AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9715		
Aircraft Registration	**ZU-BNH**	**Date of Accident**	11 June 2018		**Time of Accident**	1221Z	
Type of Aircraft	Cozy Fish Eagle		**Type of Operation**		Private (Part 94)		
Pilot-in-command Licence Type	PPL		**Age**	56	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		724.55		Hours on Type	158.2	
Last point of departure	Port Elizabeth International Airport (FAPE): Eastern Cape						
Next point of intended landing	Port Elizabeth International Airport (FAPE): Eastern Cape						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Baakens Valley 1nm north east of FAPE GPS coordinates: S 33°58'17.26", E 025°36'46.50"; elevation 123 feet							
Meteorological Information	Wind: 070/9kts, Visibility: >10 km CAVOK, Temperature: 18˚, Dew Point: 9˚						
Number of people on board	1+0	**No. of people injured**	0		**No. of people killed**	1	
Synopsis							

The pilot, being the sole occupant of the aircraft, took off from runway (RWY) 08 at FAPE for a private flight in the general flying area (GFA). After take-off, the pilot turned left towards the GFA. The aircraft was observed on radar while climbing to 1700 feet (ft), whereupon the pilot broadcasted a “Mayday” call and reported an engine failure. He further advised the Air Traffic Controller (ATC) that he was turning back to the airport. The ATC pressed the crash alarm, activated the airport’s fire and rescue services and put them on standby positions for RWY 08. According to the air traffic services (ATS) radar recording, the aircraft turned back and lost height rapidly. The aircraft flew towards the airport, while continuously losing height. On the ATS audio recordings the pilot reported that he was in a valley and it did not look good. The aircraft then crashed in a valley and post-impact fire erupted. The airport’s fire and rescue services were advised of the accident and were given the location of the accident site. The aircraft was destroyed by the post-impact fire and the pilot was fatally injured.

The cause of the accident was attributed to an unsuccessful forced landing following an inflight engine failure as a result of a failed distributor drive gear. The distributor drive gear teeth failed and caused disruption in the engine ignition timing system leading to the engine stoppage.

Probable Cause

Unsuccessful forced landing following an inflight engine failure as a result of a failed distributor drive gear. The distributor drive gear teeth failed and caused disruption in the engine ignition timing system leading to the engine stoppage.

SRP Date	11 September 2018	Release Date	

Name of Owner/Operator	**:** R Burger
Manufacturer	**:** R Burger
Model	**:** Fish Eagle
Nationality	**:** South African
Registration Marks	**:** ZU-BNH
Place	**:** Baakens Valley, 1 nautical mile north of FAPE
Date	**:** 11 June 2018
Time	**:** 1221Z

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

Purpose of the Investigation:

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

Disclaimer:

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

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 On 11 June 2018 a Cozy Fish Eagle aircraft registration ZU-BNH took off from RWY 08 Port Elizabeth airport (FAPE) at 1216Z with one person on board for a private flight to the GFA. According to the ATS recording, the pilot reported two hours of fuel endurance with the intention to fly to the GFA and back. On take-off the pilot was instructed to comply with the SANTA VFR departure clearance. (The SANTA VFR departure clearance states the following: after departure RWY08 maintain RWY track, climb to 1000ft then turn left track 350 degrees and climb to 1500 ft, at 1500 ft set course to SANTA, at SANTA route to the GFA entry point.)

1.1.2 The pilot complied with the clearance, and at 1700 ft above ground level, approximately 3.5 nautical miles north of the airport, the pilot broadcasted a “Mayday” call due to engine failure. The pilot stated that he was turning back to the airport. The ATC pressed the crash alarm, activated the airport’s fire and rescue services and put them on standby positions for RWY 08.

