AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	**CA18/2/3/8725**	
Aircraft Registration	**ZS-NKB**	**Date of Accident**	18 December 2009	**Time of Accident**	1330Z	
Type of Aircraft	Beech 95-B55 (Aircraft)		**Type of Operation**	Type conversion Training		
Pilot-in-command Licence Type		Airline Transport	**Age**	34	**Licence Valid**	Yes
Pilot-in-command Flying Experience		Total Flying Hours	2759.4		Hours on Type	42
Last point of departure	FAWB (Wonderboom) – Gauteng					
Next point of intended landing	FAWB (Wonderboom) – Gauteng					
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)						
Near FAWB at GPS position S25° 39’ 16.32” E028° 12’ 49.43” at an elevation of 4065ft AMSL						
Meteorological Information	Fine weather conditions prevailed at the time of the accident with the wind at 340°TN, 5 Kts and the temperature at 34°C					
Number of people on board	2+0	**No. of people injured**	0	**No. of people killed**	2	

Synopsis

A flight instructor accompanied by a student (holder of a valid private pilot licence) took-off from FAWB to the general flying area #2 for a type conversion training flight. Various witnesses observed that the aircraft failed to gain height after takeoff and was flying very low.

The pilot transmitted a MAYDAY call but did not state the nature of the emergency.

Shortly after take-off the aircraft collided with trees and crashed into the Apies River, 3,5 km from the airport.

The aircraft was destroyed and both occupants sustained fatal injuries during the accident sequence.

Probable Cause

The aircraft failed to gain height after takeoff and collided with vegetation and terrain.

Contributing Factors

Fouled spark plugs on the right-hand engine.

The fuel boost pumps were switched to High, resulting in a negative rate of climb and an over rich mixture setting on both engines, and the engines consequently failed to produce full power.

The instructor’s view of position selected of the fuel boost pumps switch was obstructed by the control column.
Lack of clear instructions in the POH on the use of the fuel boost pumps.

Limited flight experience of both the pilot-in-command and the student pilot on the aircraft type.

IARC Date		Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner/Operator	**:** Loutzavia CC
Manufacturer	**:** Beech Aircraft Corporation
Model	**:** 95-B55
Nationality	**:** South Africa
Registration Marks	**:** ZS-NKB
Place	**:** Near FAWB - Gauteng
Date	**:** 18 December 2009
Time	**:** 1330Z

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 (1997) 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:

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 18 December 2009 at approximately 1330Z, an instructor accompanied by a student (holder of a valid private pilot licence) took off from RWY 29 at FAWB for a type conversion training flight in the GF2 area.

1.1.2 Various witnesses observed that the aircraft failed to gain height after take off and was flying very low.

1.1.3 The pilot transmitted a MAYDAY call but did not state the nature of the emergency.

1.1.4 Shortly after takeoff the aircraft collided with vegetation and terrain, 3.5 km from the airport, fatally injuring the two occupants.

1.2 Injuries to Persons

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

1.3 Damage to Aircraft

1.3.1 The aircraft was destroyed by the impact and the post-impact fire that erupted during the accident sequence.

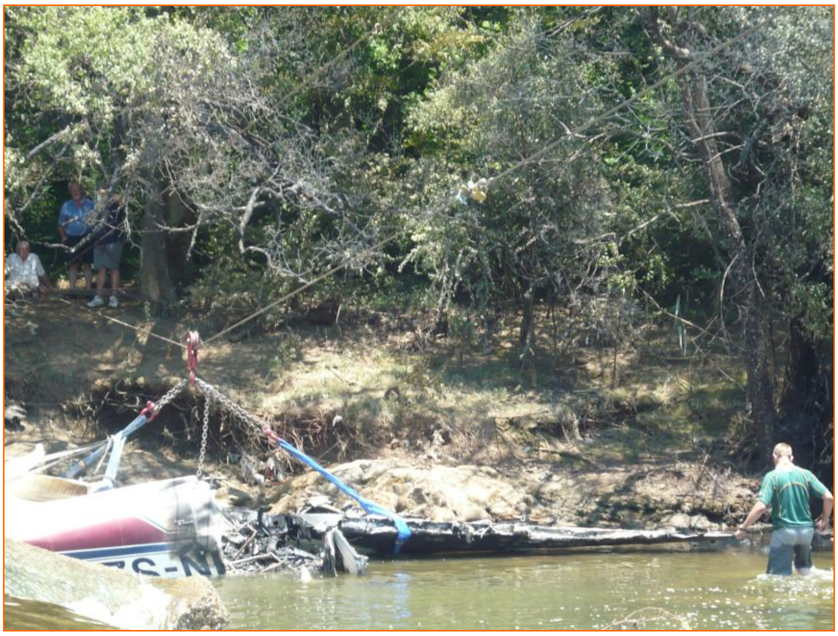


Figure 1: View of the wreckage in the Apies River.

1.4 Other Damage

1.4.1 Minor heat damage was caused to the immediate vegetation surrounding the area, and a substantial amount of fuel was spilt into the river.

1.5 Personnel Information

1.5.1 Pilot-in-command (Instructor)

Nationality	British	Gender	Male	Age	34
Licence Number	***************	Licence Type	Airline		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Instructor Gr II (Valid from 15 May 2007 to 14 May 2010) Flight Test (SEP & MEP) (Valid from 30 April 2009 to 31 May 2011) (SEP = Single Engine Piston; MEP = Multi Engine Piston) Instrument (Aircraft) (Valid from 30 April 2009 to 31 May 2010) Night				
Medical Expiry Date	31 May 2010				
Restrictions	Nil				
Previous Accidents	None				

Flying Experience:

Total Hours	2759.4 (Multi-engine: 888.8)
Total Past 90 Days	179.39 (Multi-engine 70.79)
Total on Type Past 90 Days	28.9
Total on Type	42

1.5.2 Co-pilot (Student)

Nationality	South Africa	Gender	Male	Age	40
Licence Number	*****************	Licence Type	Private		
Licence valid	Yes	Type Endorsed	No		
Ratings	Night				
Medical Expiry Date	31 October 2010				
Restrictions	Nil				
Previous Accidents	None				

Flying Experience:

Total Hours	611.8
Total Past 90 Days	2
Total on Type Past 90 Days	2
Total on Type	2

Note: The student pilot flew the aircraft earlier the morning for two hours with another instructor accompanying him. No problems were recorded during that flight.

1.6 Aircraft Information

1.6.1 Airframe:

Type	Beech 95 – B55	
Serial No.	TC-1213	
Manufacturer	Beech Aircraft Corporation	
Year of Manufacture	1969	
Total Airframe Hours (At time of Accident)	5428.9	
Last MPI (Date & Hours)	18/08/2009	5414.7
Hours since Last MPI	14.2	
C of A (Issue Date)	23/12/1993	
C of R (Issue Date) (Present owner)	29/01/2008	
Operating Categories	Standard	

1.6.2 Engine No 1 (Left-hand side):

Type	Continental IO-470 L
Serial No.	454428
Hours since New	2154.8
Hours since Overhaul	1308.0

1.6.3 Propeller No 1 (Left-hand side):

Type	Hartzell PHC A3VF
Serial No.	BR 772
Hours since New	Unknown
Hours since Overhaul	196.7

1.6.4 Engine No 2 (Right-hand side):

Type	Continental IO-470 L
Serial No.	CS 201453-71L
Hours since New	5415.1
Hours since Overhaul	528.3

1.6.5 Propeller No 2 (Right-hand side):

Type	Hartzell PHC A3VF
Serial No.	BR 715
Hours since New	4038.9
Hours since Overhaul	941.9

1.6.6 Weight and Balance

According to available information the aircraft was loaded within the weight limitations as specified by the manufacturer and the centre of gravity was within the specified limitations as per the manufacturer's specifications.

