SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-12a

AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

			Reference:	CA18/2/3/9397	
Aircraft Registration	**ZU-WCC**	**Date of Accident**	08 January 2015	**Time of Accident**	0738Z
Type of Aircraft	Bantam B22J		**Type of Operation**	Private-Part 91	
Pilot-in-command Licence Type	National Pilot Licence	**Age**	22	**Licence Valid**	Yes
Pilot-in-command Flying Experience	Total Flying Hours	131.1		Hours on Type	107.2
Last point of departure	Hoedspruit Civil (FAHT) : Limpopo Province				
Next point of intended landing	Hoedspruit Civil (FAHT) : Limpopo Province				

Location of the accident site with reference to easily defined geographical points (GPS readings if possible)

2 nm North East of Hoedspruit Civil (GPS position S24°20'14.02" E030°57'17.75").

Meteorological Information	Wind direction: 240°, Speed: 02 kts, Temperature: 25°, Visibility: Clear, Dew point: 18°C.				
Number of people on board	1+1	**No. of people injured**	0	**No. of people killed**	2

Synopsis

A Bantam B22J microlight departed from Hoedspruit Civil (FAHT) airfield on a scenic flight around Hoedspruit neighbouring game reserves with the pilot and a passenger on board. The pilot contacted Air Force Base Hoedspruit air traffic controller (FAHS-ATC) on frequency 126.4MHz using a hand-held two-way radio, as they are the space controller. The pilot requested clearance for take-off from Hoedspruit Civil using runway 35. The ATC gave the pilot QNH 1019 and surface wind as light and variable. During a return flight the pilot was contacted by FAHS-ATC enquiring about their position and heading. The pilot in return reported to be 4 nautical miles (nm) north of the FAHT airfield. A few minutes later the pilot contacted the FAHS and made a MAYDAY call reporting aircraft engine failure and that they were at position 2 nm north of the aerodrome. After this call the ATC indicated that they were unable to establish communications with the aircraft. From the point of engine failure reporting, the pilot was able to glide the aircraft however he could not find a suitable spot for landing. The aircraft stalled and crashed in a nose first attitude. Several aircraft in the area dispatched to assist with the search and rescue of the accident aircraft. The aircraft was spotted 45 minutes later at approximately 1 nm north-east of the FAHT airfield crashed and positioned in a nosedive attitude.

The aircraft was substantially damaged and both occupants were fatally injured. The recovery of the aircraft wreckage was made by an approved AMO and the engine was taken by an investigation team for further investigation.

Probable Cause

Unsuccessful forced landing following an engine failure.

Contributory Factors

- Mechanical Failure
- Failed to Maintain Flying Speed/Stall

SRP Date		Release Date	

SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigation Division**

Form Number: CA 12-12a

AIRCRAFT ACCIDENT REPORT

Name of Owner/Operator	**:** Sargant M R
Manufacturer	**:** Micro Aviation New Zealand LTD
Model	**:** Bantam B22J
Nationality	**:** South African
Registration Marks	**:** ZU-WCC
Place	**:** Hoedspruit Civil (FAHT)
Date	**:** 08 January 2015
Time	**:** 0738Z

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

Purpose of the Investigation:

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

Disclaimer:

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 The pilot, accompanied by a passenger, took-off from Hoedspruit Civil airfield (FAHT) on a scenic flight around neighbouring game reserves. At approximately 0700Z, the pilot contacted Air Force Base Hoedspruit air traffic controller (FAHS-ATC), who are the airspace controller in the area on frequency 126.4 MHz using a hand-held two-way radio. The pilot requested clearance for take-off from FAHS-ATC using runway 35. The ATC gave the pilot clearance and also gave him QNH 1019 and surface wind as light and variable. The flight was conducted under visual flight rules (VFR) at 2000 ft or below.

1.1.2 Approximately 17 minutes later, FAHS-ATC contacted the pilot enquiring about the aircraft's position, which the pilot confirmed to be 4 nautical miles (Nm) north of FAHT. The pilot constantly reported his position and made enquiries to the FAHS-ATC during this flight. The pilot returned over the Oliphant River, which he also reported to the ATC. In response the ATC asked the pilot of ZU-WCC to be on the lookout for the Jabiru (ZU-JOS) which was flying in the same airspace.

1.1.3 At approximately 0736Z, during the approach flight, the pilot contacted the FAHS-ATC and made a MAYDAY call declaring an aircraft engine failure. The pilot further advised the ATC of his intention to execute a forced landing on an area approximately 2 nm north of FAHT. The ATC copied the MAYDAY call and gave surface wind as 140° at 05 kts. After this call the ATC stated that they were unable to establish communications with the aircraft. Two Bantams, a microlight and a helicopter left to assist with the search and rescue. At 0830Z, the microlight spotted the aircraft at 1 nm north-east of FAHT, crashed and positioned in a nosedive attitude.