1.1.3 The ATS radar recording indicated that after the “Mayday” call the aircraft lost 300 ft in height immediately and continued to lose height until it crashed. Before the accident, the pilot had reported that he was in a valley and it did not look good (as heard from the ATS audio recordings). Another aircraft that took off from FAPE a few minutes after ZU-BNH reported at 1221Z that ZU-BNH had crashed and was on fire. The airport’s fire and rescue team was dispatched to the accident site. On reaching the accident site, the fire was extinguished. However, the fire had destroyed most of the aircraft; only the engine, firewall, main landing gear struts and the one winglet remained. The pilot was fatally injured.

1.1.4 The aircraft accident occurred during day-light conditions at approximately 1 nautical mile north-east of FAPE in Baakens Valley, with GPS coordinates determined to be S 33°58'17.26", E 025°36'46.50"; elevation 123 AMSL.

Figure 1: Google Earth image showing the aircraft flight path as seen on radar

1.2 Injuries to Persons

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

1.3 Damage to Aircraft

1.3.1 The aircraft was destroyed by the post-impact fire.

Figure 2: The wreckage as found at the accident site. The SANDF helicopter hovering above was assisting with the engine recovery.

1.4 Other Damage

1.4.1 None

1.5 Personnel Information

Nationality	South African	Gender	Male	Age	56
Licence Number	0270104177	Licence Type	PPL		
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Night, Test (Class2) and Safety Pilot				
Medical Expiry Date	31 March 2018				
Restrictions	Corrective Lenses				
Previous Accidents	ZU-BNH 16 June 2006: over-ran the runway during take-off ZU-GAO 6 November 2016: in-flight engine failure during test flight				

Flying Experience:

Total Hours	724.55
Total Past 90 Days	Unknown
Total on Type Past 90 Days	Unknown
Total on Type	158.2

Note: Flying hours as at 4 March 2018 as obtained in the pilot's logbook.

1.6 Aircraft Information

1.6.1 The aircraft Cozy Fish Eagle MK4 is a three-seater home-built non-type certified aircraft, equipped with a Rover 3500 V8 engine which was introduced in 1976 to be utilised in a Rover 2000 body-shell motor vehicle. According to the available information, several modifications were made on the engine regarding engine mountings and push rods lubrication splash tubes. The engine type is equipped with a wet sump oil reservoir.

Airframe:

Type	Cozy MKIV/ Fish Eagle	
Serial Number	1(one)	
Manufacturer	R Burger	
Date of Manufacture	1998	
Total Airframe Hours (At time of Accident)	199.0	
Last MPI (Date & Hours)	24 July 2017	190.9
Hours since Last MPI	8.1	
ATF (Issue Date/ Expiry Date)	31 July 2017/ 31 July 2018	
C of R (Issue Date) (Present owner)	21 April 1998	
Operating Categories	Standard Part 94 NTCA	

Note: The flight folio was not found at the accident site. All instruments were damaged by the post-impact fire. The total airframe hours are recorded as at 4 March 2018.

Propeller:

Type	P-Prop
Serial Number	2970FEG 4
Hours since New	64.1
Hours since Overhaul	TBO not yet reached

Note: Total hours since new as at 4 March 2018

Engine:

Type	Rover 3500 V8
Serial Number	10A 28565
Hours since New	190.9
Hours since Overhaul	39

Note: According to the engine log book on the 13 April 2013 the engine was installed after a complete rebuilt and major overhaul.

1.6.2 The engine type is designed for the Rover 1976 to 1987 automobile car type. On its original use, the engine is equipped with a gearbox which will be connected to the rear wheel through an axel drive. In motor vehicles, the transmission generally is connected to the engine crankshaft via a flywheel or clutch or fluid coupling, partly because internal combustion engines cannot run below a particular speed. The output of the transmission is transmitted via the driveshaft to one or more differentials, which drives the wheels. While a differential may also provide gear reduction, its primary purpose is to permit the wheels at either end of an axle to rotate at different speeds (essential to avoid wheel slippage on turns) as it changes the direction of rotation.