1.7 Meteorological Information

1.7.1 According to an official weather report from the South African Weather Service, the following weather conditions prevailed at the time of the accident:

Wind direction	340°TN	Wind speed	5 Kts	Visibility	10 km +
Temperature	34°C	Cloud cover	Few	Cloud base	4500 ft +
Dew point	11°C	Density Altitude & QNH at FAWB		7326 ft & 1013 hPa	

1.8 Aids to Navigation

1.8.1 The aircraft was equipped with standard navigation equipment in accordance with the minimum equipment list approved by the regulator for the aircraft type.

1.9 Communications

1.9.1 The aircraft was equipped with standard communications equipment according to the minimum equipment list approved by the regulator for the aircraft type.

1.9.2 Radio transmission recording between FAWB Control Tower and ZS-NKB:
From the recorded radio transmission between the Wonderboom Control Tower and ZS-NKB it was noted that the aircraft was standing at the holding point of Rwy 29 for 18 minutes and 3 seconds before reporting ready for the take-off.

1.9.3 After takeoff the instructor called MAYDAY twice on frequency 120.6 MHz but did not specify the emergency before the aircraft went down. See Appendix "E"

1.10 Aerodrome Information

1.10.1 Not applicable. The accident did not happen on the aerodrome.

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

1.12.1 The left wing of the aircraft collided with vegetation prior to the impact in the river bed.

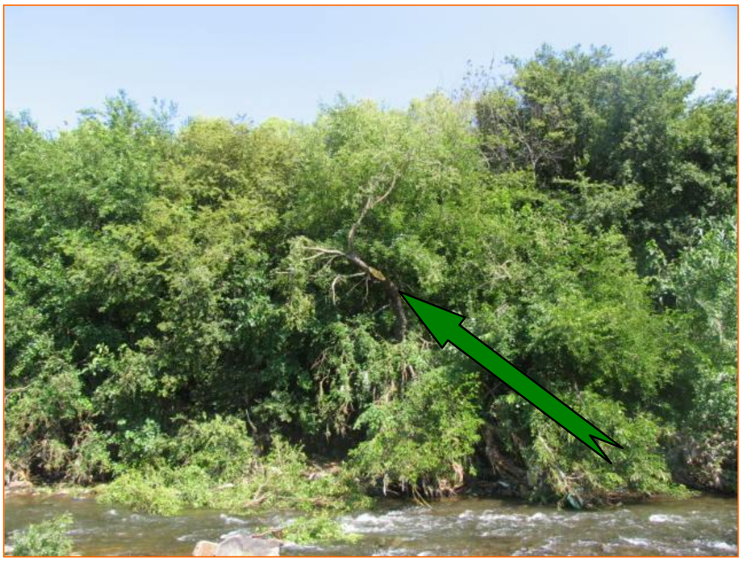
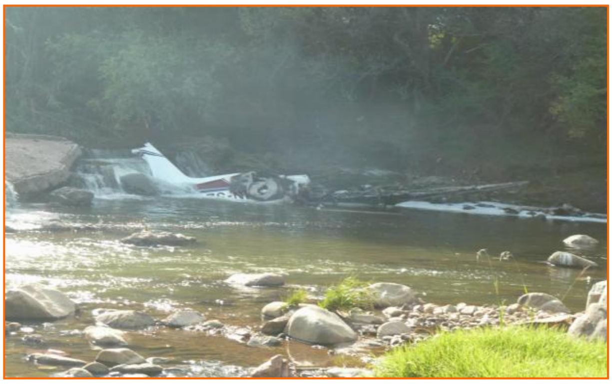


Figure 2: View of the tree branch (indicated by the arrow) with which the left wing collided before the aircraft crashed into the river bed

1.12.2 After the collision with the tree, the aircraft crashed into the river ending up against a retainer wall in the river. The aircraft was destroyed during the impact sequence.

Figure 3: View of the wreckage in the river with the empennage against a retainer wall in the river.



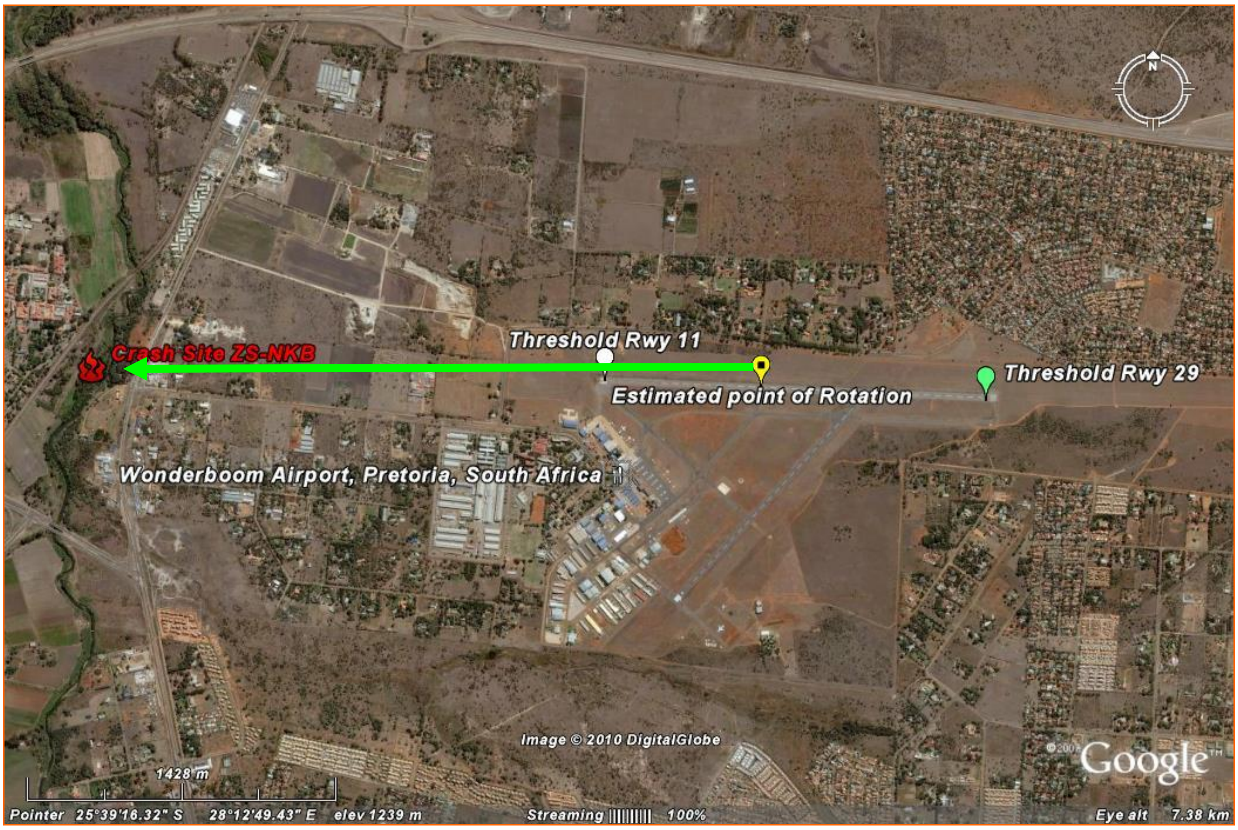


Figure 4: Aerial view of the flight path followed from takeoff on Rwy 29 to the accident site