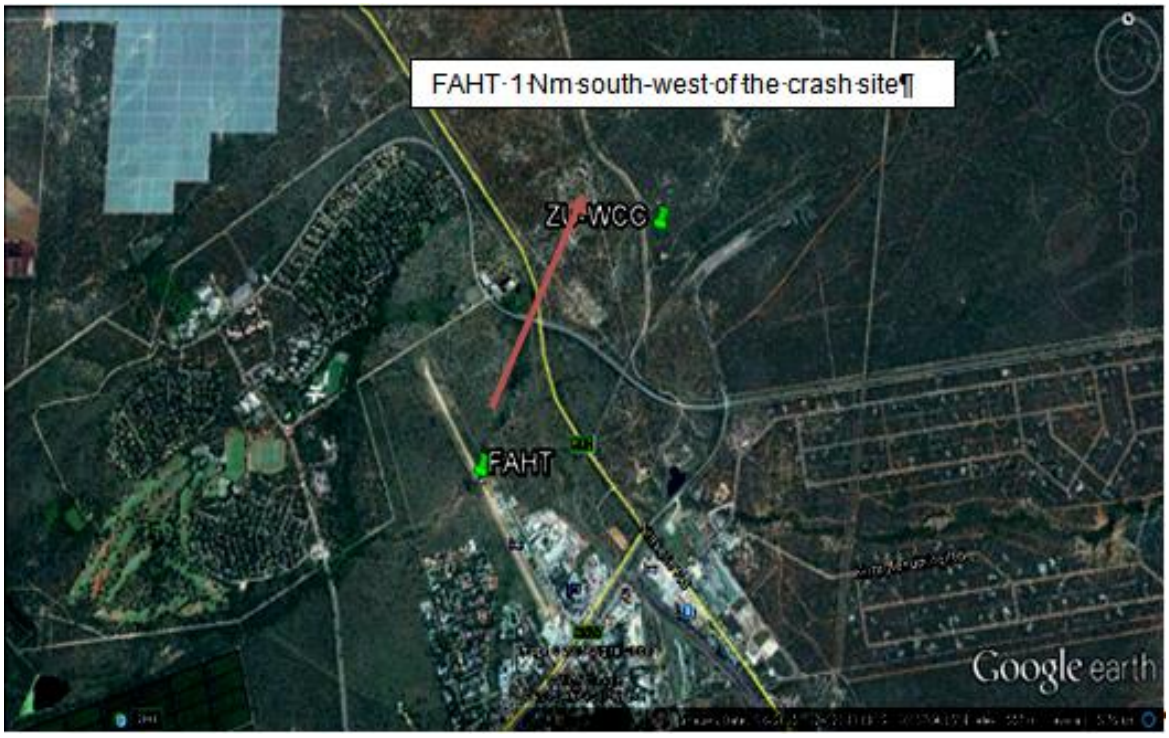


FIGURE 1: The crash site and the airport on a Google map

1.1.4 The aircraft was substantially damaged. The pilot and the passenger were fatally injured. The accident occurred during daylight conditions at a geographical position determined to be (S24°20'14,02" E030°57'17.75") at a field elevation of 1807 feet

above mean sea level (AMSL), which was approximately 1 Nm north-east of FAHT.

1.2 Injuries to Persons

1.2.1 Both occupants were fatally injured during the accident.

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

1.3 Damage to Aircraft

1.3.1 The aircraft was substantially damaged during the accident sequence.

FIGURE 2: Shows the damaged aircraft.