1.6.3 The engine was fitted on an aircraft with a direct drive connection to the propeller. There is no limit to the failed component on the engine owner workshop manual "Rover 3500 V8 by JH Haynes and CB Barge". Also the engine manual does not have the engine overhaul limits however it gives guidance on the routine maintenance and overhaul. The manual indicates the limits of routine maintenance which begin at 250km intervals until 60000km. The manual was not written for aviation use thus the limits are only in kilometre.

1.6.4 According to the engine log book there is no entry about the inspection or maintenance of the failed component; distributor driving gear. The investigation team could not establish if the ignition system was overhauled during the engine overhaul on 13 April 2013 as the log book entry only states that the engine was installed after complete rebuild/major overhaul.

1.6.5 According to the CAR Part 24.01.2 a non-type certified aircraft needs to obtain a built number before it can be constructed. It's then given an authority to fly and not a certificate of airworthiness. According to SA-CATS 24.01.2 it is desirable but not prescribed that the constructor makes use of approved aircraft components such as engines propellers, wheels, instruments, avionics, electrical components and similar items. Armature built aircraft must carry the following warning:" Amateur built aircraft t are not required to comply with the regulations for type certified aircraft.

Extract from South African-Civil Aviation Technical Standard (SA-CATS) 24.01.2

Ameture built aircraft

1.2 Design criteria

In the design of an amateur-built aircraft, the following conditions must be met:

(1) The aircraft must be able to withstand the maximum loads to be expected in service without any permanent deformation or any deformation which may interfere with the safe operation of the aircraft. See Section 1.7 "Static tests".

(2) The aircraft structure must be designed to be able to withstand ultimate loads; that is the limit loads multiplied with a safety factor as specified in the relevant subgroup.

(3) The aircraft must not have any apparent unsatisfactory features of design and construction.

(4) (a) It is desirable, but not prescribed, that the constructor makes use of approved aircraft components, such as engines, propellers, wheels, instruments, avionics, electrical components and similar items. Structural components of other aircraft that are still airworthy may also be used.

(b) Where items, including materials, not normally approved for aircraft construction are to be used, the constructor shall prove to the Director or, if applicable, to the organisation approved for the purpose in terms of Part 149, as the case may be, that the item, items or materials have characteristics which make them suitable in all respects for the intended purpose and meet the design criteria referred to in Section 1.1(2)(a).

(c) The items, referred to in subparagraph (b) above, include engines and propellers, provided that no adverse characteristics of the engine, propeller, or engine-propeller combination are evident.

1.6 Instruments, equipment and placards

(1) Instruments

An amateur-built aircraft shall be equipped with the instruments prescribed in Part 91, Part 94 and Part 96, as applicable for the operation of the particular type of aircraft, unless exempted in terms of this Part.

(2) Equipment

An amateur-built aircraft shall be equipped as prescribed in Part 91, Part 94 and Part 96, as applicable for the operation of the particular type of aircraft, unless exempted in terms of this Part.

(3) Placards

The following placards shall be installed in an amateur-built aircraft, unless exempted in terms of this Part:

(a) In a prominent position in full view of the pilot and all passengers, and in capital letters of not less than 3 mm high:

WARNING
AMATEUR-BUILT AIRCRAFT
THIS AIRCRAFT IS NOT REQUIRED TO COMPLY WITH ALL THE REGULATIONS FOR TYPE-CERTIFICATED AIRCRAFT
TO BE OPERATED FOR SPORT OR RECREATIONAL PURPOSES ONLY
YOU FLY IN THIS AIRCRAFT AT YOUR OWN RISK

1.7 Meteorological Information

1.7.1 The meteorological conditions were obtained from FAPE weather station and the weather conditions from the SAWS weather report. Fine weather conditions prevailed on the day and time of the accident.

Wind direction	070°	Wind speed	09 kts	Visibility	>10 km

Temperature	18°C	Cloud cover	None	Cloud base	Nil
Dew point	09°C				

1.8 Aids to Navigation

1.8.1 The aircraft was fitted with standard navigational equipment as approved at the time of certification by the regulator. No defects were recorded or reported prior to or during the accident flight.