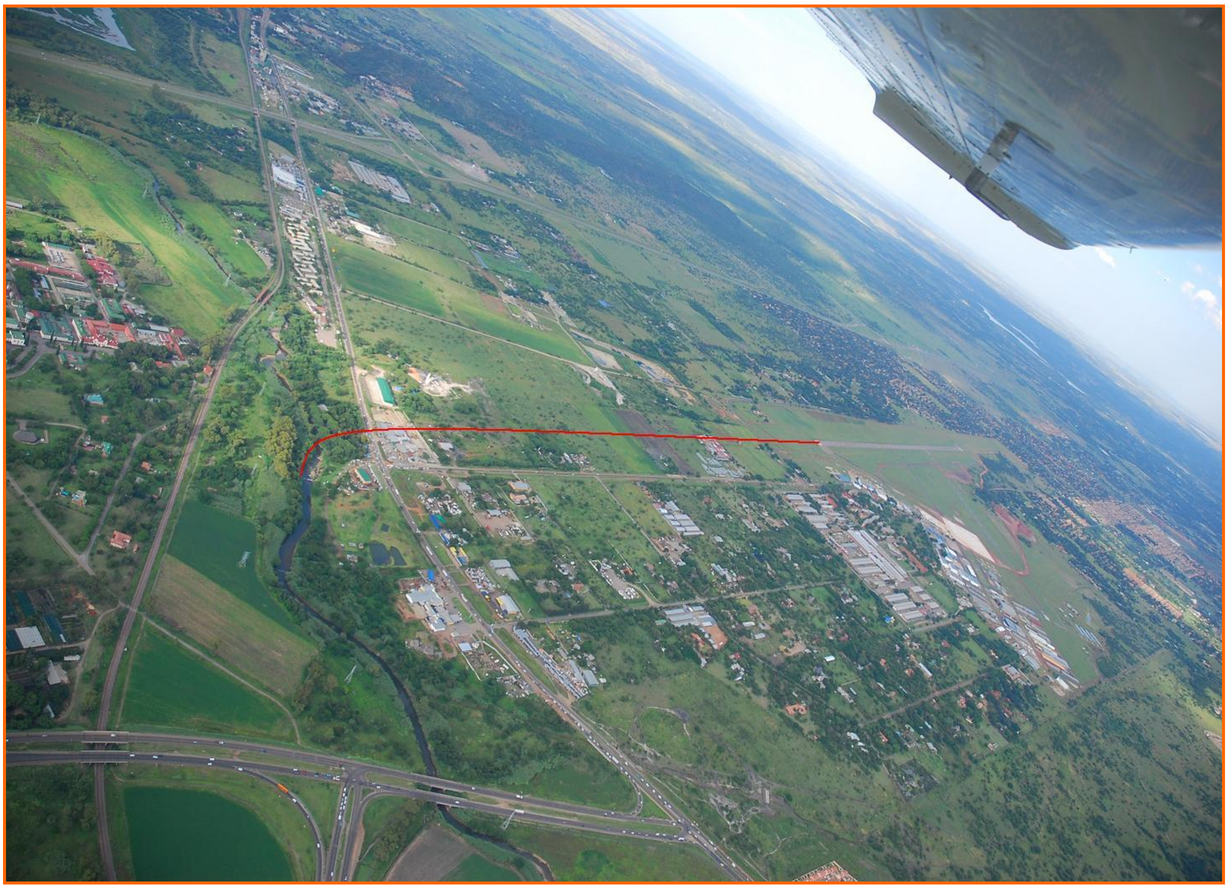


Figure 5: Another aerial view of the flight path followed from takeoff on Rwy 29 to the accident site. The red line indicates the flight path from the Threshold of Rwy 11 to the accident site.

1.13 Medical and Pathological Information

1.13.1 Post-mortem examinations were performed on the instructor and the student pilot after the accident. The results of the post-mortems and toxicology tests were not available at the time the report was compiled. Should any of the results, once received, indicate that medical aspects may have affected the performance of the flight crew members, this will be considered as new evidence and the investigation reopened.

1.14 Fire

1.14.1 The aircraft erupted in fire during the impact.

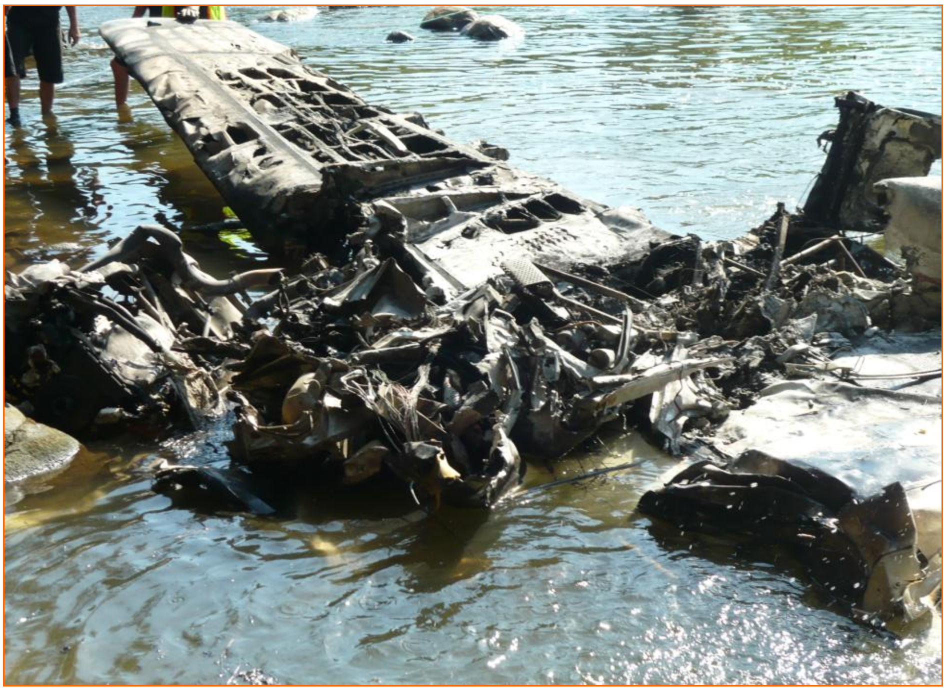


Figure 6: The wreckage was destroyed by the impact damage and the ensuing fire after the impact.

1.14.2 The empennage was submerged in water and did not sustain any fire damage. The rest of the aircraft was destroyed as a result of the impact and the ensuing fire.

1.15 Survival Aspects

1.15.1 The magnitude of the impact sequence, followed by the ensuing fire, rendered this accident not survivable.

1.16 Tests and Research.

1.16.1 At the accident site it was found that the right-hand engine had been running on the right-hand magneto only and the left-hand engine on the left-hand magneto only. It was also found that the fuel booster pumps were selected in the high position.