1.4 Other Damage

1.4.1 Tree branches were broken by the propeller during the aircraft dive.

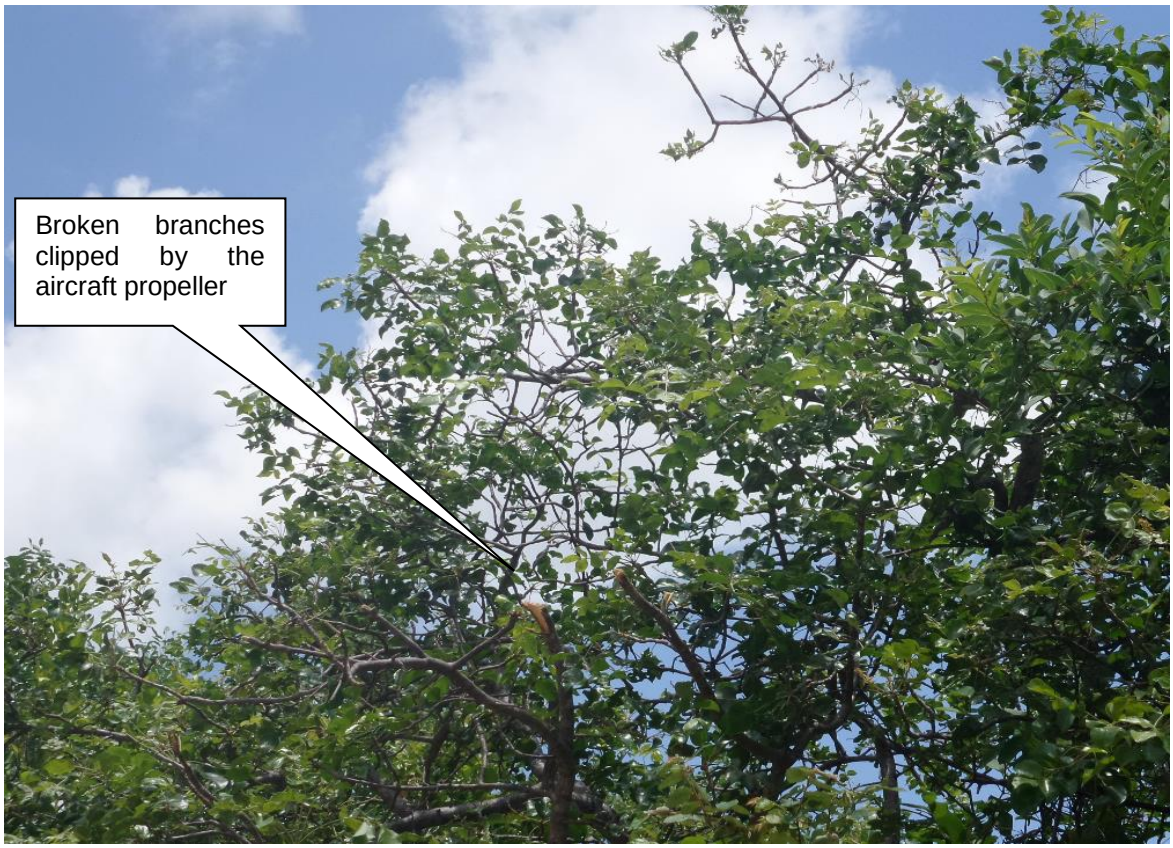


FIGURE 3: Damage caused to the trees.

1.5 Personnel Information

Nationality	South African	Gender	Male	Age	22
Licence Number	0279003693	Licence Type	National Pilot Licence		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	None				
Medical Expiry Date	30/06/2015				
Restrictions	None				
Previous Accidents	None				

Flying Experience:

Total Hours	131.1
Total Past 90 Days	11.5
Total on Type Past 90 Days	11.5
Total on Type	107.2

1.5.1 The pilot was licensed in accordance with the regulations and was rated on the

aircraft type. The pilot had accumulated 107.2 hours on the aircraft type until the date of the accident. The pilot was familiar with the aircraft and its flying characteristics. The pilot made a MAYDAY call declaring an engine failure prior to an accident.

1.6 Aircraft Information

Airframe:

Type	Bantam B22J	
Serial Number	06-0281	
Manufacturer	Micro Aviation New Zealand	
Date of Manufacture	5 May 2006	
Total Airframe Hours (At time of Accident)	516.5	
Last Annual Inspection (Date & Hours)	27 August 2014	488
Hours since Last Annual Inspection	28.5	
Authority to Fly	02/09/2014	
C of R (Issue Date) (Present owner)	28/02/2014	
Operating Categories	Part 24	

Engine:

Type	Jabiru 2200A
Serial Number	22A2313
Hours since New	516.5
Hours since Overhaul	Not yet reached

Propeller:

Type	Brent Thompson
Serial Number	224
Hours since New	516.5
Hours since Overhaul	Not yet reached

The below information was extracted from the aircraft type flight manual:

Bantam B22J,
Rev 0,
01 May 2006

1.6.1 The Bantam is a high wing monoplane with the crew of two seated side by side in an under slung tubular frame structure surrounded by a glass fibre composite fairing. Crew members are protected from the weather by a large wrap around windshield. The propeller and the engine is mounted in a tractor position above and ahead of the crew. The empennage is conventional in location and layout. The undercarriage is a tricycle arrangement with a steerable nose wheel.