1.9 Communications

1.9.1 The aircraft was fitted with standard communication equipment as approved by the regulator for this aircraft type. No defects were reported prior to the accident. The pilot was able to communicate with FAPE ATC on 118.1 Mhz.

1.10 Aerodrome Information

1.10.1 The aircraft accident occurred during day-light conditions at approximately 1 nautical mile north-east of the airport on the upslope of a valley with GPS coordinates of S 33°58'17.26", E 025°36'46.50"; elevation 123ft.

Aerodrome Location	Port Elizabeth	
Aerodrome Co-ordinates	S 33°59'11.46"S, E 025°36'36.80"	
Aerodrome Elevation	200 ft	
Runway Designations	08/26	17/35
Runway Dimensions	1980 m x 46 m	1677 m x 46 m
Runway Used	08	
Runway Surface	Asphalt	
Approach Facilities	VOR, ILS	

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 this aircraft type

1.12 Wreckage and Impact Information

1.12.1 The aircraft accident occurred on an upslope of the valley with a bushy terrain. The accident site is 123 ft AMSL. See Figure 3 below.

Figure 3: View of the area around the accident site

1.12.2 The onsite investigation revealed that the aircraft approached the accident site at a steep right-banked angle and high speed. The aircraft was flying in a south-westerly direction when it crashed. This was consistent with the angle at which it went through the bush and cut through the trees. See Figure 4 below.

1.12.3 A post impact fire erupted and engulfed most of the aircraft; only a winglet, main gear strut and the engine were left. The engine was burnt and its top covers were melted. The main landing gear struts were burnt and still attached to the engine mountings. Several mechanical tools (spanners) were found on the accident site.

Figure 4: Shows the angle at which the aircraft cut through the trees

Figure 5: Photo of the accident site and the engine as it was found (photo courtesy of the SAPS crime scene photographer)

1.13 Medical and Pathological Information

1.13.1 According to the post-mortem report, the cause of death was determined to be multiple injuries with extensive burns. A toxicology report was not available at the time of the compilation of this report. Should any of the results have a bearing on the circumstances leading to this accident; it will be treated as new evidence that will necessitate the reopening of this investigation.

1.14 Fire

1.14.1 A post-impact fire ensued and destroyed the aircraft.

1.15 Survival Aspects

1.15.1 The accident was considered not survivable due to high impact forces and the degree of the post-impact fire that melted the aluminium parts of the aircraft; the cockpit was destroyed and the safety harness was burnt into the pilot's body.

1.16 Tests and Research

1.16.1 The engine was recovered for a teardown inspection. During the teardown inspection, most of the vital engine components were inspected, including the engine timing section.

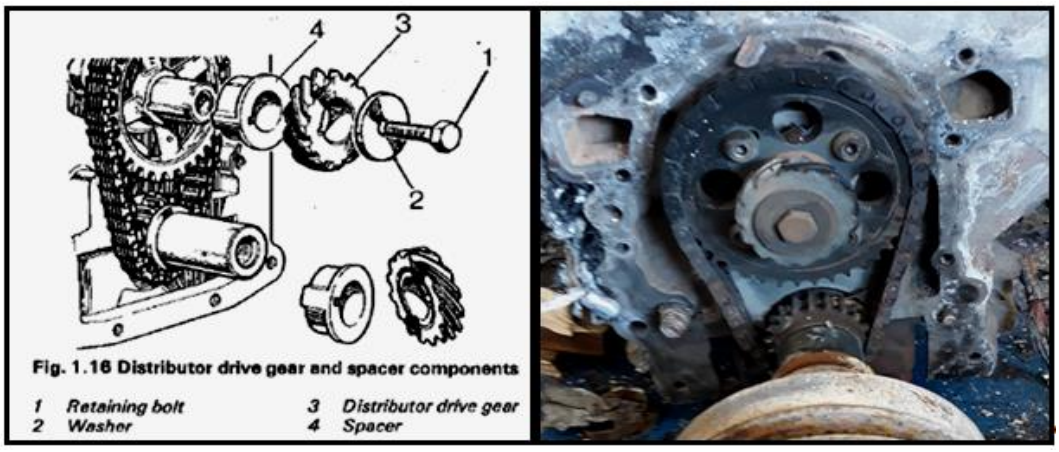

Figure 6: Shows the timing section of the engine type; photo shot during engine tear down inspection