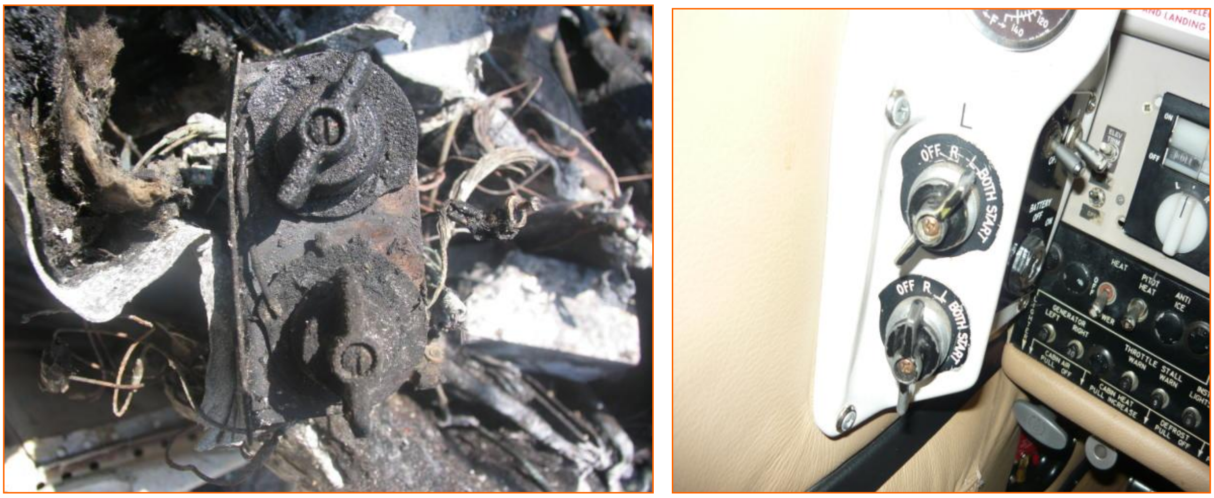


Figure 7: The magneto switches on the wreckage: The left-hand engine was selected on the left magneto and the right-hand engine was selected on the right magneto.

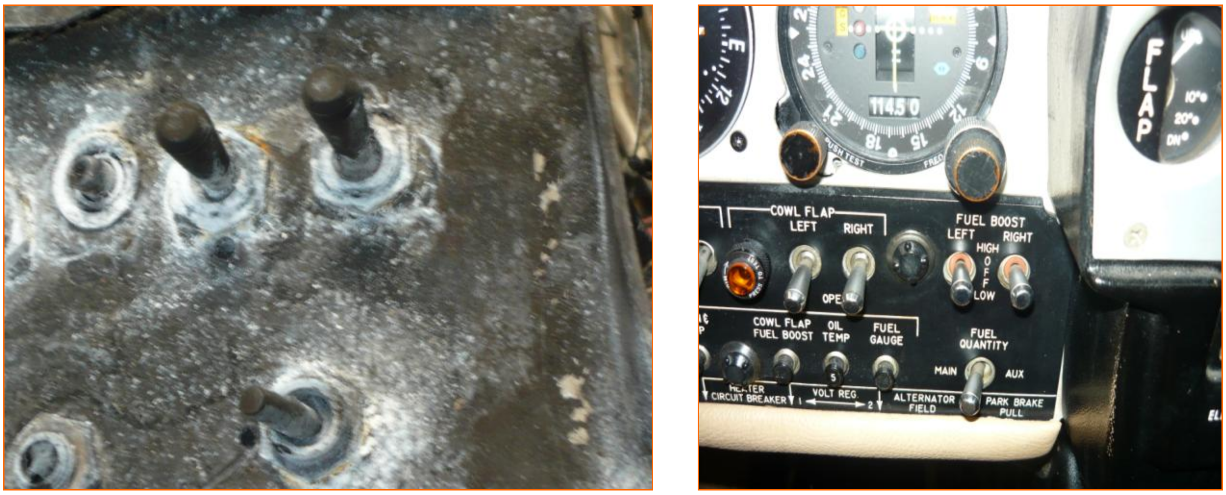


Figure 7: The fuel booster pumps on the wreckage were in the High position.

1.16.2 It was therefore decided to do flight testing (on 22 January 2010) in a similar aircraft type. The purpose was to determine the effect of switching one magneto off and also to determine the effect of switching the fuel booster pump onto the OFF, LOW and HIGH positions at full power, eg 2600 rpm. This was first done with a full rich mixture setting and then repeated with a lean mixture setting. (See Appendix "A".)

It was established that when the mixture setting is on FULL RICH for both engines and the fuel booster pumps were switched to the HIGH position, all engine parameters appeared normal. However, it was noticed that the aircraft descended at a rate of 300+ ft/minute at full power with the landing gear and the flap retracted.

1.16.3 Engine examination done on 4 and 5 January 2010 (See Appendix "B")

Investigation revealed that the top spark plugs (# 1, 3, 5 cylinders and the bottom spark plugs # 2 & 4 cylinders) on the right-hand engine were fouled to an extent where they failed to fire under pressure on a spark plug tester.

Figure 8: The top spark plugs from cylinders 1, 3 & 5 from the right-hand engine.

The engines were dismantled and inspected at an approved maintenance facility.

Apart from accident-related damage, the engines were in a serviceable condition.

1.16.4 Engine Component examination (See Appendix “C”)

Some engine components were tested or dismantled and inspected at an approved maintenance facility. Apart from accident-related damage, these components were in a serviceable condition.

1.16.5 Airframe examination:

On 19 December 2009, an on-site investigation was carried out on the airframe. Apart from accident-related damage, no structural failures were observed on the airframe.

1.16.5.1 Primary Flight Controls

During the on-site investigation it was determined that there were positive connections between the primary flight control surfaces (ailerons, rudder and elevator) and the controls in the aircraft cabin.

1.16.5.2 Secondary Flight Controls

During the on-site investigation it was determined that there were positive connections between the secondary flight control surfaces (elevator trim and flaps) and the controls in the aircraft cabin. The flaps were retracted at the time of impact.

1.16.5.3 Landing Gear

The follow-up investigation on 4 January 2010 revealed that the landing gear was retracted at the time of impact.

1.16.6 Propeller examination:

The propellers were dismantled and inspected at an approved maintenance facility on 4 and 5 January 2010. (See Appendix “D”.)

A*part from accident-related damage, the propellers were in a serviceable condition.*

1.17 Organizational and Management Information

1.17.1 Operator

1.17.1.1 The operator was in possession of a valid Aviation Training Organization (ATO) Approval which had been issued on 3 March 2009 and would expire on 3 March 2010.

1.17.1.2 The last audit at the operator was performed on 2 March 2009. No major findings were recorded.

1.17.2 AMO (Aircraft Maintenance Organisation)

1.17.2.1 The AMO was in possession of a valid AMO approval, which had been issued on 4 March 2009 and which would expire on 3 March 2010.

1.17.2.2 The last audit at the AMO was performed on 3 March 2009. No major findings were recorded.

1.18 Additional Information

1.18.1 According to the Pilot Operating Handbook (POH):

1.18.1.1 Should an engine failure occur after lift-off or in flight (Section III - **Emergency Procedures**, Engine failure after Lift-off and In Flight, Page 3-5, Paragraph 6c) the fuel boost pump should be OFF.