1.6.2 The aircraft was maintained by the same aircraft maintenance organisation (AMO) from April 2006 to October 2009. During this period, Jabiru Service Bulletin JSB 013-1 (Engine Rocker Chamber Vent Modification) was carried out on 11 October 2006 and a Black Max wheel modification No. A0030031 was carried out on 16 June 2014. The aircraft flight folio and logbook revealed that no adjustments were made on the engine. Jabiru released carburettor tuning Service Bulletin JSB 018-1 on 05 October 2007 and JSB 018-2 on 07 May 2009, which was not carried out.

1.6.3 Another AMO took over the maintenance of the aircraft from September 2010 until the date of the accident, 08 January 2015, and in that period Jabiru released a Service Bulletin JSB018-3 on 15 October 2014, which was also not carried out.

1.7 Meteorological Information

1.7.1 Meteorological condition as obtained from the official weather service offices

Wind direction	240°	Wind speed	02kts	Visibility	Clear
Temperature	24°C	Cloud cover	N/A	Cloud base	N/A
Dew point	18°C				

1.8 Aids to Navigation

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

the flight.

1.9 Communications

1.9.1 The aircraft was in contact with FAHS-ATC using a Vertex transceiver two-way hand-held radio on frequency 126.4MHz in the area. There were no recorded defects to the aircraft's communication equipment prior to the accident.

Below is the transcript of the communication between the FAHS_ATC and the ZU-WCC as per ATC recordings during the accident flight

07:35:45	FAHS-ATC	ZU-WCC	Whisky charlie charlie juliet oscar sierra, the jabiru, is now 8 miles to the north east of the field…
07:35:56	ZU-WCC	FAHS ATC	Thank you copied, whisky charlie charlie…
07:36:49	ZU-WCC	FAHS ATC	***Mayday, mayday, mayday, this is whisky charlie charlie we have had an engine failure just 2 nautical miles north of Hoedspruit civil. We will do forced landing…***
07:36:58	FAHS-ATC	ZU-WCC	Whisky charlie charlie copy the mayday the surface wind is 140 degrees at 05 knots report final approach…

The aircraft lost communication with the FAHS-ATC.

1.9.2 According to available evidence the pilot was keeping the constant radio contact with the FAHS-ATC with regard to his current location update and surrounding air traffic enquiry. The radio contact between FAHS ATC and the pilot was lost following the engine failure.

1.10 Aerodrome Information

Aerodrome Location	Hoedspruit Civil (FAHT) : Limpopo
Aerodrome Co-ordinates	S 24°21´06.0´´ E030°56´58.0´´
Aerodrome Elevation	1800 ft

Runway Designations	17/35	
Runway Dimensions	989 m x 30 m	
Runway Used	17	
Runway Surface	Gravel	
Approach Facilities	Nil	

1.11 Flight Recorders

1.11.1 The aircraft was not fitted with a cockpit voice recorder (CVR) or a flight data recorder (FDR) and neither was required by regulations to be fitted to this type of aircraft.