1.16.2 The engine timing is co-ordinated between the crankshaft and the camshaft to synchronise the opening of the valves during four-stroke combustion. Further, a distributor electrical firing box is linked to a timing component through a gear mechanism (distributor driving gear). The size of the gear and its teeth are design to determine the firing sequence of each piston cylinder during engine operation. Each gear tooth co-ordinates the electrical spark according to piston cylinder four-stroke procedures. This also allows the engine to operate normally at certain ranges of revolution per minutes. On a motor vehicle this is indicated by rev-counter indicator instrumentation.

Figure 7 : Shows the worn out distributor driving gear teeth

1.16.3 During engine teardown, the timing components were inspected. The timing chain and timing gear were still intact. However, the distributor driving gear was worn out beyond limits. The general condition of the gear was not good. Three of the gear teeth failed, with the rest having sharp edges, showing signs of them having been worn-out. The damage on the gear was consistent with a component that was loaded and worn over time during operations.

1.17 Organisational and Management Information

1.17.1 This was a private flight operated under the provision of Standard Part 94.

1.17.2 The last annual inspection that was carried out on the aircraft prior to the accident flight was certified on 24 July 2017 at 190.9 airframe hours by an approved person number 066, who was approved by the Aero Club of SA. The approved person that performed the annual inspection on the aircraft was in possession of a valid approved person certificate.

1.17.3 The pilot, who built and maintained the aircraft, was also an approved person.

1.18 Additional Information

1.18.1 When you lose power and need to do a power-off landing you need to maintain the best glide speed as published in the pilot operating handbook (POH) in order to cover the most glide distance. You can glide 1,5 nm per 1000 ft, for example if you are at 4000 ft you can glide for 6 nm. See the graph below.