1.18.1.2 Section IV (**Normal Procedures**, Page 4-9, Before Take-Off, Paragraph 3) states that the fuel boost pumps should be OFF (If ambient temperature is 90°F {31°C} or above, use LOW pressure boost).

1.18.1.3 For normal Starting, Section IV (**Normal Procedures**, Page 4-7, Starting, and Paragraph 4) states that the fuel boost pumps should be on HIGH until pressure stabilises, and then OFF.

1.18.2 An important observation with reference to the POH is that other than the references above, the POH does not mention anything else about the use of the fuel boost pumps in any emergency situations.

1.18.3 Flight testing revealed that the engines failed to produce full power when the boost pumps were switched in the HIGH position with a full rich mixture setting. In the air it resulted in a descent rate of 300 ft/minute.

1.18.4 It was also noted that the fuel boost pump switches are located in a position where the Instructor is unable to see them when sitting in the right-hand seat. This obstruction is caused by the bar of the control column.

1.18.5 Furthermore it was noted that when the mixture setting is on full rich for both engines and the fuel booster pumps are switched to the HIGH position, all engine parameters appear normal. However, it was noticed that the aircraft descended at a rate of 300 ft/min at full power with the landing gear and the flap retracted.

1.18.6 The aircraft was equipped with normal toggle switches, used for the fuel boost pumps.

1.18.7 In an accident that happened at Kimberley on 3 March 2009 (ZS-SVM, a Beech B36C equipped with a Teledyne Continental TSIO 520 UB) the fuel boost pump switch was also unintentionally switched into the HIGH position resulting in the engine losing power or failing during the take-off. Ground testing with a similar aircraft revealed that the engine had failed 11 seconds after the electric auxiliary fuel pump was switched onto HIGH at maximum power and with the mixture setting on full rich.

1.18.8 The aircraft was fuelled to maximum capacity (112 gal of which 106 gal are useable) of Avgas 100LL fuel prior to the accident flight.
Following the accident a fuel sample was taken from the fuel bay at FAWB. This sample was found to be clean of contamination.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1.1 After takeoff various witnesses observed that the aircraft failed to gain height and was flying very low after the takeoff. Examination revealed that the aircraft was standing at the holding point for 18 minutes before advising the ATC that it was ready for the takeoff. Investigation also revealed that some spark plugs on the #2 engine were fouled to an extent where they probably failed to fire under compression

2.1.2 On the accident site it was found that the right-hand engine was running on the left-hand magneto only and the left-hand engine was running on the right hand magneto only. It was also found that the fuel booster pumps were selected in the high position.

2.2 The ambient temperature on the day and time of the accident was recorded as 34°C. The POH calls for the fuel boost pumps to be switched on low when the ambient temperature exceeds 31°C.

2.2.1 From the previous three points it was concluded that the following scenario probably led to the accident:

2.2.2 The long standing at the holding point fouled the said spark plugs mentioned in paragraph 2.1. The fuel boost pumps were switched on because the ambient temperature was 34°C.
On the take-off roll the fuel boost pumps should be switched off. Being normal toggle switches, it is considered possible that the switches were accidentally switched to the HIGH position. This was the configuration in which the wreckage was found.

As a result of the fouled spark plugs, the right-hand engine failed to produce full power.

2.3 The fuel boost pump switches are located in a position where the instructor is unable to see it when sitting in the right-hand seat. In addition, the fuel boost pump switches were normal toggle switches and not gated switches as on some of the newer Beech aircraft.
The POH is unclear on the use of the boost pumps.

2.3.1 Flight testing revealed that when the mixture setting is on full rich for both engines and the fuel booster pumps are switched to the HIGH position, all engine parameters appear normal. However, the aircraft descended at a rate of 300 ft/minute at full power with the landing gear and the flap retracted.

3. CONCLUSION

3.1 Findings

3.1.1 A flight instructor accompanied by a student pilot took-off from FAWB to the General Flying Area #2 for a type conversion training flight. Various witnesses observed that the aircraft failed to gain height and was flying very low after the takeoff.

3.1.2 Shortly after takeoff the aircraft collided with vegetation and crashed into the Apies River, 3.5 km from the airport.

3.1.3 The aircraft was destroyed and both occupants sustained fatal injuries during the accident sequence.

3.1.4 The instructor held a valid Airline Transport License, was rated on the aircraft type and held a valid medical certificate.

3.1.5 The student pilot held a valid Private Pilot License, was not rated on the aircraft type, but held a valid medical certificate.

3.1.6 The aircraft was correctly maintained according to the regulations.

3.1.7 The aircraft was loaded within the weight limitations as specified by the manufacturer and the centre of gravity was within the specified limitations.

3.1.8 Fine weather conditions prevailed at the time of the accident. However, it was hot.

3.1.9 The aircraft was equipped with standard navigation and communications equipment according to the minimum equipment list approved by the regulator for the aircraft type. No defects were reported prior to the flight.

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

3.1.11 Flight testing revealed that when the mixture setting is on FULL RICH for both engines and the fuel booster pumps are switched ON to the HIGH position, all engine parameters appear normal. However, the aircraft descended at a rate of 300+ ft/minute at full power with the landing gear and the flap retracted.

3.1.12 Engine examinations revealed that apart from accident-related damage, both engines were in a serviceable condition prior to the accident.

3.1.13 Engine component examinations revealed that apart from accident-related damage, all components were in a serviceable condition prior to the accident.

3.1.14 Propeller examinations revealed that apart from accident-related damage, both propellers were in a serviceable condition prior to the accident.

3.1.15 Apart from accident-related damage, airframe examination revealed no structural failures. All primary and secondary flight controls were serviceable prior to the accident. The landing gear and flap were retracted at the time of impact.

3.1.16 The pilot transmitted a MAYDAY call but did not state the nature of the emergency.

3.1.17 The operator was in possession of a valid ATO Approval.

3.1.18 The AMO was in possession of a valid AMO approval.

3.1.19 The POH is unclear on the use of the boost pumps as it does not mention anything about the use of the fuel boost pumps in any emergency situations.

3.1.20 The fuel boost pump switches are located in a position where the instructor is unable to see them when sitting in the right-hand seat.

3.1.21 The aircraft was equipped with normal toggle switches, used for the fuel boost pumps.

3.2 Probable Cause/s

3.2.1 The aircraft failed to gain height after takeoff and collided with vegetation and terrain.

3.3 Contributing Factors

3.3.1 Fouled spark plugs on the right-hand engine.

3.3.2 Switching the fuel boost pumps onto HIGH resulting in a negative rate of climb and an over-rich mixture setting on both engines, resulting in the engines failing to produce full power.

3.3.3 The inability of the instructor to see the position selected on the fuel boost pumps due to an obstruction by the control column.

3.3.4 Lack of clear instructions in the POH on the use of the fuel boost pumps.

3.3.5 Limited flight experience from the instructor as well as the student pilot on the aircraft type.

4. SAFETY RECOMMENDATIONS

4.1.1 As was the case in the Kimberley accident (3 March 2009, ZS-SVM, a Beech B36C equipped with a Teledyne Continental TSIO 520 UB), it is recommended that, although it is already part of the syllabus for flying training, instructors should be stricter on procedures followed after an engine failure. Not complying with the correct procedures should be considered an immediate failure of the flight test.