1.12 Wreckage and Impact Information

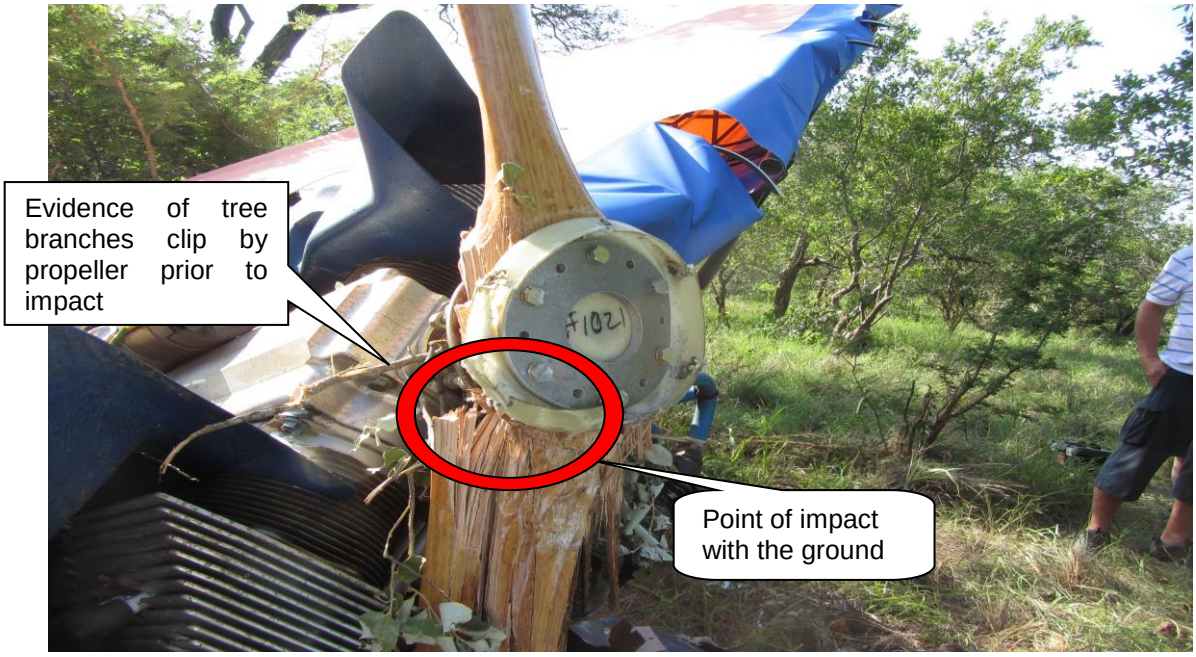
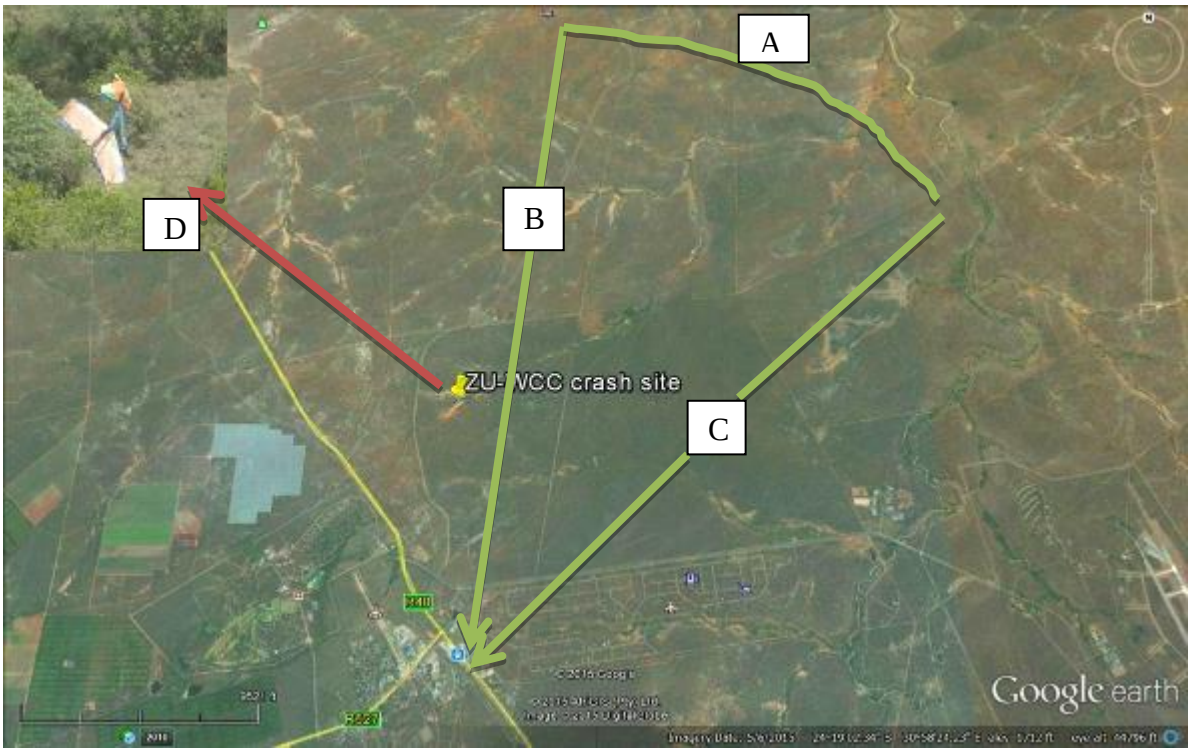


FIGURE 4: Shows point of initial impact.

1.12.1 The aircraft accident occurred in bushy terrain approximately 1 nm north-east of FAHT. According to the eyewitness, the aircraft looked like it was flying upside down. Prior to impact the propeller blades hit the treetop and collected some evidence of broken branches. This was followed by the aircraft making contact with the ground with the right wing first and then impacted hard with the propeller on a rocky surface.



KEY: The below defines the details of the picture above

- Arc A: is the approximate position were the Mayday call was made, according to the pilot's information as recorded. The pilot indicated that he was 2 nm from Hoedspruit civil.

