially issued an approved person (AP) certificate for NTCA on 17 February 2007 and reissued on 9 January 2019 with an expiry date of 31 January 2021. He was rated APC2 on category A, C & W and APC1 on category X. The AP (pilot) was not rated to conduct an engine overhaul on this type certified aircraft or engine; and the engine fitted on this aircraft was a type certified engine.

2.2.6 The AP modified the originally manufactured 1978 model Piper PA-38-112 Tomahawk (MSN: 38-78A0720) and recertified it as an NTCA. The aircraft was initially registered as ZS-KHV and, in 2012, the Regulator recertified it as an NTCA with the aircraft model stated as an RT13B. The aircraft was then allocated registration marks ZU-FUO. It is not known who the TDCS holder for the aircraft is and which maintenance schedule programme the AP was following.

2.2.7 The aircraft was issued a certificate of registry (C of R) as an RT13B on 30 August 2012 and was allocated registration marks ZU-FUO.

2.2.8 The last maintenance inspection on the aircraft was carried out by an AP on 6 January 2019 at 5209.8 hours and the aircraft was issued a certificate of release to service (CRS) on the same day with an expiry date of 31 January 2020 or at 5309.8 hours, whichever occurs first. The authority to fly (ATF) was issued on 8 January 2019 with an expiry date of 31 January 2020. The aircraft had operated a further 4.8 hours since its last inspection. The AP was not allowed to work on a type certified engine, but he carried out maintenance on the Lycomming engine fitted on the NTCA aircraft. The engine did not reveal any signs of mechanical damage prior to impact as it was turning freely by hand.

2.2.9 Upon arrival at his destination, the pilot did not carry out unmanned aerodrome joining procedure, which required joining at 2000ft. The pilot carried out a fly past at approximately 700ft AGL which was lower than the circuit height of 1000ft required for runway inspection. The pattern and the way the wreckage was found at the accident site did not suggest that the aircraft had stalled before impact. The investigation determined that the aircraft approached the accident site from an easterly direction in a slightly left-wing low attitude. Marks on the face of the rocks indicated that the right-hand (R/H) wing tip impacted the rocks on the ridge first.

2.2.10 The weather was CAVOK with a calculated precipitation of 48% and serious icing conditions during approach. The aircraft had just conducted a fly past on the runway and was on a left turn; thus, icing was ruled out as a cause or contributory factor to the engine failure.

2.2.11 The aircraft's total fuel capacity was 32 US gallons with 2 US gallons unuseable fuel and that gives the total useable fuel of 30 US gallons for this aircraft. Investigators drained 15 litres (or 3.9 US gallons) from the left tank, which may indicate that the right tank had the same amount of fuel and the aircraft had 7.8 US gallons prior to crashing. The unuseable fuel for this aircraft was 2 US gallons, indicating that the aircraft was left with 5.8 US gallons of useable fuel in both tanks prior to the crash.

2.2.12 The icing probability chart indicated that there was a moderate icing probability during cruise power and a serious icing probability during descent. The aircraft had just carried out a fly past and on a turn when the accident occurred, thus, there was no icing.

2.2.13 The pilot carried out the fly past on the runway at approximately 700ft AGL and made a left turn at the end of it. It was also likely that during the left turn and as a result of low fuel, the fuel supply to the engine was interrupted, resulting in a power loss or the engine losing power. The engine power loss during a left turn caused the aircraft to lose height and it crashed as the aircraft lost thrust and the ability to climb.

2.2.14 The investigation determined that it was likely that the pilot carried out the fly past on the runway at approximately 700ft AGL and made a left turn at the end of it. It was also likely that during the left turn and, because of low fuel and a steep turn, the engine may have been starved of fuel. The engine power loss during a left turn caused the aircraft to lose height and, hence, the subsequent crash due to the aircraft losing thrust and its ability to climb.