4.1.2 It is recommended that an urgent AD be issued to recommend to owners of this type of aircraft and maintenance organisations, that in the interests of aviation safety:

4.1.2.1 All fuel boost pump toggle switches be replaced with gated switches to prevent unintentional switching to the HIGH position.

4.1.2.2 Although the aircraft in the Kimberley accident was equipped with a gated switch, the pilot unintentionally switched the boost pump into the HIGH position. It is therefore recommended that warning lights be installed in an appropriate place in the aircraft to warn pilots when the fuel boost pumps are switched on in the HIGH position.

4.1.2.3 The POH be revised to clarify the use of the Fuel Boost Pumps, especially when using the HIGH setting while flying and during emergencies in the air.

5. APPENDICES

5.1 Appendix “A” Ground- and Flight Test Results
5.2 Appendix “B” Engine dismantling and inspection report
5.3 Appendix “C” Engine Component dismantling/testing report
5.4 Appendix “D” Propeller dismantling and inspection report
5.5 Appendix “E” Radio Transmission between FAWB Control Tower and ZS-NKB

Report reviewed and amended by the Advisory Safety Panel on 20 April 2010.

-END-

Appendix "A" - Ground- and Flight Test Results

Ground Tests were carried out at FAWB on 22 January 2010 on a similar aircraft type by a suitably qualified pilot. The purpose was to determine the effect of switching one magneto off and also to determine the effect of switching the fuel booster pump onto the OFF, LOW & HIGH positions respectively at 1000 RPM and 2200 RPM. This was first done with a full rich mixture setting and then it was repeated with a lean mixture setting.

ZS-NKB (LEFT-HAND ENGINE)				
FULL RICH MIXTURE SETTING	**@ 1000 RPM**	**@ 2200 RPM**	**@ 2600 RPM**	**NOTE(S)**
Fuel Booster Pump OFF & both Magnetos ON	No Effect	No Effect	Not performed because Spark Plugs tend to foul up	(1) When switching ON the ANR (Acive Noise Reduction) on the headset, it was not possible to hear any changes in Engine sound. (2) When switching OFF the ANR on the headset, changes in Engine sound were vaguely observed. (3) Without headsets, changes in engine sound were clearly noticed.
Fuel Booster Pump OFF & R/H Magneto OFF	No Effect	Drop of ± 150 RPM		
Fuel Flow (US Gal/Hr)	2.5	9		
EGT	1000° F, 538° C	1100° F, 593° C		
Manifold Pressure in INCHES	15	19		
Fuel Booster Pump LOW & both Magnetos ON	No Effect	No Effect		
Fuel Booster Pump LOW & R/H Magneto OFF	No Effect	Drop of ± 150 RPM		
Fuel Flow (US Gal/Hr)	4.5	11		
EGT	1000° F, 538° C	1100° F, 593° C		
Manifold Pressure in INCHES	15	19		
Fuel Booster Pump HIGH & both Magnetos ON	Engine failed after 5 seconds	Engine ran rough after 3 seconds & failed after 7 seconds		
Fuel Booster Pump HIGH & R/H Magneto OFF	No Effect	Drop of ± 150 RPM		
Fuel Flow (US Gal/Hr)	10.5	17		
EGT	1000° F, 538° C	1100° F, 593° C		
Manifold Pressure in INCHES	15	19		

ZS-NKB (RIGHT-HAND ENGINE)				
FULL RICH MIXTURE SETTING	**@ 1000 RPM**	**@ 2200 RPM**	**@ 2600 RPM**	**NOTE(S)**
Fuel Booster Pump OFF & both Magnetos ON	No Effect	No Effect	Not performed because Spark Plugs tend to foul up	(1) When switching ON the ANR (Acive Noise Reduction) on the headset, it was not possible to hear any changes in Engine sound. (2) When switching OFF the ANR on the headset, changes in engine sound were vaguely observed. (3) Without headsets, changes in engine sound were clearly noticed.
Fuel Booster Pump OFF & L/H Magneto OFF	No Effect	Drop of ± 150 RPM		
Fuel Flow (US Gal/Hr)	2.5	9		
EGT	1000° F, 538° C	1100° F, 593° C		
Manifold Pressure in INCHES	15	19		
Fuel Booster Pump LOW & both Magnetos ON	No Effect	No Effect		
Fuel Booster Pump LOW & L/H Magneto OFF	No Effect	Drop of ± 150 RPM		
Fuel Flow (US Gal/Hr)	4.5	11		
EGT	1000° F, 538° C	1100° F, 593° C		
Manifold Pressure in INCHES	15	19		
Fuel Booster Pump HIGH & both Magnetos ON	Engine failed after 5 seconds	Engine ran rough after 3 seconds & failed after 7 seconds		
Fuel Booster Pump HIGH & L/H Magneto OFF	No Effect	Drop of ± 150 RPM		
Fuel Flow (US Gal/Hr)	10.5	17		
EGT	1000° F, 538° C	1100° F, 593° C		
Manifold Pressure in INCHES	15	19		

ZS-NKB (LEFT-HAND ENGINE)				
LEAN MIXTURE SETTING	**@ 1000 RPM**	**@ 2200 RPM**	**@ 2600 RPM**	**NOTE(S)**
Fuel Booster Pump OFF & both Magnetos ON	No Effect	No Effect	Not performed because spark plugs tend to foul up	(1) When switching ON the ANR (Acive Noise Reduction) on the headset, it was not possible to hear any changes in engine sound. (2) When switching OFF the ANR on the headset, changes in engine sound were vaguely observed. (3) Without headsets, changes in engine sound were clearly noticed.
Fuel Booster Pump OFF & R/H Magneto OFF	No Effect	Drop of ± 150 RPM		
Fuel Flow (US Gal/Hr)	2.5	9		
EGT	1000° F, 538° C	1100° F, 593° C		
Manifold Pressure in INCHES	15	19		
Fuel Booster Pump LOW & both Magnetos ON	No Effect	No Effect		
Fuel Booster Pump LOW & R/H Magneto OFF	No Effect	Drop of ± 150 RPM		
Fuel Flow (US Gal/Hr)	4.5	11		
EGT	1000° F, 538° C	1100° F, 593° C		
Manifold Pressure in INCHES	15	19		
Fuel Booster Pump HIGH & both Magnetos ON	Engine failed after 5 Seconds	Engine ran rough after 3 seconds & failed after 7 seconds		
Fuel Booster Pump HIGH & R/H Magneto OFF	No Effect	Drop of ± 150 RPM		
Fuel Flow (US Gal/Hr)	10.5	17		
EGT	1000° F, 538° C	1100° F, 593° C		
Manifold Pressure in INCHES	15	19		