- B & C tracks cover an area bounded by headings 210° and 240°. The aircraft could have been anywhere between those tracks.

- D shows enlarged resting position of the aircraft facing 250°.

1.12.2 Damage was caused to the propeller, supporting tubes, wings and nose section of the aircraft. (See figures 6, 7 and 8 below.)

FIGURE 6: Damage to the propeller

FIGURE 7: Damage to right wing structure

FIGURE 8: Destroyed cockpit

1.13 Medical and Pathological Information

1.13.1 The pilot was the holder of a medical certificate which was valid until 30 June 2015.

1.13.2 The pilot and passenger were fatally injured. According to their respective medico-legal post mortem reports, the cause of death was multiple injuries sustained on impact.

1.14 Fire

1.14.1 There was no pre- or post-impact fire.

1.15 Survival Aspects

1.15.1 The accident was not survivable due to the magnitude of the impact forces and the attitude of the aircraft during the accident sequence. The cockpit area was destroyed during the impact.

1.15.2 The aircraft was equipped with shoulder harness which both occupants made use of during the flight.

1.15.3 The aircraft was found 45 minutes later due to the search and rescue initiating their search based on the location at which the pilot initially reported the engine failure. Below is the transcript information that guided the search and rescue during their search for the missing aircraft

07:36:49	WCC	FAHS ATC	***Mayday, mayday, mayday, this is whisky charlie charlie we have had an engine failure just 2 nautical miles north of Hoedspruit civil. We will do forced landing…***
07:58:42	Apron	HWV	There is a bantam down about 4 south of civil. Can you go there and have a look please?
07:58:49	HWV	Apron	Say again sir
07:59:50	Apron	HWV	We got a bantam that has gone down about 4 miles south of Hoedspruit civil. Is it north of civil, you can go and have look…

1.16 Tests and Research

TESTS

1.16.1 Engine inspection

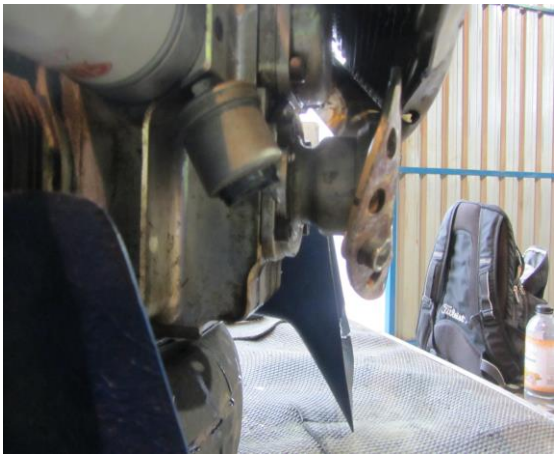


FIG 9: Damage during the accident

FIG 10: Engine taken to AMO for inspection

The engine, a Jabiru 2200, serial No. 22A2313, was removed from the wreckage during recovery and was taken to an approved engine maintenance facility. Due to impact damage and internal engine damage, it was not possible to perform an engine bench test run. A teardown inspection was performed on Wednesday 14 January 2015 by engine type accredited AMO personnel. The examination of the engine revealed that the number 2 cylinder had seized. An engine teardown report is attached to this report as Appendix B.

All damage was accounted for as the result of the accident sequence. Post-accident inspection revealed that the crankshaft propeller flange was bent to the right due to the angle of impact with the ground. (See figure 9 and 10 above.)

FIGURE 11: Metal fracture

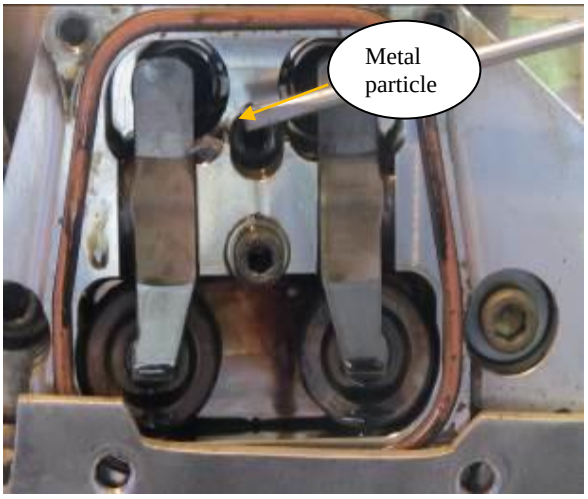


FIGURE 12: Valve rocker arm damaged

Further investigation was carried out and engine cylinders were removed. Metal particles were found on number 2 rocker covers as shown in figure 11 above. Various metal and aluminium particles were found in the rocker box area of cylinder number 2 as shown in figure 12 above.