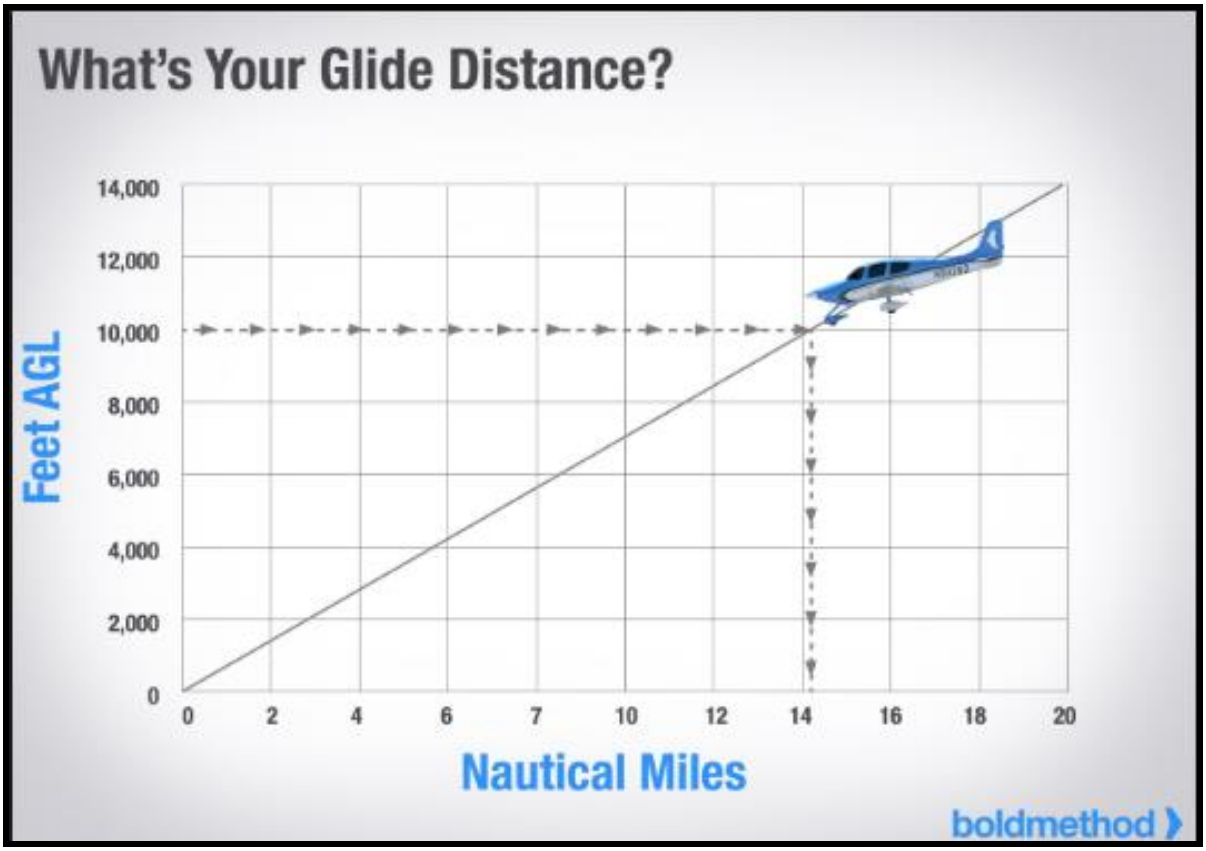

Figure 9 Graph showing glide distance

1.18.2 ZU-BNH reported engine failure at 1700 ft and lost 300 ft in height during the turn, so the glide started at 1400 ft. He could only glide for 2.1 nm, which is the distance from the stadium to the accident site indicated by the maroon arrow in Figure 10 below. The pilot reported engine failure overhead the stadium, which is 3 nm north-east of the airport. The pilot needed to be at 2000 ft to glide 3 nm. which is indicated by the black arrow. See the Google Earth image below.

Figure 10 Google Earth images of the stadium, accident site and FAPE

1.18.3 Critical decision making during engine failure.

During engine failure, depending on the height and distance, the pilot has to make a decision on how and where to execute a forced landing. An area survey has to be conducted. If possible, and where the conditions are favourable, the pilot can turn the aircraft 30 degrees to either the left or right or land straight ahead on a favourable safe place. However, any manoeuvring turns made that exceed 30 degrees will result in a significant loss of height. The area at which the aircraft experienced an engine failure was a populated built-up area over a radius of approximately 8 nm. However, there was an open area near the stadium and the dam, which was just below the point of engine failure. The beach was also on the pilot's right hand side before the aircraft turned. In the area near the accident site, there are several open sports fields along the pilot's return flight path, which were at approximately 2 nm from the position of the engine failure.

According to the pilot's website address https://zandvleitrust.org.za/archive/art-cozy%20article%20rego%20test%20flying.html : The pilot stated and posted information relating to the built of the aircraft and his experience during test flights, which he undertook with the aircraft. He also shared information on how he had proved that motor vehicle engines can be used on aircraft.

1.19 Useful or Effective Investigation Techniques

1.19.1 None

2. ANALYSIS

2.1 The pilot held a valid private pilot licence with the aircraft type rating endorsed on the licence. His aviation medical certificate was valid and required him to use corrective lenses during flight. The pilot had a total of about 724.55 flying hours and 158.2 on type as per the logbook that was last updated in March 2018.

2.2 The aircraft had both a valid Certificate of Registration (C of R) and Authority to Fly (ATF) respectively at the time of the accident. The pilot was an approved person, number 066, with a valid approved person certificate. The pilot built and maintained the aircraft himself. The last annual inspection was carried out on the 24 July 2017 by the pilot himself at a total airframe hours of 190.9. The flight folio was not found at the accident site. The total airframe hours as updated on 4 March 2018 are 199.0. The total airframe hours at the time of the accident were unknown.