3. CONCLUSION

3.1. General

From the evidence available, 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 particular 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.
- **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 or incident occurring, or mitigated the severity of the consequences of the accident or incident. 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 pilot was issued a Private Pilot Licence (PPL) on 27 February 2018 with an expiry date of 28 February 2019. The aircraft type rating was endorsed on his licence. He accumulated a total of 3094.78 flying hours and 354.6 flying hours on the RT13B type. There was no evidence indicating that the pilot was reissued a licence following its expiration on 28 February 2019, thus, contravening CAR 2011 Part 61.01.5(7)(a).

3.2.2 The pilot was issued a Class 2 aviation medical certificate on 16 January 2019 with an expiry date of 16 January 2020.

3.2.3 The pilot was initially issued an approved person (AP) certificate for NTCA on 17 February 2007 and reissued on 9 January 2019 with an expiry date of 31 January 2021. He was rated APC2 on category A, C & W and APC1 on category X. The AP was not rated to conduct an engine overhaul on this type certified aircraft or engine; and the engine fitted on this aircraft was a type certified engine.

3.2.4 The pilot did not adhere to unmanned airfield procedure by joining at approximately 700ft AGL instead of joining at 2000ft AGL and conducting his runway inspection at 1000ft AGL.

3.2.5 This flight would have been the first flight the pilot undertook to the destined aerodrome.

3.2.6 The AP modified the originally manufactured 1978 model Piper PA-38-112 Tomahawk (MSN: 38-78A0720). The aircraft was initially registered as ZS-KHV and, in 2012, the Regulator recertified it as an NTCA with the aircraft model stated as an RT13B. The aircraft was then allocated registration marks ZU-FUO. Numerous attempts in search of the holder of the TDCS for the aircraft were made without any success. It is not known which maintenance schedule the AP followed.

3.2.7 The aircraft was issued a certificate of registry (C of R) as an RT13B on 30 August 2012 and was allocated registration marks ZU-FUO.

3.2.8 The last maintenance inspection on the aircraft was carried out by an AP on 6 January 2019 at 5209.8 hours and the aircraft was issued a certificate of release to service (CRS) on the same day with an expiry date of 31 January 2020 or at 5309.8 hours, whichever occurs first. The authority to fly (ATF) was issued on 8 January 2019 with an expiry date of 31 January 2019. The aircraft had operated a further 4.8 hours since its last inspection. The AP was not allowed to carry out maintenance on type certified aircraft, but he did so on the Lycoming engine fitted on this aircraft.

3.2.9 This investigation could not find any documents that supported or approved the modification to install a Lycoming O-320 series engine in ZU-FUO as required by Part 24 of the CAR 2011 as amended.

3.2.10 Upon arrival at his destination, the pilot did not carry out unmanned aerodrome joining procedure, which required joining at 2000ft. The pilot carried out a fly past at approximately 700ft AGL, which was lower than the circuit height of 1000ft required for runway inspection. The pattern and the manner in which the wreckage was found at the accident site did not suggest that the aircraft had stalled before impact.

3.2.11 The weather was CAVOK with a calculated precipitation of 48% and serious icing conditions during approach. The aircraft had just conducted a fly past on the runway and was on a left turn; thus, icing was ruled out as a cause or contributory factor to the engine failure.

3.2.12 The aircraft's total fuel capacity was 32 US gallons with 2 US gallons unusable fuel; that gives the total useable fuel of 30 US gallons for this aircraft. Investigators drained 15 litres (or 3.9 US gallons) from the left tank which may indicate that the right tank had similar amount of fuel. The unuseable fuel was 2 US gallons, indicating that the aircraft was left with a total 5.8 US gallons of useable fuel in both tanks prior to the crash.

3.2.13 The aircraft had just carried out a fly past and on a turn when the accident occurred, thus, there was no icing.

3.2.14 The investigation determined that it was likely that the pilot carried out the fly past on the runway at approximately 700ft AGL and made a left turn at the end of it. It was also likely that during the left turn, and as a result of low fuel and a steep turn, the engine may have been starved of fuel. The engine power loss during a left turn caused the aircraft to lose height and thus, its subsequent crash due to the aircraft losing thrust and its ability to climb.