FIGURE13: Broken exhaust valve head

FIGURE 14: Damaged piston head

Number 2 exhaust valve head was found broken off from the valve neck as shown in figure 13 above. The piston on number 2 cylinder was damaged and got stuck in the cylinder barrel as shown in figure 14 above.

FIGURE15: Bent connecting rod

Number 2 connecting rod was found bent as shown in figure 15 above. No other defects could be found on the engine or components.

1.16.2 The engine settings were checked. The carburettor tuning was as follows:

Needle jet – 2.78

Main jet – 2.20

Idle jet – 0.45

According to the Jabiru manufacturer, the settings were supposed to be as follows:

Needle jet – 2.90

Main jet – 2.45

Idle jet – 0.45

According to the Jabiru manufacturer, the settings found on the accident aircraft engine were incorrect. This caused the engine to run lean and a lean running engine will eventually result in engine failure.

RESEARCH

Article extracted from Phantom Media PTY Ltd on the internet at the time the report was compiled.

Source: All Rights Reserved

1.16.3 Australian CASA proposed operational limitations on Jabiru powered aircraft

The Civil Aviation Safety Authority placed a set of precautionary operating limitations on aircraft powered by Jabiru engines.

These precautionary limitations follow a high number of Jabiru engine failures and power loss incidents, some of which resulted in forced landings.

More than 45 Jabiru engine failures or in-flight engine incidents were reported in 2014, with CASA recently becoming aware of incidents in previous years.

Problems with Jabiru engines include failures of through bolts, flywheel bolts and valve train assemblies as well as cylinder cracking.

The failures affect a range of Jabiru engine models and have occurred in aircraft used in different flying activities, although many have been reported in aircraft used for flying training.

CASA is currently working with Jabiru and other stakeholders to identify the causes of the engine problems and to implement appropriate solutions.

Causes being investigated include design and mechanical issues, how aircraft are flown and maintenance-related issues.

While this investigative work is on-going, the precautionary limitations are primarily intended to reduce risks for people on the ground and trainee pilots flying solo. The limitations also ensure that trainee pilots flying solo and passengers understand and accept the risk of a Jabiru engine failure.

The limitations:

- Restrict flights to daytime under the visual flight rules
- Require aircraft to be flown so they can at all times glide clear of a populous area
- Require passengers and trainee pilots flying solo to sign a statement saying they are aware of and accept the risk of an engine failure
- Require trainee pilots to have recently and successfully completed engine failure exercises before solo flights.

Australian CASA consulted with the aviation community on the Jabiru limitations, receiving more than 630 comments. Many pilots maintained they had the right to accept the risk of engine power loss and argued that this right should be extended to passengers and trainee pilots.

1.17 Organisational and Management Information

1.17.1 This was a private flight with the pilot being the owner of the aircraft.

1.17.2 The aircraft maintenance organisation (AMO) that certified the last annual inspection carried out on the aircraft prior to the accident flight was in possession of a valid AMO approval certificate.

1.17.3 According to the maintenance records, the aircraft was maintained and equipped in accordance with the prescribed approved maintenance procedure. The aircraft was in possession of a valid authority to fly which was to expire on 26 August 2015.

According to the aircraft logbook, the aircraft was registered in March 2006.

1.18 **Additional Information**

The information was extracted from the aircraft's Flight Manual.

1.18.1 ENGINE FAILURE IN FLIGHT

1) Immediately lower the nose to maintain 45 kts.
2) Select a suitable landing place within glide range of the aircraft. Plan the approach. Remember, the aircraft has a very steep glide slope without applied power.

   As a guide, any landing place which is visible just above the nose of the aircraft when in level flight is within gliding distance in still air conditions.
3) If time permits, conduct a trouble check:
   - Check ignition on (cycle ignition switches)
   - Check fuel pump on and fuel contents
   - Check choke off (cycle choke control)
   - Check fuel cock on
4) Pre-landing checks:
   - Fuel pump off
   - Fuel cock off
   - Master switch off
   - Ignition switches off
   - Check harnesses is tight and safety helmet straps are secured.
5) Land as detailed in the engine failure after take-off procedure.

1.19 **Useful or Effective Investigation Techniques**

1.19.1 No new methods were applied.

2. ANALYSIS

2.1 The pilot was licensed in accordance with the existing regulatory procedures and was rated on the aircraft type. The pilot flew the aircraft under visual flight rules

(VFR) and was accompanied by a passenger. The pilot had accumulated 107.2 hours on the aircraft type until the date of the accident. The pilot was familiar with the aircraft operating systems and its flying characteristics.