<table>
<tr><th colspan="5">ZS-NKB (RIGHT-HAND ENGINE)</th></tr>
<tr><th>LEAN MIXTURE SETTING</th><th>@ 1000 RPM</th><th>@ 2200 RPM</th><th>@ 2600 RPM</th><th>NOTE(S)</th></tr>
<tr><td>Fuel Booster Pump OFF & both Magnetos ON</td><td>No Effect</td><td>No Effect</td><td rowspan="15">Not performed because Spark Plugs tend to foul up</td><td rowspan="15">(1) When switching ON the ANR (Acive Noise Reduction) on the headset, it was not possible to hear any changes in Engine sound. (2) When switching OFF the ANR on the headset, changes in engine sound were vaguely observed. (3) Without headsets, changes in engine sound were clearly noticed.</td></tr>
<tr><td>Fuel Booster Pump OFF & L/H Magneto OFF</td><td>No Effect</td><td>Drop of ± 150 RPM</td></tr>
<tr><td>Fuel Flow (US Gal/Hr)</td><td>2.5</td><td>9</td></tr>
<tr><td>EGT</td><td>1000° F, 538° C</td><td>1100° F, 593° C</td></tr>
<tr><td>Manifold Pressure in INCHES</td><td>15</td><td>19</td></tr>
<tr><td>Fuel Booster Pump LOW & both Magnetos ON</td><td>No Effect</td><td>No Effect</td></tr>
<tr><td>Fuel Booster Pump LOW & L/H Magneto OFF</td><td>No Effect</td><td>Drop of ± 150 RPM</td></tr>
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<tr><td>Manifold Pressure in INCHES</td><td>15</td><td>19</td></tr>
</table>

Flight tests were carried out on a similar aircraft type by a suitably qualified pilot. The purpose was to determine the effect of switching one magneto off and also to determine the effect of switching the fuel booster pump onto the OFF, LOW & HIGH positions at full power, eg: 2600 RPM. This was 1st done with a full rich mixture setting and then it was repeated with a lean mixture setting.

Runway used:	29
Ambient Temperature:	28°C
Time & Date:	14h40 (1240Z), 22 January 2010 @ FAWB
QNH	1017mB

ZS-NKB (LEFT HAND ENGINE)				
FULL RICH MIXTURE SETTING	**@ 1000 RPM**	**@ 2200 RPM**	**@ 2600 RPM**	**NOTE(S)**
Fuel Booster Pump OFF & both Magnetos ON	Not possible to obtain this RPM in the air	Not performed as the pilot considered it unsafe to do		(1) When switching ON the ANR (Acive Noise Reduction) on the headset, it was not possible to hear any changes in engine sound. (2) When switching OFF the ANR on the headset, changes in engine sound were vaguely observed. (3) Without headsets, changes in engine sound were clearly noticed.
Fuel Booster Pump OFF & R/H Magneto OFF				
Fuel Flow (US Gal/Hr)				
EGT			1100° F, 593° C	
Manifold Pressure in INCHES			24	
Fuel Booster Pump LOW & both Magnetos ON				
Fuel Booster Pump LOW & R/H Magneto OFF				
Fuel Flow (US Gal/Hr)				
EGT				
Manifold Pressure in INCHES				
Fuel Booster Pump HIGH & both Magnetos ON				
Fuel Booster Pump HIGH & R/H Magneto OFF				
Fuel Flow (US Gal/Hr)				
EGT				
Manifold Pressure in INCHES				

ZS-NKB (RIGHT-HAND ENGINE)				
FULL RICH MIXTURE SETTING	**@ 1000 RPM**	**@ 2200 RPM**	**@ 2600 RPM**	**NOTE(S)**
Fuel Booster Pump OFF & both Magnetos ON	Not possible to obtain this RPM in the air	Not performed as the pilot considered it unsafe to do	No effect	(1) When switching ON the ANR (Acive Noise Reduction) on the headset, it was not possible to hear any changes in engine sound. (2) When switching OFF the ANR on the headset, changes in engine sound were vaguely observed. (3) Without headsets, changes in engine sound were clearly noticed.
Fuel Booster Pump OFF & L/H Magneto OFF			Drop of ± 150 RPM	
Fuel Flow (US Gal/Hr)			10	
EGT			1100° F, 593° C	
Manifold Pressure in INCHES			24	
Fuel Booster Pump LOW & both Magnetos ON			No effect	
Fuel Booster Pump LOW & L/H Magneto OFF			Drop of ± 150 RPM	
Fuel Flow (US Gal/Hr)			12	
EGT			1100° F, 593° C	
Manifold Pressure in INCHES			24	
Fuel Booster Pump HIGH & both Magnetos ON			Engine ran rough after 5 seconds but kept on running	
Fuel Booster Pump HIGH & L/H Magneto OFF			Drop of ± 150 RPM	
Fuel Flow (US Gal/Hr)			18	
EGT			1100° F, 593° C	
Manifold Pressure in INCHES			24	

ZS-NKB (LEFT-HAND ENGINE)

LEAN MIXTURE SETTING	@ 1000 RPM	@ 2200 RPM	@ 2600 RPM	NOTE(S)
Fuel Booster Pump OFF & both Magnetos ON	Not possible to obtain this RPM in the air	Not performed as the pilot considered it unsafe to do		(1) When switching ON the ANR (Acive Noise Reduction) on the headset, it was not possible to hear any changes in Engine sound. (2) When switching OFF the ANR on the headset, changes in Engine sound were vaguely observed. (3) Without headsets, changes in engine sound were clearly noticed.
Fuel Booster Pump OFF & R/H Magneto OFF				
Fuel Flow (US Gal/Hr)				
EGT			1100° F, 593° C	
Manifold Pressure in INCHES			24	
Fuel Booster Pump LOW & both Magnetos ON				
Fuel Booster Pump LOW & R/H Magneto OFF				
Fuel Flow (US Gal/Hr)				
EGT				
Manifold Pressure in INCHES				
Fuel Booster Pump HIGH & both Magnetos ON				
Fuel Booster Pump HIGH & R/H Magneto OFF				
Fuel Flow (US Gal/Hr)				
EGT				
Manifold Pressure in INCHES				

ZS-NKB (RIGHT HAND ENGINE)				
LEAN MIXTURE SETTING	**@ 1000 RPM**	**@ 2200 RPM**	**@ 2600 RPM**	**NOTE(S)**
Fuel Booster Pump OFF & both Magnetos ON	Not possible to obtain this RPM in the air	Not performed as the pilot considered it unsafe to do	No effect	(1) When switching ON the ANR (Acive Noise Reduction) on the headset, it was not possible to hear any changes in Engine sound. (2) When switching OFF the ANR on the headset, changes in Engine sound were vaguely observed. (3) Without headsets, changes in Engine sound were clearly noticed.
Fuel Booster Pump OFF & L/H Magneto OFF			Drop of ± 150 RPM	
Fuel Flow (US Gal/Hr)			10	
EGT			1100° F, 593° C	
Manifold Pressure in INCHES			24	
Fuel Booster Pump LOW & both Magnetos ON			No effect	
Fuel Booster Pump LOW & L/H Magneto OFF			Drop of ± 150 RPM	
Fuel Flow (US Gal/Hr)			12	
EGT			1100° F, 593° C	
Manifold Pressure in INCHES			24	
Fuel Booster Pump HIGH & both Magnetos ON			No apparent effect. All engine instruments appeared normal.	
Fuel Booster Pump HIGH & L/H Magneto OFF			Drop of ± 150 RPM	
Fuel Flow (US Gal/Hr)			18	
EGT			1100° F, 593° C	
Manifold Pressure in INCHES			24	