3.3. **Probable Cause/s**

3.3.1 It is likely that during the left turn and as a result of low fuel and a steep turn, the engine may have been starved of fuel. The engine power loss during a left turn caused the aircraft to lose height and, thus, its subsequent crash due to the aircraft losing thrust and its ability to climb.

3.4 **Contributory Factors:**

3.4.1 None.

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 message: Pilots need to be aware of the safety risk associated with not adhering to minimum fuel amount carried in the aircraft as well as not adhering to unmanned aerodrome landing procedures.

5. APPENDICES

5.1. Appendix 1: Extract from the Piper Aircraft Corporation PA-38-112 Tomahawk Maintenance Manual

5.2. Appendix 2: Extract from the Piper Aircraft Corporation Service Letter No. 944

5.3. Appendix 3: CAR 2011 Part 24 extracts.

This Report is issued by:

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

Appendix 1

C. Inspection and Lubrication

See Figure 1.

Each 400 hours time-in-service, inspect and lubricate the fuel selector valve as follows:

(1) With the valve removed from the aircraft, remove the valve cap and interior parts.

(2) Check condition of plug cock and valve body for scored surfaces. The surfaces, if not badly scored, may be reconditioned by lapping with a fine polishing compound. Clean away all compound after lapping. If plug cock will not seat properly or if scoring remains evident, replace the valve.

(3) Check condition of valve item in the area where the "O" ring seats. Should the stem be worn or damaged so that the "O" ring will not seal, replace the valve.

(4) With a 10x magnifying glass, inspect the valve plug cock for cracks. If cracks are visible, replace the valve.

(5) Clean the valve of all foreign material and lubricate the plug sparingly with Dow Corning Molykote No. FS-3451 or FS-3452 (P/N 761-281) lubricant. Turn the plug cock several times in its seat, and wipe off any excess lubricant in the plug cock and valve parts. Lubricate the position washer and "O" rings with light film of the above lubricant. Reassemble the valve with new "O" rings.

(6) Pressure check the valve for leaks using 15 psi of air pressure.

NOTE: If the valve is submerged in water for the test, insure that all water is removed.

(7) Insuring proper selector positions, install the valve in the aircraft and inspect for fuel leaks.

Appendix 2

PIPER

SERVICE LETTER No. 944

Piper Aircraft Corporation

Lock Haven, Pennsylvania, U.S.A.

April 20, 1982 S

Subject: Fuel Selector Valve Inspection and Lubrication

Models Affected:	Serial Numbers Affected:
PA-18-150 Super Cub	18-7909040 through 18-8109086
PA-38-112 Tomahawk	38-78A0001 through 38-82A0023

NOTE: Service Letter No. 944 applies to any Piper aircraft in which plastic plug Fuel Selector Valve, Piper Part Number 77413-02, is installed and has accumulated 400 hours or more total time in service.

Compliance Time: If fuel selector valve has 400 hours or more total time in service, within the next one hundred (100) hours of aircraft operation and every four hundred (400) hours thereafter.

Purpose: An improperly maintained three-position fuel selector valve, Piper Part Number 77413-02, could become difficult to rotate; this could result in damage to the selector lever mechanism and/or inability to switch tanks.

SUBPART 2:
AUTHORITY TO FLY, PROVING FLIGHT AUTHORITY AND SPECIAL FLIGHT PERMIT

*[**Editorial note:** See AIC 60.2 for important guidelines on the procedures to follow in respect of obtaining design or production approvals for NTCA, their registration, and for the issue of an Authority to Fly.]*

Application

24.02.1 (1) (*a*) An owner of a non-type certificated aircraft classified in the paragraphs (*a*) to (*g*) of subregulation 24.01.1 (2), or his, her or its authorised representative, may apply for the issuing of an authority to fly for the aircraft, or for an amendment thereof.