2.2 During flight the pilot was making constant contact with the FAHS-ATC enquiring about the surrounding traffic in the area. Prior to the accident the pilot made a MAYDAY call declared an emergency and reported an engine failure. This was followed by him reporting his position (2 nm north of FAHT) at the time of an engine failure and his intention to execute a forced landing. A search and rescue was initiated with reference to the reported position of engine failure, which took them approximately 45 minutes to find the accident aircraft. The aircraft was discovered at approximately 1 nm north-east of FAHT.

2.3 Based on the information on the recordings and the position of the aircraft crash site, the investigation concludes that prior to the aircraft accident, the pilot was able to glide the aircraft from the point of engine failure but did not find a suitable landing area. As a result the aircraft stalled and crashed in a nose first attitude.

2.4 According to the maintenance records, the aircraft was maintained in accordance with the prescribed maintenance procedures and was in possession of a valid authority to fly. However, during investigation it was revealed that all Service Bulletins released by the engine manufacture were not adhered to by the maintenance organisations who maintained the aircraft. The engine was found with original factory carburettor settings meaning that JSB 018-1, JSB018-2 and JSB018-3, which were released on 05 October 2007, 07 May 2009 and 15 October 2014, were not carried out on the engine.

2.5 The carburettor tuning was as follows: Needle jet – 2.78, Main jet – 2.20 and Idle jet – 0.45. According to the Jabiru manufacturer, the settings were supposed to be as follows: Needle jet – 2.90, Main jet – 2.45 and Idle jet – 0.45. According to the engine manufacturer, the needle jets were significantly smaller than the manufacturer’s directive and this caused the engine to run lean and in their experience, a lean running engine will eventually result in engine failure. The lean promotes excessive heating during operation that required sufficient cooling. The mounting of the engine on the aircraft type did not provide sufficient cooling on engine cylinder number 2.

3 CONCLUSION

3.1 Findings:

3.1.1 The pilot was a holder of a valid private pilot licence and had the aircraft type endorsed in his logbook.

3.1.2 The pilot and the passenger were fatally injured as a result of the accident, in which he suffered multiple blunt force injuries.

3.1.3 This was a scenic flight operated under VFR rules around Hoedspruit neighbouring game reserves.

3.1.4 Fine weather conditions prevailed at the time of the accident, and the weather was not considered to have any bearing on the accident.

3.1.5 The aircraft was in possession of a valid authority to fly and certificate of registration.

3.1.6 The AMO that performed the last maintenance inspection on the aircraft prior to the accident flight was in possession of a valid AMO approval certificate No. 1255.

3.1.7 Examination of the aircraft's technical logbooks revealed that Jabiru service bulletins JSB018-1, JSB018-2 and JSB018-3 were not carried out.

3.1.8 The accident was not considered to be survivable.

3.2 Probable Cause/s

3.2.1 Unsuccessful forced landing following an engine failure.

3.3 Contributing factors

3.3.1 Mechanical Failure

3.3.2 Failed to Maintain Flying Speed/Stall

4 SAFETY RECOMMENDATIONS

4.1 It is recommended that the regulator (Recreation Aviation Administration- South Africa) verify compliance of Service Bulletins on engines fitted on this aircraft type. This should be done in accordance with South African Civil Aviation Regulations Part 149.01.2 (a-g).

5 APPENDICES

5.1 Appendix A (Engine teardown inspection)

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0017
15 January 2015
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E-mail:yolandilok@gmail.com

To whom it may

South African Civil Aviation Authority

We were approached by [redacted] after the accident of ZU-WCC to strip the engine down for investigation.

The engine was stripped down for visual inspection, to determine all defects. All exterior components were inspected and found serviceable. Crank shaft propeller flange found to be bent to the right and propeller blade snapped off to the right. Propeller blade indicated that the aircraft went in nose down, vertical to the ground. Further investigation was carried out and engine cylinders were removed. Metal particles found in number 2 and 4 cylinder rocker covers. Various metal and aluminum particles were found in the rocker box area. Number 2 exhaust valve head found to be broken off. Piston on number 2 cylinder found to be broken and stuck in barrel. Number 2 conrod found to be bent. No other defects could be found on the engine as well as components. The engine found to be in good mechanical order and no previous major repairs were carried out on the engine.

Possible cause of engine failure, exhaust valve on number 2 cylinder's valve head broke off and turned side-ways in combustion chamber with catastrophic results.

JH Lok
Warbird Aircraft Services cc
AMO 1095

…END…