Appendix "B" - Engine dismantling and inspection report

Left-hand Engine		Right-hand Engine	
Item checked	**Result**	**Item checked**	**Result**
EngineType	Continental IO-470 L	Engine Type	Continental IO-470 L
Engine Serial Number	454428	Engine Serial Number	CS 201453-71L
L/H Magneto R/H Magneto	Internal timing correct. Timing to engine correct at 25˚BTDC. Bench tested and functioned correctly. Slick 680 Serial number 4050027 Internal timing correct. Timing to engine correct at 25˚BTDC. Bench tested and functioned correctly. Slick 662 Serial number 7010242	L/H Magneto R/H Magneto	Internal timing correct. Timing to engine correct at 25˚BTDC. Bench tested and functioned correctly. Slick 680 Serial number 004062 Internal timing correct. Timing to engine correct at 25˚BTDC. Bench tested and functioned correctly. Slick 680 Serial number 107042
Cylinders	All cylinders in good condition and within dimensional limitations.	Cylinders	All cylinders in good condition and within dimensional limitations.
Pistons & Rings	All pistons were in good condition and within dimensional limitations. All rings were intact.	Pistons and rings	All pistons were in good condition and within dimensional limitations. All rings were intact.
Main bearings & Big-end bearings	All bearings in good condition	Main bearings and big-end bearings	All bearings in good condition
Camshaft bearings	Bearings in good condition	Camshaft bearings	Bearings in good condition
Spark plugs & HT Leads	All the spark plugs were in good condition and functioned correctly when under pressure.	Spark plugs and HT leads	The TOP spark plugs on cylinders no 1, 3 and 5 and the BOTTOM spark plugs on cylinders no 2 & 4 were fouled to an extent where

	Although all the high tension leads sustained accident-related damage, they all appeared to be in a good condition.		they failed to fire under pressure on a spark plug tester. Although all the high tension leads sustained accident-related damage, they all appeared to be in a good condition.
Vacuum Pump	Drive shaft intact.	Vacuum pump	Drive shaft intact.
Oil Filter	Clean oil and no traces of metal particles	Oil filter	Clean oil and no traces of metal particles
Rockers and rocker shafts	All intact and in operating condition. Clearances within limits.	Rockers and rocker shafts	All intact and in operating condition. Clearances within limits.
Inlet valves	All intact and within wear limitations.	Inlet valves	All intact and within wear limitations.
Exhaust valves	All intact and within wear limitations.	Exhaust valves	All intact and within wear limitations.
Inlet valve guides	All intact	Inlet valve guides	All intact
Exhaust valve guides	All intact	Exhaust valve guides	All intact
Gear train	Intact	Gear train	Intact

Appendix "C" - Engine Component dismantling/testing report

Left-hand engine:

Components fitted:

1. Left-hand mag Slick 680 serial number 4050027
2. Right-hand mag Slick 662 serial number 7010242
3. Fuel control unit part number 625219-2 serial number D017404
4. Engine governor part number B210438 serial number 1150262/m
5. Engine-driven fuel pump part number 638154-9 serial number P220189
6. Fuel manifold valve part number 631427A4 serial number I 107116
7. 6 Fuel nozzles 12D

Prior to "flowing" the nozzles they were all checked and found free of obstructions. The fuel nozzles were flow-checked at 12.5 psi and the following results obtained:

Nozzle spray pattern Manufacturer's spec required and actual obtained in brackets

1. Good spray pattern 23 - 24 (25.5)
2. Good spray pattern 23 - 24 (26.5)
3. Good spray pattern 23 - 24 (25.5)
4. Good spray pattern 23 - 24 (25.5)
5. Good spray pattern 23 - 24 (27)
6. Good spray pattern 23 - 24 (27.5)

The outlet pressure was checked with the nozzles assembled onto the manifold valve and all nozzles met manufacturer's specifications.

The fuel pump was unable to be bench tested due to accident damage, but the pump was dismantled and no abnormalities were found.

Both magnetos were bench tested and found to be in proper working order.

The governor was bench tested and met all manufacturers' specifications.

The fuel control unit was not bench tested due to accident damage but both the throttle and mixture controls were free and no obstructions found. The fuel filter was removed and found to be clean.

Right-hand engine:

Components fitted:

1. Left-hand mag Slick 680 serial number 004062
2. Right-hand mag Slick 680 serial number 107042
3. Fuel control unit part number 625219-2 serial number 21558
4. Engine governor part number B210439 serial number 917676/k
5. Engine-driven fuel pump part number 630947-3 serial number 111584
6. Fuel manifold valve no data plate serial number 0289409 engraved on base of unit

7. 6 Fuel nozzles 12D

Prior to “flowing” the nozzles they were all checked and found free of obstructions. The fuel nozzles were flow-checked at 12.5 psi and the following results obtained:

Nozzle spray pattern manufacturer’s spec required and actual obtained in brackets

1. Good spray pattern 23 – 24 (24.5)
2. Good spray pattern 23 – 24 (25.5)
3. Good spray pattern 23 – 24 (24)
4. Good spray pattern 23 – 24 (24.5)
5. Good spray pattern 23 – 24 (25.5)
6. Good spray pattern 23 – 24 (25)

The outlet pressure was checked with the nozzles assembled onto the manifold valve and all nozzles met manufacturer’s specifications.

The fuel pump was unable to be bench tested due to accident damage, but the pump was dismantled and no abnormalities were found.

Both magnetos were bench tested and found to be in proper working order.

The governor could not be bench tested due to excessive accident damage.

The fuel control unit was not bench tested due to accident damage but both the throttle and mixture controls were free and no obstructions found. The fuel filter was removed and found to be clean.

Appendix “D” - Propeller dismantling and inspection report

Left-hand propeller		Right-hand propeller	
Item checked	Result	Item checked	Result
Propeller Type	Hartzell PHC A3VF	Propeller Type	Hartzell PHC A3VF
Propeller Serial Number	BR 772	Propeller Serial Number	BR 715
Note(s)	Apart from accident-related damage, the propeller was in a good condition	Note(s)	Apart from accident-related damage, the propeller was in a good condition

Appendix "E" - Radio Transmission between FAWB Control Tower and ZS-NKB

TIME (Z PM)	**FROM**	**TO**	**MESSAGE**
01 16 05	FAWB Control Tower	ZS-NKB	NKB go ahead
	ZS-NKB	FAWB Control Tower	Good day sir it's a Baron 55 with 2 on board, 5 hrs endurance, requesting taxi clearance for a flight to the GF 2 for approximately 2 hrs sir
	FAWB Control Tower	ZS-NKB	NKB taxi to holding point 29, cross Rwy 24 QNH1013
	ZS-NKB	FAWB Control Tower	QNH1013, Holding point 29, Clear to cross 24, NKB
01 34 59	ZS-NKB	FAWB Control Tower	Wonderboom Uhh, NKB is ready
01 35 08	FAWB Control Tower	ZS-NKB	NKB Surface Wind 300 degrees 5 kts, Rwy 29, Cleared for take off, Right turn, Climb to 7000ft, Report 5miles North East of Roodeplaat dam
	ZS-NKB	FAWB Control Tower	Surface Wind, 29, Clear take-off, Right turn, Climb 7000ft and 5 miles North East Roodeplaat dam next, NKP uhh B
	ZS-NKB	FAWB Control Tower	Mayday, Mayday!