(*b*) In respect of an aircraft, classified in paragraphs (*h*) to (*l*) of subregulations 24.01.1 (2), no authority to fly or proving flight authority is required.

(Editorial Note: Wording as per original *Government Gazette*. It is suggested that the word "subregulations" is intended to be "subregulation".)

(2) An application for the issuing of an authority to fly, or an amendment thereof, shall be—

(*a*) made to the Director or, if applicable, the organisation designated for the purpose in terms of part 149 of these regulations, as the case may be, on the prescribed form;

(*b*) accompanied by—

(i) the appropriate fee as prescribed in part 187;

(ii) proof of compliance with the provisions of regulation 24.01.2 (5);

(iii) the aircraft logbook/s or similar document, or certified true copies of all entries;

(iv) certified true copies of all documents and records in the construction or testing file;

(v) a certified true copy of the flight manual, if applicable; and

(vi) a certified true copy of the approved maintenance schedule, referred to in part 44.

Requirements

24.02.2 (1) An applicant for the issuing of an authority to fly for a non-type certificated aircraft, or an amendment thereof, shall provide the Director or, if applicable, the organisation designated for the purpose in terms of part 149, as the case may be, with proof that, in the case of—

(*a*) a non-type certificated aircraft, built in the Republic,—

(i) the provisions of Document SA-CATS 24 in respect of proving flights and of performance, handling and strength tests have been complied with; and

(ii) the aircraft, other than an amateur-built aircraft, was manufactured or assembled by an organisation designated by the Director in terms of regulation 24.03.1;

(*b*)

an imported non-type certificated aircraft, where the owner requests the aircraft to be registered in the South African Civil Aircraft Register, the aircraft—

(i) has been deregistered in the country of export or was never registered;

(ii) had been issued with a certificate of airworthiness, an authority to fly, or similar certificate by the appropriate authority of the country of de-registration; and

(iii) complies with all the applicable provisions of this part; or

(iv) where the aircraft is a production-built aircraft which has not been previously issued with an authority to fly or similar certificate by an appropriate authority, it was manufactured or assembled by an organisation designated by the Director in terms of regulation 24.03.1.

(2) Prospective owners of an aircraft referred to in paragraph (*b*) of subregulation (1) shall first consult the Director and obtain approval before importing such an aircraft.

(3) Examples of documentation, required to show compliance with the provisions of subregulation (1), are outlined in Document SA-CATS 24.

(4) Except for the production-built aircraft referred to in subregulation (1) (*b*) (iv), only aircraft which previously have been registered and issued with a certificate of airworthiness, an authority to fly, or similar document by the appropriate authority of the country of deregistration may be imported into the Republic.

(5) The applicant shall, in addition to the provisions of subregulation (1), submit proof that—

(*a*) any modification to the aircraft conforms to the design changes approved for the type;

(*b*) the aircraft complies with all appropriate airworthiness directives issued in terms of regulation 24.01.6;

(*c*) the aircraft is issued with the appropriate flight manual, and any logbooks, repair and alteration forms and documents which the Director may require;

(*d*) an annual inspection has been carried out in accordance with the requirements of regulation 44.01.6; and

(*e*) the aircraft is in a condition for safe operation.

(6) (*a*) Where the application is in respect of a previously type-certificated aircraft, other than a veteran aircraft, the applicant shall provide proof that the original identification plate has been removed and handed to the appropriate authority and the aircraft re-registered as a different make and type of aircraft.

(*b*) The Director shall inform the original manufacturer of the fact that the aircraft no longer meets its type certificate.

(7) In addition to the provisions of subregulation (1), (5) and (6), the applicant shall provide—

(*a*)
any other airworthiness data which the Director or, if applicable, the organisation designated for the purpose in terms of part 149, as the case may be, may require; and

(*b*)
any document relating to the operation of the aircraft which the Director or, if applicable, the organisation designated for the purpose in terms of part 149, as the case may be, may require.

(8) An application referred to in subregulation (1) shall be accompanied by the appropriate fee as prescribed in part 187.