2.3 The pilot took off for a private flight to the GFA at 1216Z and complied with the SANTA VRF departure clearance. At 1219Z, the pilot made a "Mayday" call to FAPE tower, indicating that the engine had failed. The pilot tried to turn back to the airport but started losing height. The aircraft lost height during the turn and crashed in a valley 1 nm north-east of the airport, at 1221Z. The aircraft could only glide a distance of 2.1 nm as it started the glide at 1400 ft and the airport was 3 nm away from the stadium where the engine had failed. The aircraft needed to start the glide at 2000 ft to make it to the airport. The cause of the accident was attributed to an unsuccessful forced landing following an inflight engine failure as a result of a failed distributor drive gear. The distributor drive gear teeth failed and caused disruption in the engine ignition timing system.

2.4 The pilot made a decision to turn back to the airport following an evaluation of the area he was flying over at the time of the engine failure. The area is a populated built-up area. However, at the point where the aircraft had turned, there was a dam and an open area near the stadium, which he could have used to ditch or land the aircraft under the emergency conditions. He could also have landed the aircraft on the beach which was on his right hand. Investigators have also observed an open area near the accident site along his flight path on return. The aircraft, however, crashed in the valley 1 nm away from the airport.

2.5 The weather conditions at the time of the accident were fine. The prevailing weather conditions did not have a bearing on the accident.

2.6 The investigators noted that there are no limits to the failed components on the engine owner workshop manual "Rover 3500 V8 by JH Haynes and CB Barge". Also the engine manual does not have the engine overhaul limits however it gives guidance on the routine maintenance and overhaul. The manual indicates the limits of routine maintenance which begin at 250km intervals until 60000km. The manual was not written for aviation use thus the limits are only in kilometre.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot held a valid private pilot licence (PPL) with the aircraft type rating endorsed on the licence.

3.1.2 The pilot held a valid aviation medical certificate with a corrective lenses restriction.

3.1.3 The pilot had a total of about 724.55 flying hours and 158.2 on type.

3.1.4 The pilot was an approved person, he maintained the aircraft himself

3.1.5 The last entry on the pilot logbook was made on 4 March 2018.

3.1.6 The aircraft had a valid C of R and ATF at the time of the accident.

3.1.7 The last annual inspection on the aircraft was carried out by an AP on 24 July 2017 at a total airframe hours of 190.9.

3.1.8 The aircraft was equipped with a Rover 3500 V8 engine which was designed for the Rover 1976 to 1987 automobile car type.

3.1.9 The engine failed due to failed distributor driving gear; three of the gear teeth were worn out and caused disruption in the engine's ignition timing system.

3.1.10 The aircraft engine failed 3 minutes after take-off and the aircraft crashed in a valley 5 min after take-off.

3.1.11 Fine weather conditions prevailed at the time of the accident.

3.1.12 The aircraft did not have enough height to glide to the airport as indicated in the glide graph provided above. (Refer to Figure 9.)

3.1.13 The pilot knew the performance of the aircraft and he could have made a better judgement and taken a decision to land the aircraft in any of the open areas rather than trying to go to the airport. His knowledge of the aircraft was revealed on his website: https:/zandvleitrust.org.za.

3.1.14 The cause of the accident was attributed to an unsuccessful forced landing following an inflight engine failure as a result of a failed distributor drive gear. The distributor drive gear teeth failed and caused disruption in the engine ignition timing system leading to the engine stoppage.

3.2 Probable Cause/s

3.2.1 Unsuccessful forced landing following an inflight engine failure as a result of a failed distributor drive gear. The distributor drive gear teeth failed and caused disruption in the engine ignition timing system leading to the engine stoppage.

4. SAFETY RECOMMENDATIONS

4.1 The regulator (SACAA) should ensure that parts used in NTCA aircraft are aligned to aviation as in this accident it was determined that the engine limits were calculated in kilometres (km) and not flying hours or cycles.

5. APPENDICES

5.1 None